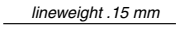
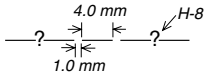
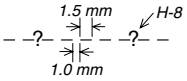
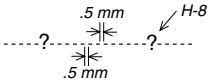
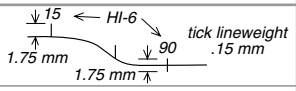
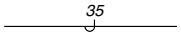
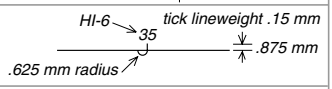
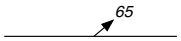
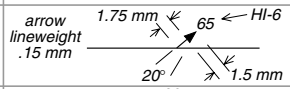
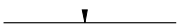
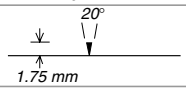
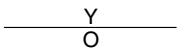
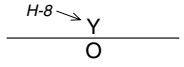
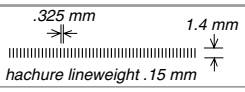
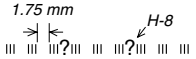
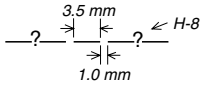
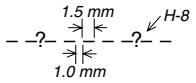
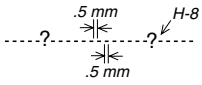
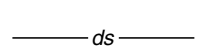
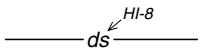
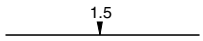
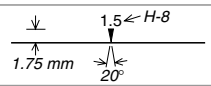
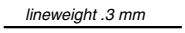
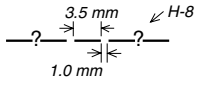
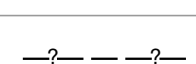
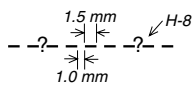
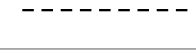
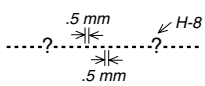
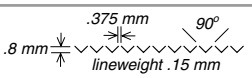
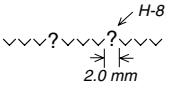
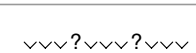
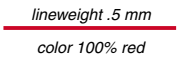
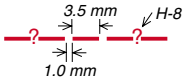
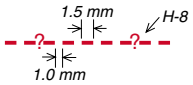
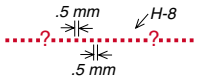
1—CONTACTS, KEY BEDS, AND DIKES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	1.1—Contacts			
1.1.1	Contact—Certain			For an explanation of the various levels of uncertainty of contacts and other line symbols, see Section 4 entitled "Guidelines for Symbol Usage" in the accompanying introductory text. For an explanation of the abbreviations used throughout this appendix, see Table 2 in the accompanying introductory text.
1.1.2	Contact—Approximately located			
1.1.3	Contact—Approximately located, queried			
1.1.4	Contact—Inferred			
1.1.5	Contact—Inferred, queried			
1.1.6	Contact—Concealed			
1.1.7	Contact—Concealed, queried			
1.1.8	Contact—Showing dip where known			Place symbol ornamentation where observation was made. Dip value indicates a measured dip direction and magnitude; if necessary for clarity, place 90 on stratigraphic top side of vertical contact. Tick without dip value indicates general direction of dip. Arrow shows lineation on contact surface; tick and arrow may be combined to show dip and lineation at one locality.
1.1.9	Overturned contact—Showing dip where known			
1.1.10	Contact—Showing direction and plunge of lineation where known			
1.1.11	Contact—Showing location where contact is well exposed in field			
1.1.12	Contact—Showing relative age of intrusive or extrusive units where known: Y, younger; O, older			
1.1.13	Gradational contact—Certain			Use to indicate gradual or continuous change from one lithology to another across contact. Placement can be arbitrary, especially on larger scale maps.
1.1.14	Gradational contact—Approximately located			
1.1.15	Gradational contact—Approximately located, queried			

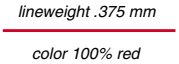
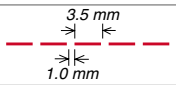
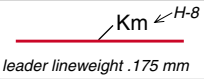
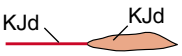
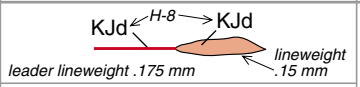
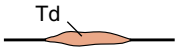
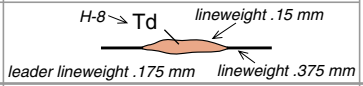
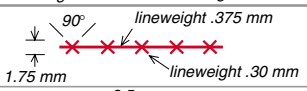
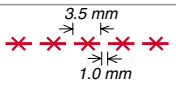
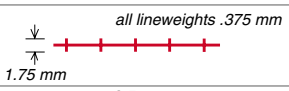
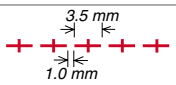
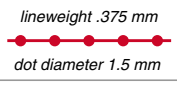
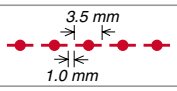
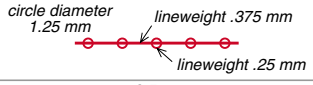
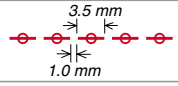
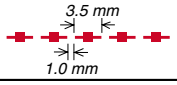
1—CONTACTS, KEY BEDS, AND DIKES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	1.2—Key beds			
1.2.1	Key bed—Certain			Use when key bed is too narrow to show as an area at map scale. May also be shown in color.
1.2.2	Key bed—Approximately located			
1.2.3	Key bed—Approximately located, queried			
1.2.4	Key bed—Inferred			
1.2.5	Key bed—Inferred, queried			
1.2.6	Key bed—Concealed			
1.2.7	Key bed—Concealed, queried			
1.2.8	Key bed—Showing name			Labels refer to individually mapped units. Name and (or) thickness notation may also be added to clay or coal beds.
1.2.9	Key bed—Showing thickness in meters and location where measured			
1.2.10	Outcrop areas of key bed, type 1			Usually shown on larger scale maps. Areas may also be used to show clay or coal beds. May be shown in color.
1.2.11	Outcrop areas of key bed, type 2			
1.2.12	Coal bed—Certain			Use when coal bed is too narrow to show as an area at map scale. May also be shown in color. Labels may be added to individually mapped coal beds; use same name and (or) thickness notation as shown above for key beds. Can also be used as contacts. Same line symbol can also be used for other economically important beds such as bentonite, phosphate, or limestone.
1.2.13	Coal bed—Approximately located			
1.2.14	Coal bed—Approximately located, queried			
1.2.15	Coal bed—Inferred			
1.2.16	Coal bed—Inferred, queried			
1.2.17	Coal bed—Concealed			
1.2.18	Coal bed—Concealed, queried			
1.2.19	Clinkered coal bed—Certain			Tops of V's follow trace of bed; V's point downward stratigraphically. Labels may be added to individually mapped clinkered coal beds; use same name and (or) thickness notation as shown above for key beds.
1.2.20	Clinkered coal bed—Approximately located			
1.2.21	Clinkered coal bed—Approximately located, queried			
1.2.22	Area of clinkered coal bed—Showing name			Labels refer to individually mapped clinkered coal beds.

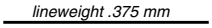
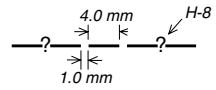
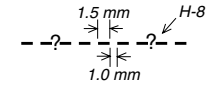
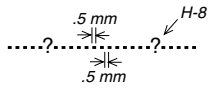
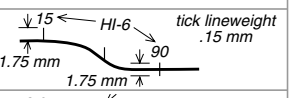
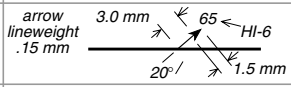
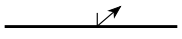
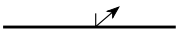
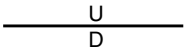
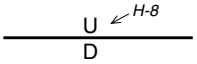
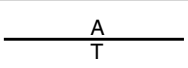
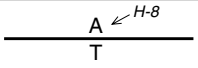
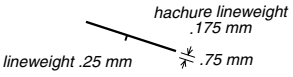
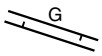
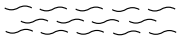
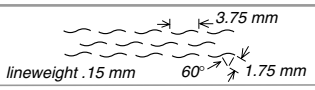
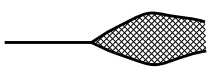
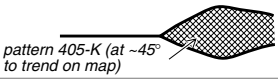
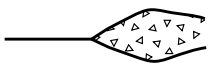
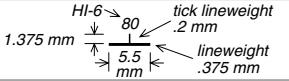
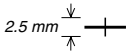
1—CONTACTS, KEY BEDS, AND DIKES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	1.2—Key beds (continued)			
1.2.23	Clay bed—Certain			For an explanation of spot color specifications used throughout this appendix, see Table 3 in the accompanying introductory text. Use when clay bed is too narrow to show as an area at map scale. May also be shown in other colors. Labels may be added to individually mapped clay beds; use same name and (or) thickness notation as shown above for key beds.
1.2.24	Clay bed—Approximately located			
1.2.25	Clay bed—Approximately located, queried			
1.2.26	Clay bed—Inferred			
1.2.27	Clay bed—Inferred, queried			
1.2.28	Clay bed—Concealed			
1.2.29	Clay bed—Concealed, queried			

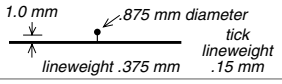
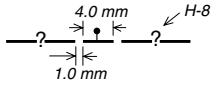
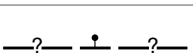
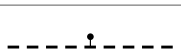
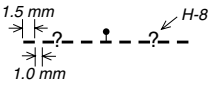
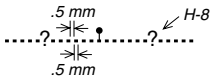
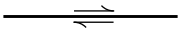
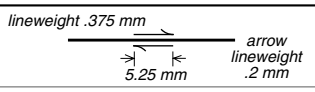
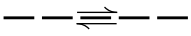
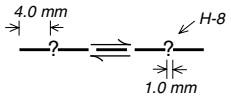
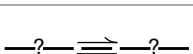
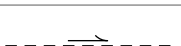
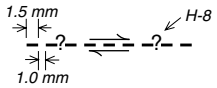
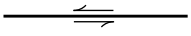
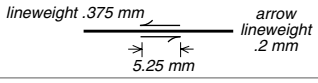
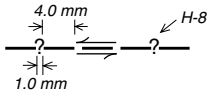
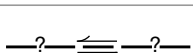
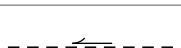
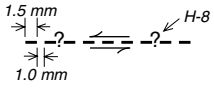
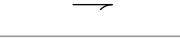
1—CONTACTS, KEY BEDS, AND DIKES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
		1.3—Dikes		
1.3.1	Dike 1—Certain			Use when dike is too narrow to show as an area at map scale. May be shown in different colors.
1.3.2	Dike 1—Approximately located			
1.3.3	Dike 1—Showing name			Labels may be added to all types of dikes if desired.
1.3.4	Dike 1—Showing variable thickness			Color fill shown for areal dikes is 50% red, but any color may be used.
1.3.5	Dike intruding fault			
1.3.6	Dike 2—Certain			Dike symbols shown may either be used alone or on maps that show more than one type of dike.
1.3.7	Dike 2—Approximately located			
1.3.8	Dike 3—Certain			
1.3.9	Dike 3—Approximately located			
1.3.10	Dike 4—Certain			
1.3.11	Dike 4—Approximately located			
1.3.12	Dike 5—Certain			
1.3.13	Dike 5—Approximately located			
1.3.14	Dike 6—Certain			
1.3.15	Dike 6—Approximately located			

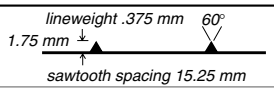
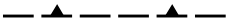
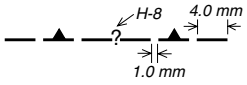
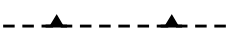
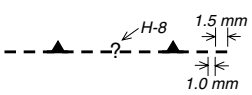
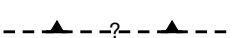
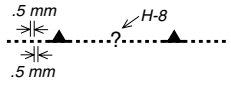
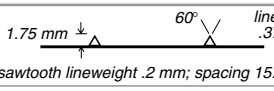
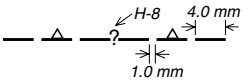
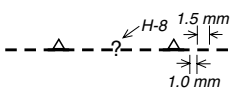
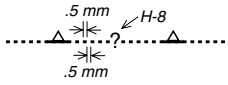
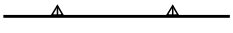
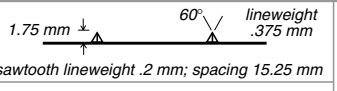
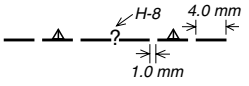
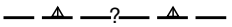
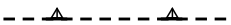
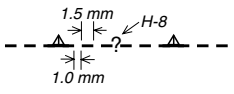
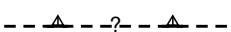
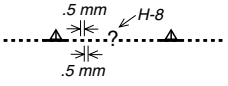
2—FAULTS

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
2.1—Faults (vertical, subvertical, reverse, or unspecified offset or orientation); shear zones; minor faults				
2.1.1	Fault—Certain			Use nonspecific, non-ornamented faults when character or sense of offset of fault is unknown; use also on small-scale maps to show regional fault patterns. If character or sense of offset is known and if scale allows, use various types of ornamented faults to indicate relative motion.
2.1.2	Fault—Approximately located			
2.1.3	Fault—Approximately located, queried			
2.1.4	Fault—Inferred			
2.1.5	Fault—Inferred, queried			
2.1.6	Fault—Concealed			
2.1.7	Fault—Concealed, queried			
2.1.8	Fault—Showing name			Place symbol ornamentation where observation was made. Dip value indicates a measured dip direction and magnitude; add 90 if necessary for clarity. Tick without dip value indicates general direction of dip. Arrow shows lineation on fault surface; tick and arrow may be combined to show dip and lineation at one locality. Use U/D on normal faults when ball and bar not used. Use A/T on strike-slip faults in cross section.
2.1.9	Fault—Showing dip where known			
2.1.10	Fault—Showing direction and plunge of lineation where known			
2.1.11	Fault—Tick shows direction of dip of fault; arrow shows direction of lineation on fault			
2.1.12	Fault—Showing relative motion: U, upthrown block; D, downthrown block			
2.1.13	Fault—Showing relative motion in cross section: A, away from observer; T, toward observer			
2.1.14	Normal fault on small-scale maps—Tick on downthrown side			Usually reserved for maps at scales of 1:1,000,000 or smaller.
2.1.15	Graben on small-scale maps—Ticks on downthrown side			
2.1.16	Reverse fault on small-scale maps—R on upthrown block			
2.1.17	Shear zone			Use S-shaped symbols to indicate trend of mylonite or other linear shear zones; spacing may be varied to show intensity of shear. Width of zone may vary. Patterns may overprint other units or be used as map units alone; add contacts when shear zones have well-defined boundaries.
2.1.18	Zone of sheared rock within fault, type 1			
2.1.19	Zone of sheared rock within fault, type 2			
2.1.20	Zone of sheared rock around fault			
2.1.21	Minor inclined fault—Showing strike and dip			Use to show minor faults observed in outcrop in terrain where they cannot be traced elsewhere.
2.1.22	Minor vertical or near-vertical fault—Showing strike			

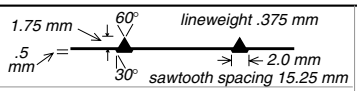
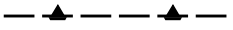
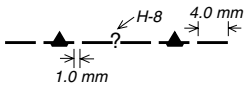
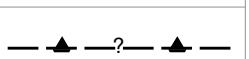
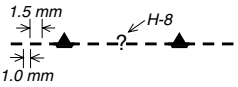
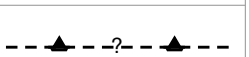
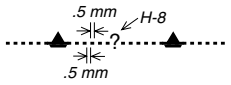
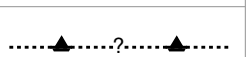
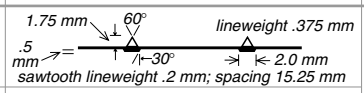
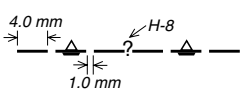
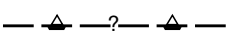
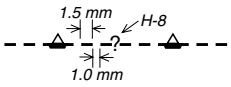
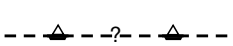
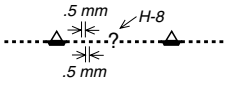
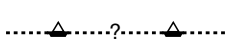
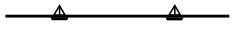
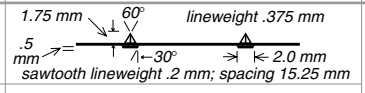
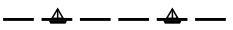
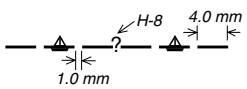
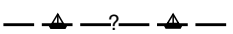
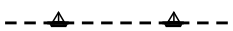
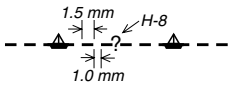
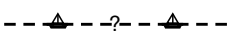
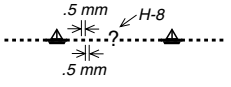
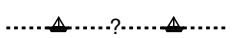
2—FAULTS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	2.2—Normal faults			
2.2.1	Normal fault—Certain			Ball and bar on downthrown block. Place ball and bar along fault to indicate general character of fault segment, not necessarily at a specific locality where an observation was made. Ball and bar symbol is preferred over U/D notation; do not mix both types on same map. Ball and bar may be combined with strike-slip arrows to show oblique offset. In cross section, use paired arrows (used for strike-slip faults in map view) to show normal offset.
2.2.2	Normal fault—Approximately located			
2.2.3	Normal fault—Approximately located, queried			
2.2.4	Normal fault—Inferred			
2.2.5	Normal fault—Inferred, queried			
2.2.6	Normal fault—Concealed			
2.2.7	Normal fault—Concealed, queried			
	2.3—Strike-slip faults			
2.3.1	Strike-slip fault, right-lateral offset—Certain			Arrows show relative motion. Place arrows along fault to indicate general character of fault segment, not necessarily at a specific locality where an observation was made. Use paired, not single, arrows whenever possible. Strike-slip arrows may be combined with ball and bar symbol to show oblique offset. In cross section, use A/T notation to show strike-slip offset. Paired arrows may also be used in cross section to show normal or thrust offset.
2.3.2	Strike-slip fault, right-lateral offset—Approximately located			
2.3.3	Strike-slip fault, right-lateral offset—Approximately located, queried			
2.3.4	Strike-slip fault, right-lateral offset—Inferred			
2.3.5	Strike-slip fault, right-lateral offset—Inferred, queried			
2.3.6	Strike-slip fault, right-lateral offset—Concealed			
2.3.7	Strike-slip fault, right-lateral offset—Concealed, queried			
2.3.8	Strike-slip fault, left-lateral offset—Certain			Arrows show relative motion. Place arrows along fault to indicate general character of fault segment, not necessarily at a specific locality where an observation was made. Use paired, not single, arrows whenever possible. Strike-slip arrows may be combined with ball and bar symbol to show oblique offset. In cross section, use A/T notation to show strike-slip offset. Paired arrows may also be used in cross section to show normal or thrust offset.
2.3.9	Strike-slip fault, left-lateral offset—Approximately located			
2.3.10	Strike-slip fault, left-lateral offset—Approximately located, queried			
2.3.11	Strike-slip fault, left-lateral offset—Inferred			
2.3.12	Strike-slip fault, left-lateral offset—Inferred, queried			
2.3.13	Strike-slip fault, left-lateral offset—Concealed			
2.3.14	Strike-slip fault, left-lateral offset—Concealed, queried			

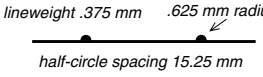
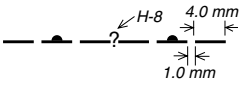
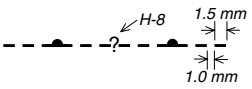
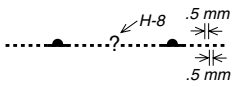
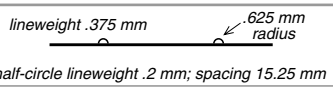
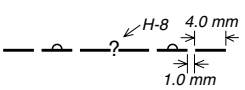
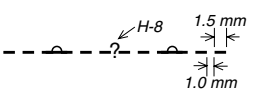
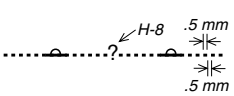
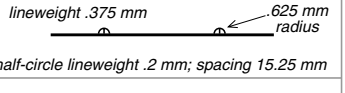
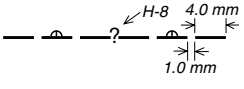
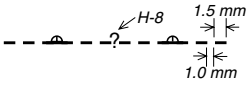
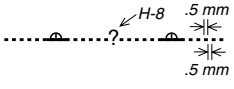
2—FAULTS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	2.4—Thrust faults			
2.4.1	Thrust fault, 1st generation—Certain			Sawteeth on upper (tectonically higher) plate. Sawteeth indicate general character of fault; they are not placed at specific locality where an observation was made. Do not vary size or spacing of sawteeth to indicate different types or generations of faulting (see below). Strike-slip arrows may be combined with sawteeth to show oblique offset. In cross section, use paired arrows (used for strike-slip faults in map view) to show thrust offset.
2.4.2	Thrust fault, 1st generation—Approximately located			
2.4.3	Thrust fault, 1st generation—Approximately located, queried			
2.4.4	Thrust fault, 1st generation—Inferred			
2.4.5	Thrust fault, 1st generation—Inferred, queried			
2.4.6	Thrust fault, 1st generation—Concealed			
2.4.7	Thrust fault, 1st generation—Concealed, queried			
2.4.8	Thrust fault, 2nd generation—Certain			Sawteeth on upper (tectonically higher) plate. Use to indicate another type or generation of thrust fault when more than one is shown on map.
2.4.9	Thrust fault, 2nd generation—Approximately located			
2.4.10	Thrust fault, 2nd generation—Approximately located, queried			
2.4.11	Thrust fault, 2nd generation—Inferred			
2.4.12	Thrust fault, 2nd generation—Inferred, queried			
2.4.13	Thrust fault, 2nd generation—Concealed			
2.4.14	Thrust fault, 2nd generation—Concealed, queried			
2.4.15	Thrust fault, 3rd generation—Certain			Sawteeth on upper (tectonically higher) plate. Use to indicate a third type or generation of thrust fault when more than two are shown on map.
2.4.16	Thrust fault, 3rd generation—Approximately located			
2.4.17	Thrust fault, 3rd generation—Approximately located, queried			
2.4.18	Thrust fault, 3rd generation—Inferred			
2.4.19	Thrust fault, 3rd generation—Inferred, queried			
2.4.20	Thrust fault, 3rd generation—Concealed			
2.4.21	Thrust fault, 3rd generation—Concealed, queried			

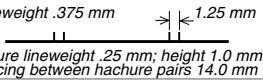
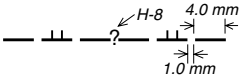
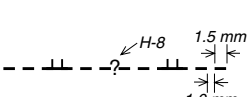
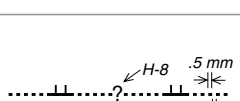
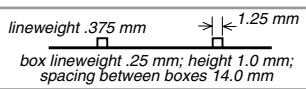
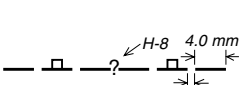
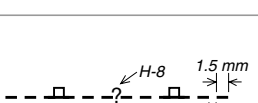
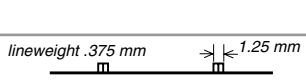
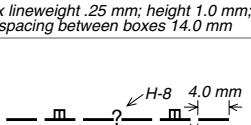
2—FAULTS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	2.5—Overturned thrust faults			
2.5.1	Overturned thrust fault, 1st generation—Certain			Bars on upper (tectonically higher) plate; sawteeth in direction of dip. Bars and sawteeth indicate general character of fault; they are not placed at specific locality where an observation was made. Do not vary size or spacing of bars and sawteeth to indicate different types or generations of faulting (see below). Strike-slip arrows may be combined with bars and sawteeth to show oblique offset. In cross section, use paired arrows (used for strike-slip faults in map view) to show thrust offset.
2.5.2	Overturned thrust fault, 1st generation—Approximately located			
2.5.3	Overturned thrust fault, 1st generation—Approximately located, queried			
2.5.4	Overturned thrust fault, 1st generation—Inferred			
2.5.5	Overturned thrust fault, 1st generation—Inferred, queried			
2.5.6	Overturned thrust fault, 1st generation—Concealed			
2.5.7	Overturned thrust fault, 1st generation—Concealed, queried			
2.5.8	Overturned thrust fault, 2nd generation—Certain			Bars on upper (tectonically higher) plate; sawteeth in direction of dip. Use to indicate another type or generation of overturned thrust fault when more than one is shown on map.
2.5.9	Overturned thrust fault, 2nd generation—Approximately located			
2.5.10	Overturned thrust fault, 2nd generation—Approximately located, queried			
2.5.11	Overturned thrust fault, 2nd generation—Inferred			
2.5.12	Overturned thrust fault, 2nd generation—Inferred, queried			
2.5.13	Overturned thrust fault, 2nd generation—Concealed			
2.5.14	Overturned thrust fault, 2nd generation—Concealed, queried			
2.5.15	Overturned thrust fault, 3rd generation—Certain			Bars on upper (tectonically higher) plate; sawteeth in direction of dip. Use to indicate a third type or generation of overturned thrust fault when more than two are shown on map.
2.5.16	Overturned thrust fault, 3rd generation—Approximately located			
2.5.17	Overturned thrust fault, 3rd generation—Approximately located, queried			
2.5.18	Overturned thrust fault, 3rd generation—Inferred			
2.5.19	Overturned thrust fault, 3rd generation—Inferred, queried			
2.5.20	Overturned thrust fault, 3rd generation—Concealed			
2.5.21	Overturned thrust fault, 3rd generation—Concealed, queried			

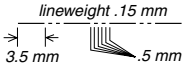
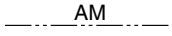
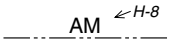
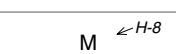
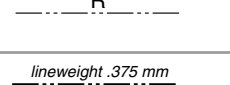
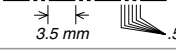
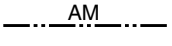
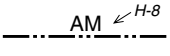
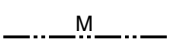
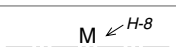
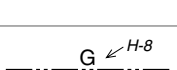
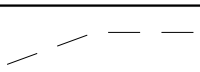
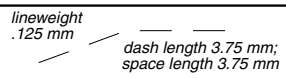
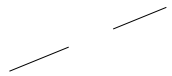
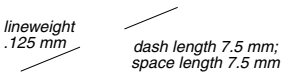
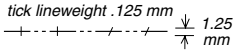
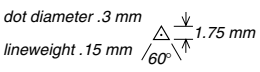
2—FAULTS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	2.6—Detachment faults			
2.6.1	Detachment fault, type 1, 1st generation—Certain			Half-circles on upper (tectonically higher) plate. Half-circles indicate general character of fault; they are not placed at specific locality where an observation was made. Do not vary size or spacing of half-circles to indicate different types or generations of faulting (see below). In cross section, use paired arrows (used for strike-slip faults in map view) to show low-angle normal offset.
2.6.2	Detachment fault, type 1, 1st generation—Approximately located			
2.6.3	Detachment fault, type 1, 1st generation—Approximately located, queried			
2.6.4	Detachment fault, type 1, 1st generation—Inferred			
2.6.5	Detachment fault, type 1, 1st generation—Inferred, queried			
2.6.6	Detachment fault, type 1, 1st generation—Concealed			
2.6.7	Detachment fault, type 1, 1st generation—Concealed, queried			
2.6.8	Detachment fault, type 1, 2nd generation—Certain			Half-circles on upper (tectonically higher) plate. Use to indicate another type or generation of detachment fault when more than one is shown on map.
2.6.9	Detachment fault, type 1, 2nd generation—Approximately located			
2.6.10	Detachment fault, type 1, 2nd generation—Approximately located, queried			
2.6.11	Detachment fault, type 1, 2nd generation—Inferred			
2.6.12	Detachment fault, type 1, 2nd generation—Inferred, queried			
2.6.13	Detachment fault, type 1, 2nd generation—Concealed			
2.6.14	Detachment fault, type 1, 2nd generation—Concealed, queried			
2.6.15	Detachment fault, type 1, 3rd generation—Certain			Half-circles on upper (tectonically higher) plate. Use to indicate a third type or generation of detachment fault when more than two are shown on map.
2.6.16	Detachment fault, type 1, 3rd generation—Approximately located			
2.6.17	Detachment fault, type 1, 3rd generation—Approximately located, queried			
2.6.18	Detachment fault, type 1, 3rd generation—Inferred			
2.6.19	Detachment fault, type 1, 3rd generation—Inferred, queried			
2.6.20	Detachment fault, type 1, 3rd generation—Concealed			
2.6.21	Detachment fault, type 1, 3rd generation—Concealed, queried			

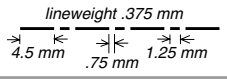
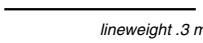
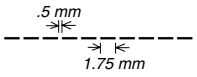
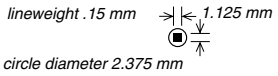
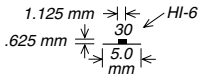
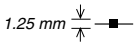
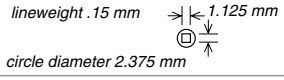
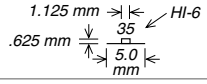
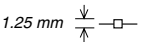
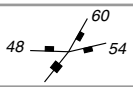
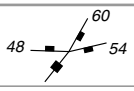
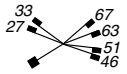
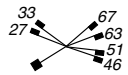
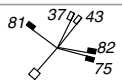
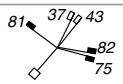
2—FAULTS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	2.6—Detachment faults (continued)			
2.6.22	Detachment fault, type 2, 1st generation—Certain			Hachures on upper (tectonically higher) plate. Hachures indicate general character of fault; they are not placed at specific locality where an observation was made. Do not vary size or spacing of hachures to indicate different types or generations of faulting (see below). In cross section, use paired arrows (used for strike-slip faults in map view) to show low-angle normal offset.
2.6.23	Detachment fault, type 2, 1st generation—Approximately located			
2.6.24	Detachment fault, type 2, 1st generation—Approximately located, queried			
2.6.25	Detachment fault, type 2, 1st generation—Inferred			
2.6.26	Detachment fault, type 2, 1st generation—Inferred, queried			
2.6.27	Detachment fault, type 2, 1st generation—Concealed			
2.6.28	Detachment fault, type 2, 1st generation—Concealed, queried			
2.6.29	Detachment fault, type 2, 2nd generation—Certain			Boxes on upper (tectonically higher) plate. Use to indicate another type or generation of detachment fault when more than one is shown on map.
2.6.30	Detachment fault, type 2, 2nd generation—Approximately located			
2.6.31	Detachment fault, type 2, 2nd generation—Approximately located, queried			
2.6.32	Detachment fault, type 2, 2nd generation—Inferred			
2.6.33	Detachment fault, type 2, 2nd generation—Inferred, queried			
2.6.34	Detachment fault, type 2, 2nd generation—Concealed			
2.6.35	Detachment fault, type 2, 2nd generation—Concealed, queried			
2.6.36	Detachment fault, type 2, 3rd generation—Certain			Boxes on upper (tectonically higher) plate. Use to indicate a third type or generation of detachment fault when more than two are shown on map.
2.6.37	Detachment fault, type 2, 3rd generation—Approximately located			
2.6.38	Detachment fault, type 2, 3rd generation—Approximately located, queried			
2.6.39	Detachment fault, type 2, 3rd generation—Inferred			
2.6.40	Detachment fault, type 2, 3rd generation—Inferred, queried			
2.6.41	Detachment fault, type 2, 3rd generation—Concealed			
2.6.42	Detachment fault, type 2, 3rd generation—Concealed, queried			

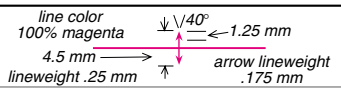
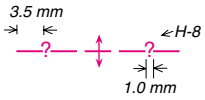
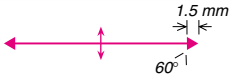
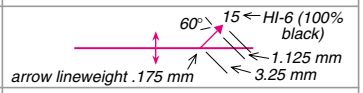
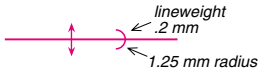
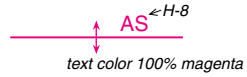
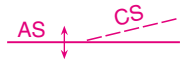
3—BOUNDARIES LOCATED BY GEOPHYSICAL SURVEYS

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
3.1—Boundaries and faults located by geophysical methods				
3.1.1	Boundary—Located by geophysical methods			Use for boundaries that have been defined by measured contrasts in rock properties but that may not be definitively identifiable as either a contact or a fault by survey methods. Indicate type of survey if known. Technique and accuracy should be described in map explanation.
3.1.2	Boundary—Located by aeromagnetic survey			
3.1.3	Boundary—Located by ground magnetic survey			
3.1.4	Boundary—Located by gravity survey			
3.1.5	Boundary—Located by radiometric survey			
3.1.6	Fault—Located by geophysical methods			Use when boundary is identified as a fault by geophysical survey or by other evidence that contributes to survey.
3.1.7	Fault—Located by aeromagnetic survey			
3.1.8	Fault—Located by ground magnetic survey			
3.1.9	Fault—Located by gravity survey			
3.1.10	Fault—Located by radiometric survey			
3.2—Geophysical survey lines and stations				
3.2.1	Geophysical data collection line—Accurately located			Specify location accuracy of data collection lines. Orientation of cross ticks follows survey lines. Survey stations are control points for geophysical survey.
3.2.2	Geophysical data collection line—Located by aerial survey			
3.2.3	Cross ticks showing location and orientation of data collection lines crossing geophysical boundary			
3.2.4	Survey station			

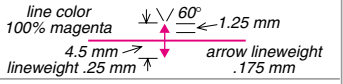
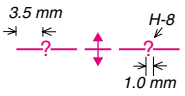
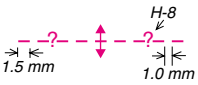
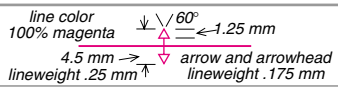
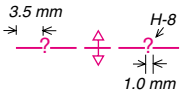
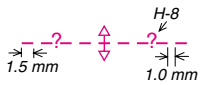
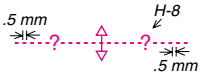
4—LINEAMENTS AND JOINTS

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
4.1	Lineament			Determined from aerial photographs; not field checked.
4.2	Joint—Certain			Use to show large-scale joint patterns.
4.3	Joint—Approximately located			
4.4	Multiple joints—Showing dip where known			
4.5	Horizontal joint, type 1			Use to show minor joints observed in outcrop in terrain where they cannot be traced elsewhere.
4.6	Inclined joint, type 1—Showing strike and dip			
4.7	Vertical or near-vertical joint, type 1—Showing strike			
4.8	Horizontal joint, type 2			Use to indicate another type or generation of minor joints when more than one is shown on map.
4.9	Inclined joint, type 2—Showing strike and dip			
4.10	Vertical or near-vertical joint, type 2—Showing strike			
4.11	Multiple joints of a single type			Use when several minor joints of different orientation and (or) type are observed at the same locality. Point of observation is the junction point common to all strike lines.
4.12	Multiple joints of a single type (use when multiple symbols would otherwise overlap)			
4.13	Multiple joints of different types			
4.14	Multiple joints of different types (use when multiple symbols would otherwise overlap)			

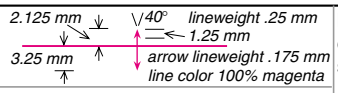
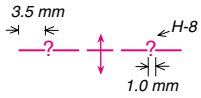
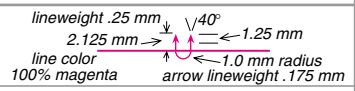
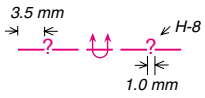
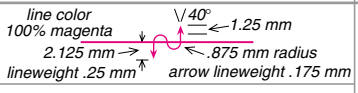
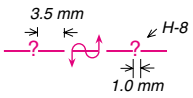
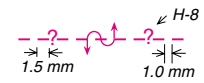
5—FOLDS

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	5.1—Anticlines; antiforms			
5.1.1	Anticline—Certain			Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.1.2	Anticline—Approximately located			
5.1.3	Anticline—Approximately located, queried			
5.1.4	Anticline—Inferred			
5.1.5	Anticline—Inferred, queried			
5.1.6	Anticline—Concealed			
5.1.7	Anticline—Concealed, queried			
5.1.8	Anticline—Showing name			Although only shown on anticlines, symbol ornamentation may be added to any type of fold trace. Plunge arrowheads indicate general direction of plunge only; do not add plunge angle. Plunge arrowheads may also be placed within fold trace. If trace of axial surface differs significantly from real plunge direction because of the topography and (or) character of fold, show direction and plunge as separate arrow placed along fold trace. Label both axial surface and crest and trough lines if both are shown on one map. May also be shown in black or other colors.
5.1.9	Plunging anticline—Showing direction of plunge			
5.1.10	Doubly plunging anticline			
5.1.11	Anticline—Showing direction and plunge of fold axis			
5.1.12	Anticline—Showing direction of closure of near-vertical fold limbs			
5.1.13	Anticline—Axial surface (AS) of fold			
5.1.14	Anticline—Showing crest line (CS) of fold where it diverges from axial surface			
5.1.15	Anticline—Showing trough line (TS) of fold where it diverges from axial surface			

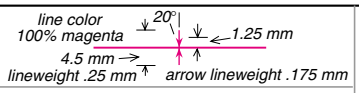
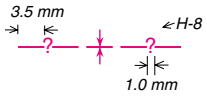
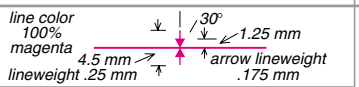
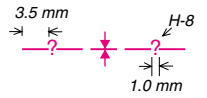
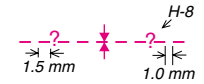
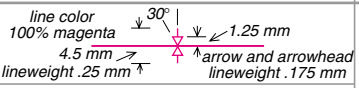
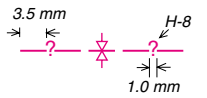
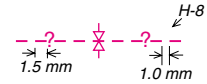
5—FOLDS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	5.1—Anticlines; antiforms (continued)			
5.1.16	Antiform, 1st type—Certain			Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.1.17	Antiform, 1st type—Approximately located			
5.1.18	Antiform, 1st type—Approximately located, queried			
5.1.19	Antiform, 1st type—Inferred			
5.1.20	Antiform, 1st type—Inferred, queried			
5.1.21	Antiform, 1st type—Concealed			
5.1.22	Antiform, 1st type—Concealed, queried			
5.1.23	Antiform, 2nd type—Certain			Use to indicate another type or generation of antiform when more than one is shown on map. May also be shown in black or other colors.
5.1.24	Antiform, 2nd type—Approximately located			
5.1.25	Antiform, 2nd type—Approximately located, queried			
5.1.26	Antiform, 2nd type—Inferred			
5.1.27	Antiform, 2nd type—Inferred, queried			
5.1.28	Antiform, 2nd type—Concealed			
5.1.29	Antiform, 2nd type—Concealed, queried			

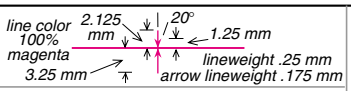
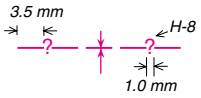
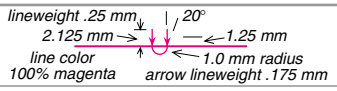
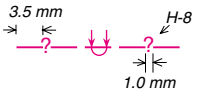
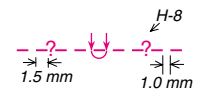
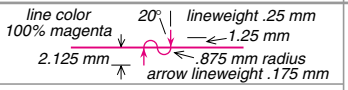
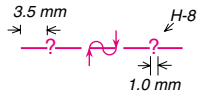
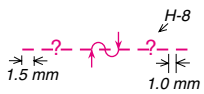
5—FOLDS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
5.2—Asymmetric, overturned, and inverted anticlines				
5.2.1	Asymmetric anticline—Certain			Beds are upright; shorter arrow indicates steeper limb. Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds having near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.2.2	Asymmetric anticline—Approximately located			
5.2.3	Asymmetric anticline—Approximately located, queried			
5.2.4	Asymmetric anticline—Inferred			
5.2.5	Asymmetric anticline—Inferred, queried			
5.2.6	Asymmetric anticline—Concealed			
5.2.7	Asymmetric anticline—Concealed, queried			
5.2.8	Overturned anticline—Certain			Beds on one limb are overturned; arrows show direction of dip of limbs. Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.2.9	Overturned anticline—Approximately located			
5.2.10	Overturned anticline—Approximately located, queried			
5.2.11	Overturned anticline—Inferred			
5.2.12	Overturned anticline—Inferred, queried			
5.2.13	Overturned anticline—Concealed			
5.2.14	Overturned anticline—Concealed, queried			
5.2.15	Inverted anticline—Certain			Beds on both limbs are overturned; arrows show direction of dip of limbs. Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.2.16	Inverted anticline—Approximately located			
5.2.17	Inverted anticline—Approximately located, queried			
5.2.18	Inverted anticline—Inferred			
5.2.19	Inverted anticline—Inferred, queried			
5.2.20	Inverted anticline—Concealed			
5.2.21	Inverted anticline—Concealed, queried			

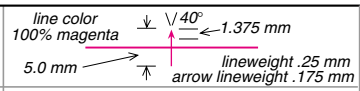
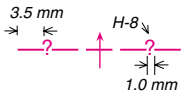
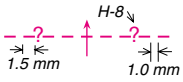
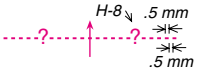
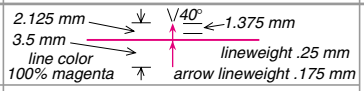
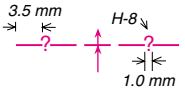
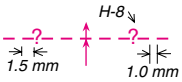
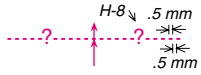
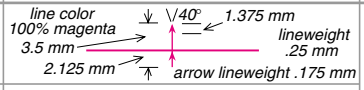
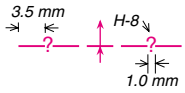
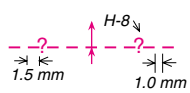
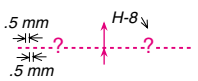
5—FOLDS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	5.3—Synclines; synforms			
5.3.1	Syncline—Certain			Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.3.2	Syncline—Approximately located			
5.3.3	Syncline—Approximately located, queried			
5.3.4	Syncline—Inferred			
5.3.5	Syncline—Inferred, queried			
5.3.6	Syncline—Concealed			
5.3.7	Syncline—Concealed, queried			
5.3.8	Synform, 1st type—Certain			Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.3.9	Synform, 1st type—Approximately located			
5.3.10	Synform, 1st type—Approximately located, queried			
5.3.11	Synform, 1st type—Inferred			
5.3.12	Synform, 1st type—Inferred, queried			
5.3.13	Synform, 1st type—Concealed			
5.3.14	Synform, 1st type—Concealed, queried			
5.3.15	Synform, 2nd type—Certain			Use to indicate another type or generation of synform when more than one is shown on map. May also be shown in black or other colors.
5.3.16	Synform, 2nd type—Approximately located			
5.3.17	Synform, 2nd type—Approximately located, queried			
5.3.18	Synform, 2nd type—Inferred			
5.3.19	Synform, 2nd type—Inferred, queried			
5.3.20	Synform, 2nd type—Concealed			
5.3.21	Synform, 2nd type—Concealed, queried			

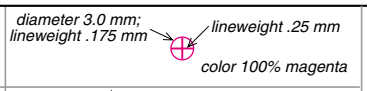
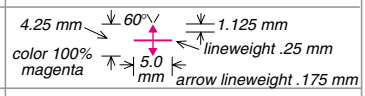
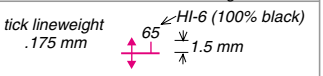
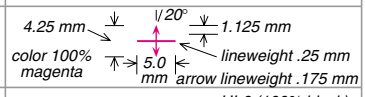
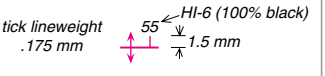
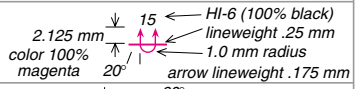
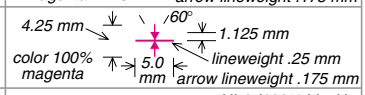
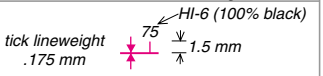
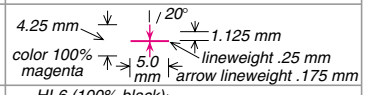
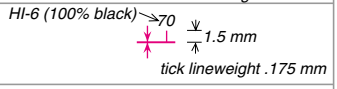
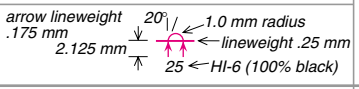
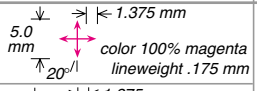
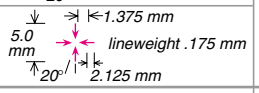
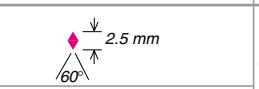
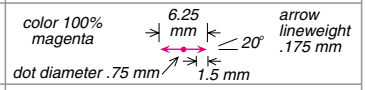
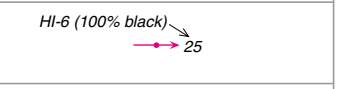
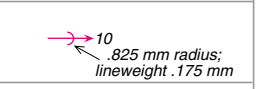
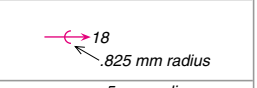
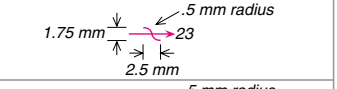
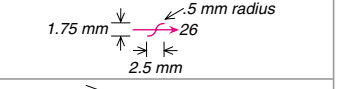
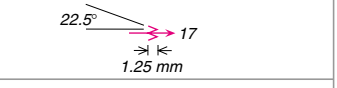
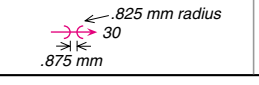
5—FOLDS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
5.4—Asymmetric, overturned, and inverted synclines				
5.4.1	Asymmetric syncline—Certain			Beds are upright; shorter arrow indicates steeper limb. Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.4.2	Asymmetric syncline—Approximately located			
5.4.3	Asymmetric syncline—Approximately located, queried			
5.4.4	Asymmetric syncline—Inferred			
5.4.5	Asymmetric syncline—Inferred, queried			
5.4.6	Asymmetric syncline—Concealed			
5.4.7	Asymmetric syncline—Concealed, queried			
5.4.8	Overturned syncline—Certain			Beds on one limb are overturned; arrows show direction of dip of limbs. Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.4.9	Overturned syncline—Approximately located			
5.4.10	Overturned syncline—Approximately located, queried			
5.4.11	Overturned syncline—Inferred			
5.4.12	Overturned syncline—Inferred, queried			
5.4.13	Overturned syncline—Concealed			
5.4.14	Overturned syncline—Concealed, queried			
5.4.15	Inverted syncline—Certain			Beds on both limbs are overturned; arrows show direction of dip of limbs. Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. Preferred usage is to show trace of axial surface of fold, not crest or trough; if the latter are shown instead, specify in symbol explanation. For folds that have near-vertical axial surfaces, trace of axial surface is independent of topography. May also be shown in black or other colors.
5.4.16	Inverted syncline—Approximately located			
5.4.17	Inverted syncline—Approximately located, queried			
5.4.18	Inverted syncline—Inferred			
5.4.19	Inverted syncline—Inferred, queried			
5.4.20	Inverted syncline—Concealed			
5.4.21	Inverted syncline—Concealed, queried			

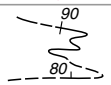
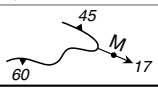
5—FOLDS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	5.5—Monoclines			
5.5.1	Monocline—Certain			Arrow points in direction of dip. Use to label trace of maximum dip of surface that connects anticlinal and synclinal bends too close together to show as separate traces. Place arrow perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. May also be shown in black or other colors.
5.5.2	Monocline—Approximately located			
5.5.3	Monocline—Approximately located, queried			
5.5.4	Monocline—Inferred			
5.5.5	Monocline—Inferred, queried			
5.5.6	Monocline—Concealed			
5.5.7	Monocline—Concealed, queried			
5.5.8	Monocline, anticlinal bend—Certain			Shorter arrow on steeper beds. Use to label trace of anticlinal bend of monocline when both anticlinal and synclinal bends can be shown at map scale. Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. May also be shown in black or other colors.
5.5.9	Monocline, anticlinal bend—Approximately located			
5.5.10	Monocline, anticlinal bend—Approximately located, queried			
5.5.11	Monocline, anticlinal bend—Inferred			
5.5.12	Monocline, anticlinal bend—Inferred, queried			
5.5.13	Monocline, anticlinal bend—Concealed			
5.5.14	Monocline, anticlinal bend—Concealed, queried			
5.5.15	Monocline, synclinal bend—Certain			Shorter arrow on steeper beds. Use to label trace of synclinal bend of monocline when both anticlinal and synclinal bends can be shown at map scale. Place arrows perpendicular to fold trace to indicate general character of fold segment; do not place at specific locality where observation was made. May also be shown in black or other colors.
5.5.16	Monocline, synclinal bend—Approximately located			
5.5.17	Monocline, synclinal bend—Approximately located, queried			
5.5.18	Monocline, synclinal bend—Inferred			
5.5.19	Monocline, synclinal bend—Inferred, queried			
5.5.20	Monocline, synclinal bend—Concealed			
5.5.21	Monocline, synclinal bend—Concealed, queried			

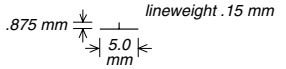
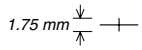
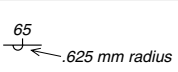
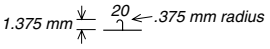
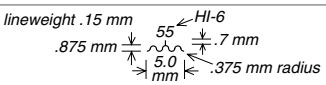
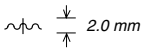
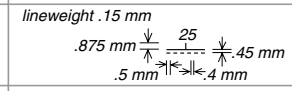
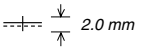
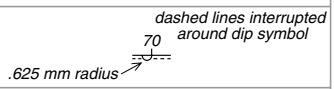
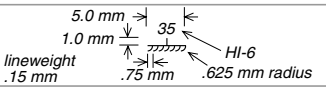
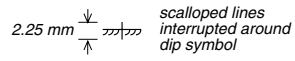
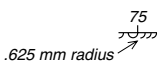
5—FOLDS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	5.6—Minor folds; boudinage			
5.6.1	Minor fold, horizontal axial surface			Preferred usage is to show trace of axial surface; may be used separately or in combination with symbols for axes of minor folds. Use when beds are too tightly folded to show traces of individual folds completely or when folds are observed in outcrop but cannot be traced elsewhere. May also be shown in black or other colors.
5.6.2	Minor antiform, vertical or near-vertical axial surface—Showing strike			
5.6.3	Minor antiform, inclined axial surface—Showing strike and dip			
5.6.4	Minor anticline, vertical or near-vertical axial surface—Showing strike			
5.6.5	Minor anticline, inclined axial surface—Showing strike and dip			
5.6.6	Minor overturned anticline, inclined axial surface—Showing strike and dip			
5.6.7	Minor synform, vertical or near-vertical axial surface—Showing strike			
5.6.8	Minor synform, inclined axial surface—Showing strike and dip			
5.6.9	Minor syncline, vertical or near-vertical axial surface—Showing strike			
5.6.10	Minor syncline, inclined axial surface—Showing strike and dip			
5.6.11	Minor overturned syncline, inclined axial surface—Showing strike and dip			
5.6.12	Minor dome			Use of minor dome and basin symbols is usually restricted to small-scale maps. May also be shown in black or other colors.
5.6.13	Minor basin			
5.6.14	Vertical minor fold axis			May be used separately or in combination with other symbols. For single, unidirectional arrow symbols, the point of observation may either be in the middle, at the tip, or at the tail end of the arrow; whichever is preferred, it is important to specify in the symbol explanation which method has been used. For combined symbols, the point of observation is at the tail end of the arrow, the junction point common to all symbols. Use when beds are too tightly folded to show traces of individual folds completely or when folds are observed in outcrop but cannot be traced elsewhere. May also be shown in black or other colors.
5.6.15	Horizontal minor fold axis—Showing bearing			
5.6.16	Inclined minor fold axis—Showing bearing and plunge			
5.6.17	Minor anticline—Showing bearing and plunge			
5.6.18	Minor syncline—Showing bearing and plunge			
5.6.19	Minor fold, dextral rotation sense (Z–shaped asymmetry)—Showing bearing and plunge			
5.6.20	Minor fold, sinistral rotation sense (S–shaped asymmetry)—Showing bearing and plunge			
5.6.21	Minor folds—Showing bearing and plunge			
5.6.22	Boudinage—Showing bearing and plunge			

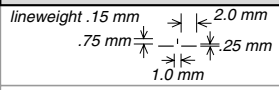
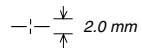
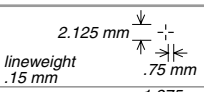
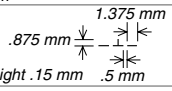
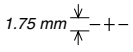
5—FOLDS (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	5.7—Free-form fold symbology			
5.7.1	Open anticlinal fold			Use to represent general character of structures in complexly deformed rocks or in terranes where outcrops are sparse. Symbols are diagrammatic: point of observation is not well-specified, and lines that represent fold limbs often extend over areas far from site of observation. May also be shown in black or other colors.
5.7.2	Tight anticlinal fold			
5.7.3	Open synclinal fold			
5.7.4	Tight synclinal fold			
5.7.5	Isoclinal fold			
5.7.6	Complex fold—Showing direction and plunge. Triangle indicates dip of foliation; tick indicates dip of beds			Examples of free-form fold symbology showing actual structures (located accurately and to scale). May be combined with other planar and linear features.
5.7.7	Trace of iron formation—Showing dip. Dashed where inferred			
5.7.8	Trace of gneiss—Showing dip of foliation and bearing and plunge of mineral lineation			

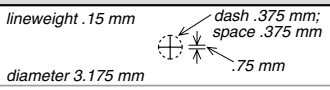
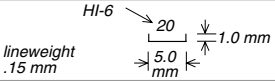
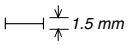
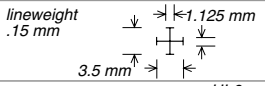
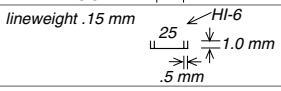
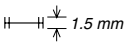
6—BEDDING

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
6.1	Horizontal bedding			May be used separately or in combination with other symbols. For all individual symbols other than horizontal bedding, point of observation is at the midpoint of strike line. For combined symbols, point of observation is at the junction point common to all strike lines. Use ball indicating known top direction only on maps where top direction may be in doubt elsewhere.
6.2	Inclined bedding—Showing strike and direction of dip			
6.3	Inclined bedding—Showing strike and dip			
6.4	Inclined bedding—Showing strike and dip. Top direction of beds known from local features			
6.5	Vertical bedding—Showing strike			
6.6	Vertical bedding—Showing strike. Ball shows top direction of beds where known from local features			
6.7	Overturned bedding—Showing strike and dip			
6.8	Overturned bedding—Showing strike and dip. Top direction of beds known from local features			
6.9	Bedding overturned more than 180 degrees—Showing strike and dip			
6.10	Bedding overturned more than 180 degrees—Showing strike and dip. Top direction of beds known from local features			
6.11	Inclined crenulated or warped bedding—Showing approximate strike and dip			
6.12	Vertical or near-vertical crenulated or warped bedding—Showing approximate strike			
6.13	Inclined graded bedding—Showing strike and dip			
6.14	Vertical or near-vertical graded bedding—Showing strike			
6.15	Overturned graded bedding—Showing strike and dip			
6.16	Inclined bedding in crossbedded rocks—Showing approximate strike and dip			
6.17	Vertical or near-vertical bedding in crossbedded rocks—Showing approximate strike			
6.18	Overturned bedding in crossbedded rocks—Showing approximate strike and dip			

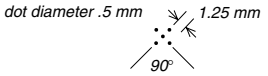
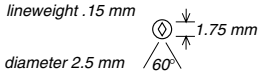
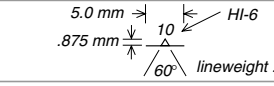
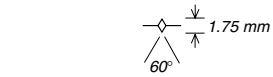
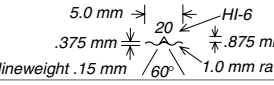
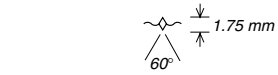
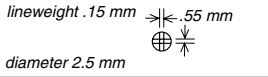
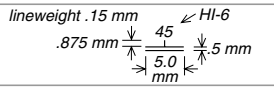
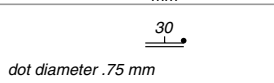
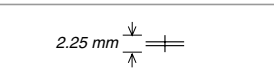
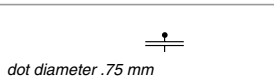
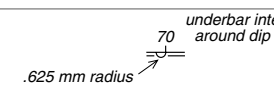
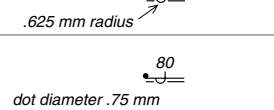
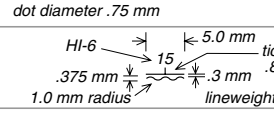
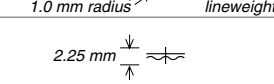
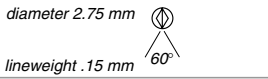
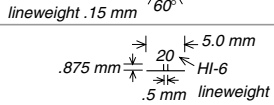
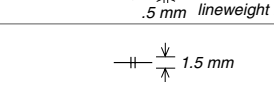
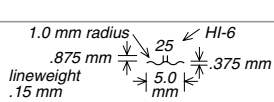
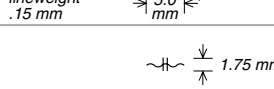
6—BEDDING (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
6.19	Inclined bedding—Showing approximate strike and direction of dip	—'—		Uncertainty is for measured values, not for location of observation.
6.20	Vertical or near-vertical bedding—Showing approximate strike	—¦—		
6.21	Horizontal bedding, determined from aerial photographs	-¦-		Usually reserved for use on reconnaissance geologic maps.
6.22	Gently inclined (between 0° and 30°) bedding, determined from aerial photographs—Showing approximate strike and direction of dip	–⊥–		
6.23	Moderately inclined (between 30° and 60°) bedding, determined from aerial photographs—Showing approximate strike and direction of dip	–⫫–		
6.24	Steeply inclined (between 60° and 90°) bedding, determined from aerial photographs—Showing approximate strike and direction of dip	–⫼–		
6.25	Vertical or near-vertical bedding, determined from aerial photographs—Showing approximate strike	–+–		

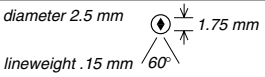
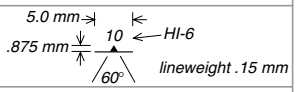
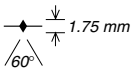
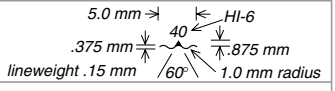
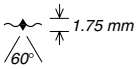
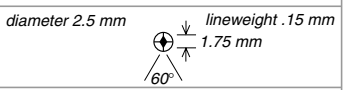
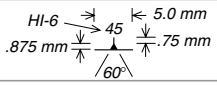
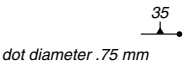
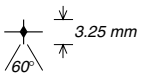
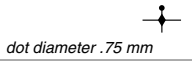
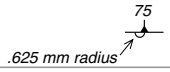
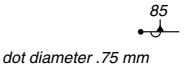
7—CLEAVAGE

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
7.1	Horizontal cleavage, type 1			
7.2	Inclined cleavage, type 1—Showing strike and dip			
7.3	Vertical or near-vertical cleavage, type 1—Showing strike			
7.4	Horizontal cleavage, type 2			Use when more than one type of cleavage is shown on map.
7.5	Inclined cleavage, type 2—Showing strike and dip			
7.6	Vertical or near-vertical cleavage, type 2—Showing strike			

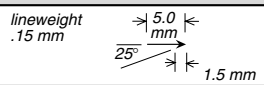
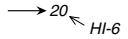
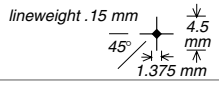
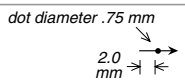
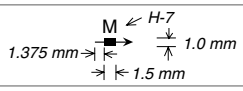
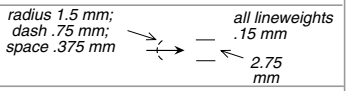
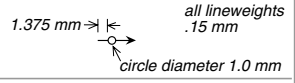
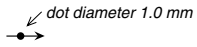
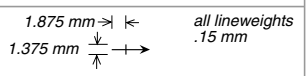
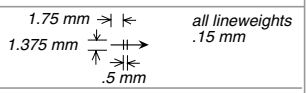
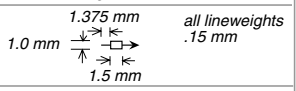
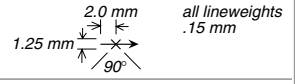
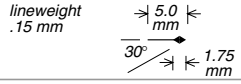
8—FOLIATION

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
8.1—Foliation and layering in igneous rock				
8.1.1	Massive igneous rock			May be used separately or in combination with other symbols. For individual symbols other than horizontal foliation and massive igneous rock, point of observation is midpoint of strike line. For combined symbols, point of observation is the junction point common to all strike lines. Use symbol for massive igneous rock at locality where foliation and lineation are absent. Use ball indicating known top direction of layers only on maps where top direction may be in doubt elsewhere.
8.1.2	Horizontal flow foliation or layering in igneous rock			
8.1.3	Inclined flow foliation or layering in igneous rock—Showing strike and dip			
8.1.4	Vertical or near-vertical flow foliation or layering in igneous rock—Showing strike			
8.1.5	Inclined crinkled or deformed flow foliation or layering in igneous rock—Showing approximate strike and dip			
8.1.6	Vertical or near-vertical crinkled or deformed flow foliation or layering in igneous rock—Showing approximate strike			
8.1.7	Horizontal cumulate foliation parallel to layering in igneous rock			
8.1.8	Inclined cumulate foliation parallel to layering in igneous rock—Showing strike and dip			
8.1.9	Inclined cumulate foliation parallel to upright layering in igneous rock—Showing strike and dip. Top direction of layers known from local features			
8.1.10	Vertical or near-vertical cumulate foliation parallel to layering in igneous rock—Showing strike			
8.1.11	Vertical or near-vertical cumulate foliation parallel to layering in igneous rock—Showing strike. Ball shows top direction of layers where known from local features			
8.1.12	Inclined cumulate foliation parallel to overturned layering in igneous rock—Showing strike and dip			
8.1.13	Inclined cumulate foliation parallel to overturned layering in igneous rock—Showing strike and dip. Top direction of layers known from local features			
8.1.14	Inclined crinkled or deformed cumulate foliation in layered igneous rock—Showing approximate strike and dip			
8.1.15	Vertical or near-vertical crinkled or deformed cumulate foliation in layered igneous rock—Showing approximate strike			
8.1.16	Horizontal compaction foliation in ash-flow tuff			
8.1.17	Inclined compaction foliation in ash-flow tuff—Showing strike and dip			
8.1.18	Vertical or near-vertical compaction foliation in ash-flow tuff—Showing strike			
8.1.19	Inclined crinkled or deformed compaction foliation in ash-flow tuff—Showing approximate strike and dip			
8.1.20	Vertical or near-vertical crinkled or deformed compaction foliation in ash-flow tuff—Showing approximate strike			

8—FOLIATION (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	8.2—Foliation and layering in metamorphic rock			
8.2.1	Horizontal foliation in metamorphic rock			May be used separately or in combination with other symbols. For individual symbols other than horizontal foliation, point of observation is midpoint of strike line. For combined symbols, point of observation is the junction point common to all strike lines. Use ball indicating known top direction of beds only on maps where top direction may be in doubt elsewhere.
8.2.2	Inclined foliation in metamorphic rock—Showing strike and dip			
8.2.3	Vertical or near-vertical foliation in metamorphic rock—Showing strike			
8.2.4	Inclined crinkled or deformed foliation in metamorphic rock—Showing approximate strike and dip			
8.2.5	Vertical or near-vertical crinkled or deformed foliation in metamorphic rock—Showing approximate strike			
8.2.6	Horizontal foliation parallel to bedding in metamorphic rock			
8.2.7	Inclined foliation parallel to bedding in metamorphic rock—Showing strike and dip			
8.2.8	Inclined foliation parallel to upright bedding in metamorphic rock—Showing strike and dip. Top direction of beds known from local features			
8.2.9	Vertical or near-vertical foliation parallel to bedding in metamorphic rock—Showing strike			
8.2.10	Vertical or near-vertical foliation parallel to bedding in metamorphic rock—Showing strike. Ball shows top direction of layers where known from local features			
8.2.11	Inclined foliation parallel to overturned bedding in metamorphic rock—Showing strike and dip			
8.2.12	Inclined foliation parallel to overturned bedding in metamorphic rock—Showing strike and dip. Top direction of beds known from local features			

9—LINEATION

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
9.1	Lineation—Showing bearing and direction of plunge			May be used separately or in combination with other symbols. For single, unidirectional arrow symbols, the point of observation may either be in the middle, at the tip, or at the tail end of the arrow; whichever is preferred, it is important to specify in the symbol explanation which method has been used. For combined symbols, the point of observation is at the tail end of the arrow, the junction point common to all symbols. In general, A lineations are in the direction of slip; B lineations are parallel to minor folds.
9.2	Lineation—Showing bearing and plunge			
9.3	Horizontal lineation—Showing bearing			
9.4	Vertical lineation			
9.5	Mineral lineation indicated by aligned streaks on foliation surface (A lineation)—Showing bearing and direction of plunge			
9.6	Slip lineation, groove, or striations on foliation surface (A lineation)—Showing bearing and direction of plunge			
9.7	Flow lineation in direction of flow on foliation surface (A lineation)—Showing bearing and direction of plunge			
9.8	Lineation indicating axes of minor folds formed by flow (B lineation)—Showing bearing and direction of plunge			
9.9	Lineation indicated by aligned elongate minerals on foliation surface parallel to minor folds (B lineation)—Showing bearing and direction of plunge			
9.10	Lineation indicated by aligned mineral grains in cumulate rocks—Showing bearing and direction of plunge			
9.11	Lineation indicated by trough banding in cumulate rocks—Showing bearing and direction of plunge			
9.12	Lineation indicating flow direction at base of ash deposits formed in surges—Showing bearing and direction of plunge			
9.13	Lineation indicating flow direction in ash-flow tuff—Showing bearing and direction of plunge			
9.14	Lineation indicating minor folds normal to flow in ash-flow tuff—Showing bearing and direction of plunge			
9.15	Lineation at intersection of bedding and cleavage—Showing bearing and direction of plunge			
9.16	Lineation at intersection of foliation and cleavage—Showing bearing and direction of plunge			
9.17	Lineation on cleavage surface—Showing bearing and direction of plunge			
9.18	Penetrative lineation—Showing bearing and direction of plunge in combination with foliation symbol			
9.19	Flow direction—Showing bearing and direction of plunge			
9.20	Slip lineation or slickenside on a fault or shear surface—Showing bearing and direction of plunge of offset			

10—PALEONTOLOGICAL FEATURES

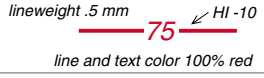
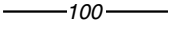
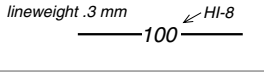
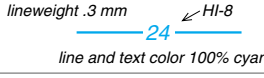
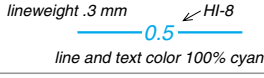
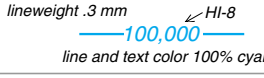
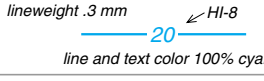
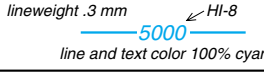
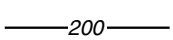
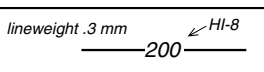
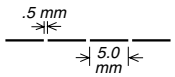
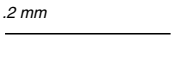
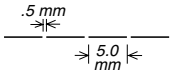
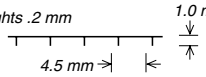
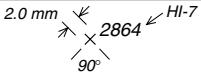
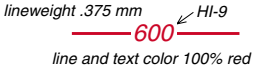
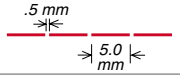
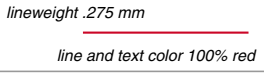
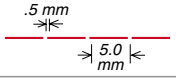
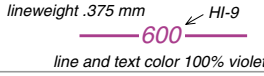
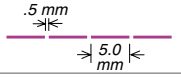
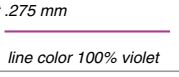
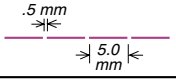
REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
10.1—Fossil localities; biostratigraphic zone boundary				
10.1.1	Fossil locality—Showing collection accession number	D4426	90° H-8 2.5 mm D4426 lineweight .2 mm dot diameter .5 mm	
10.1.2	Fossil locality—Fossils not accessioned		45° 2.375 mm lineweight .2 mm	
10.1.3	Biostratigraphic zone boundary—Showing approximate boundary of diagnostic fossil assemblage	baculite	HI-8 baculite lineweight .375 mm	May also be shown in magenta or other colors.

REF NO	FOSSIL TYPE	SYMBOL
10.2—Fossil symbols		
10.2.1	Acritarchs	
10.2.2	Algae	
10.2.3	Ammonites	
10.2.4	Archaeocyathides	
10.2.5	Belemnites	
10.2.6	Bones	
10.2.7	Brachiopods	
10.2.8	Brackish-water fossils	
10.2.9	Bryozoa	
10.2.10	Calcareous nannoplankton (coccoliths)	
10.2.11	Cephalopods	
10.2.12	Charophytes	
10.2.13	Chitinozoans	
10.2.14	Conodonts	
10.2.15	Corals	
10.2.16	Crinoids	
10.2.17	Diatoms	
10.2.18	Dinoflagellates	
10.2.19	Echinoderms	
10.2.20	Echinoids	

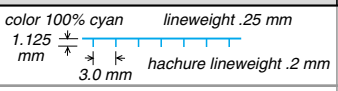
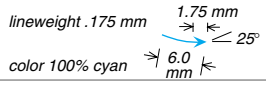
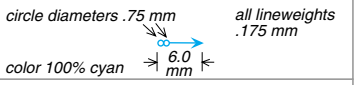
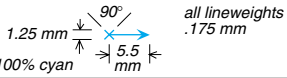
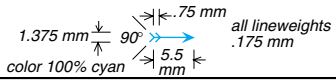
REF NO	FOSSIL TYPE	SYMBOL
10.2—Fossil symbols (continued)		
10.2.21	Fish remains	
10.2.22	Fish scales	
10.2.23	Foraminifers, in general	
10.2.24	Foraminifers, larger	
10.2.25	Foraminifers, smaller and benthonic	
10.2.26	Foraminifers, smaller and pelagic	
10.2.27	Fossils, abundant	
10.2.28	Fossils, in general	
10.2.29	Fossils, sparse	
10.2.30	Fresh-water fossils	
10.2.31	Gastropods	
10.2.32	Graptolites	
10.2.33	Hyoliths	
10.2.34	Insects	
10.2.35	Lamellibranchs (pelecypods)	
10.2.36	Leaves	
10.2.37	Marine fossils	M
10.2.38	Microfossils, calcareous	
10.2.39	Microfossils, in general	*
10.2.40	Needles	

REF NO	FOSSIL TYPE	SYMBOL
10.2—Fossil symbols (continued)		
10.2.41	Oncolites	
10.2.42	Ostracodes	
10.2.43	Plant remains	
10.2.44	Pollen and (or) spores	
10.2.45	Radiolaria	
10.2.46	Roots	
10.2.47	Rostroconchs	
10.2.48	Rudists	
10.2.49	Silicoflagellates and (or) ebridrians	
10.2.50	Spicules	
10.2.51	Sponges	
10.2.52	Sporomorphs	
10.2.53	Stromatolites	
10.2.54	Stromatoporoids	
10.2.55	Teeth	
10.2.56	Trace fossils	
10.2.57	Trilobites	
10.2.58	Vertebrates	
10.2.59	Wood	

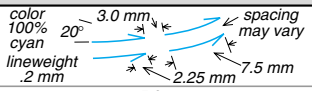
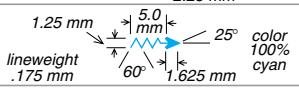
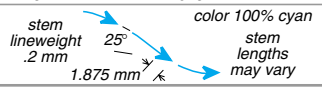
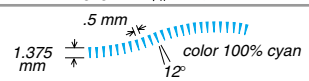
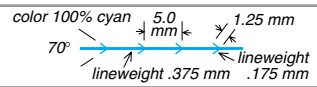
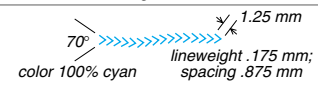
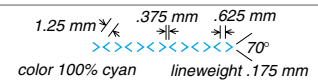
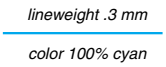
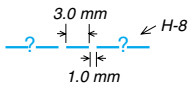
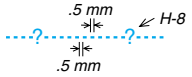
11—ISOPLETHS

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
11.1—Lines of equal physical or chemical properties				
11.1.1	Line of equal thickness or equal chemical value			Isopleths may be used to represent many different types of physical or chemical properties. If data accuracy is high enough or if the data covers a wide range of values, intermediate contours may be added; use a lineweight that is .1 mm narrower than that of the index contour. On most maps, every fourth or fifth contour should be an index contour, and only index contours are labeled. If values of change are shown, all values other than zero must be preceded by a plus (+) or minus (–) sign. May be shown in black or other colors.
11.1.2	Line of equal depth			
11.1.3	Line of equal precipitation			
11.1.4	Line of equal runoff			
11.1.5	Line of equal aquifer transmissivity or hydraulic conductivity			
11.1.6	Line of equal water-level change			
11.1.7	Line of equal physical or chemical property of water			
11.2—Geophysical and structure contours				
11.2.1	Line of equal intensity of potential field (geophysical contour)—Index			On most maps, every fourth or fifth contour should be an index contour, and only index contours are labeled. Add hachures to the lowest unlabeled (intermediate) contours to indicate closed areas of low values if it is unclear that the contour values are decreasing (hachures point into closed depression). Although only shown on geophysical contours, hachures may be added to any type of contour. May be shown in black or other colors.
11.2.2	Line of equal intensity of potential field (geophysical contour)—Index; dashed where data is incomplete			
11.2.3	Line of equal intensity of potential field (geophysical contour)—Intermediate			
11.2.4	Line of equal intensity of potential field (geophysical contour)—Intermediate; dashed where data is incomplete			
11.2.5	Line of equal intensity of potential field (geophysical contour)—Intermediate; hachures indicate closed areas of lower values			
11.2.6	Maximum or minimum intensity within closed high or closed low			
11.2.7	Line of equal elevation of geologic unit surface (structure contour), first surface—Index			
11.2.8	Line of equal elevation of geologic unit surface (structure contour), first surface—Index; dashed where control is poor			
11.2.9	Line of equal elevation of geologic unit surface (structure contour), first surface—Intermediate			
11.2.10	Line of equal elevation of geologic unit surface (structure contour), first surface—Intermediate; dashed where control is poor			
11.2.11	Line of equal elevation of geologic unit surface (structure contour), second surface—Index			
11.2.12	Line of equal elevation of geologic unit surface (structure contour), second surface—Index; dashed where control is poor			
11.2.13	Line of equal elevation of geologic unit surface (structure contour), second surface—Intermediate			
11.2.14	Line of equal elevation of geologic unit surface (structure contour), second surface—Intermediate; dashed where control is poor			

12—FLUVIAL AND ALLUVIAL FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
12.1	Fluvial terrace scarp			Hachures point down-scarp.
12.2	Fluvial transport direction			Arrow points in direction of downstream flow.
12.3	Sediment transport direction—Determined from imbrication			
12.4	Sediment transport direction—Determined from crossbeds			
12.5	Sediment transport direction—Determined from flute casts			

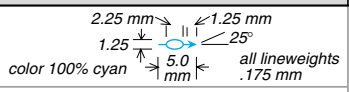
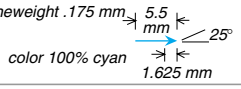
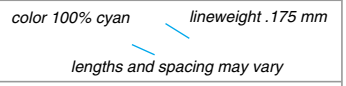
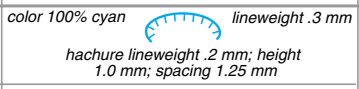
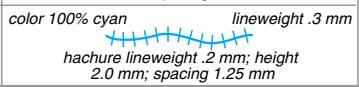
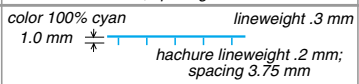
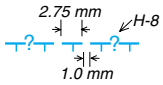
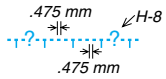
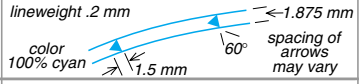
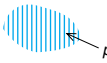
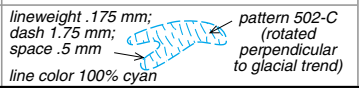
13—GLACIAL AND GLACIOFLUVIAL FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
13.1	Glacial meltwater channel, abandoned			Arrow(s) point in direction of downstream flow.
13.2	Glacial meltwater spillway			
13.3	Flow direction, glacial stream			
13.4	Kame terrace scarp			Hachures point downscarp.
13.5	Esker 1, known transport direction			Chevrons point in direction of transport.
13.6	Esker 2, known transport direction			
13.7	Esker, unknown transport direction			
13.8	Glacial limit or terminus—Certain			
13.9	Glacial limit or terminus—Approximately located			
13.10	Glacial limit or terminus—Approximately located, queried			
13.11	Glacial limit or terminus—Concealed			
13.12	Glacial limit or terminus—Concealed, queried			
13.13	Glacial limit or terminus—Showing name (BL, Bull Lake)			

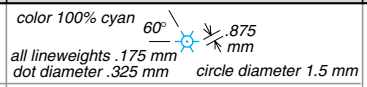
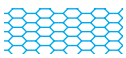
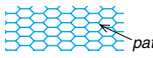
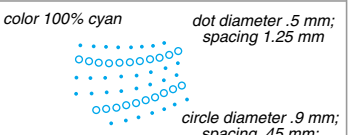
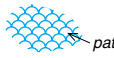
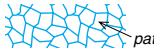
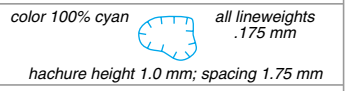
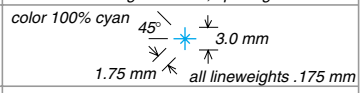
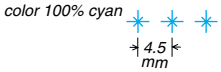
13—GLACIAL AND GLACIOFLUVIAL FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
13.14	Limit of significant glacial advance—Certain		color 100% cyan; 4.5 mm; 1.25 mm; lineweight .3 mm; hachure lineweight .25 mm	Hachures point in direction of glaciated area.
13.15	Limit of significant glacial advance—Approximately located		3.5 mm; H-8; 1.0 mm	
13.16	Limit of significant glacial advance—Approximately located, queried			
13.17	Limit of significant glacial advance—Concealed		.5 mm; H-8; .5 mm	
13.18	Limit of significant glacial advance—Concealed, queried			
13.19	Limit of significant glacial advance—Showing name (BL, Bull Lake)	BL	H-8; BL	
13.20	Retreatal position of stagnant ice margin—Certain		lineweight .4 mm; color 100% cyan	
13.21	Retreatal position of stagnant ice margin—Approximately located		3.5 mm; H-8; 1.0 mm	
13.22	Retreatal position of stagnant ice margin—Approximately located, queried			
13.23	Retreatal position of stagnant ice margin—Inferred		1.5 mm; H-8; 1.0 mm	
13.24	Retreatal position of stagnant ice margin—Inferred, queried			
13.25	Retreatal position of stagnant ice margin—Concealed		.5 mm; H-8; .5 mm	
13.26	Retreatal position of stagnant ice margin—Concealed, queried			
13.27	Retreatal position of stagnant ice margin—Showing name of depositional unit	Qsf	H-8; Qsf	
13.28	Crest line of moraine, sense of symmetry unspecified, type 1		color 100% cyan; lineweight .175 mm; circle diameter .675 mm; spacing .625 mm	
13.29	Crest line of moraine, sense of symmetry unspecified, type 2		color 100% cyan; circle diameter .825 mm; spacing .625 mm	
13.30	Crest line of symmetrical moraine		3.0 mm; .5 mm; color 100% cyan; all lineweights .175 mm; circle diameter .675 mm; hachure height 1.5 mm	
13.31	Crest line of asymmetrical moraine—Ticks point down steeper slope		3.0 mm; .5 mm; color 100% cyan; all lineweights .175 mm; circle diameter .675 mm; hachure height .75 mm	
13.32	Ridges on moraine		color 100% cyan; lineweight .25 mm; lengths and spacing may vary	

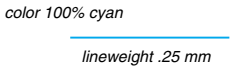
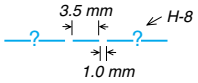
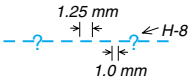
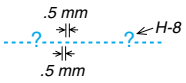
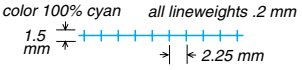
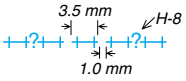
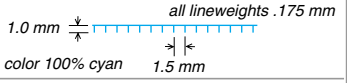
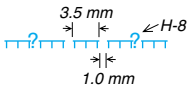
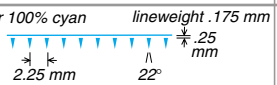
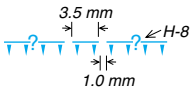
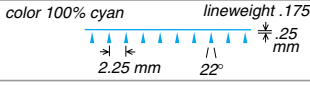
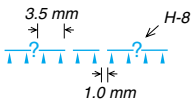
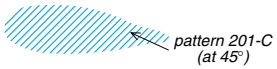
13—GLACIAL AND GLACIOFLUVIAL FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
13.33	Drumlin—Showing bearing and direction of flow			Arrow points in direction of downstream flow.
13.34	Drumloid form—Showing bearing of flow; flow direction unknown			
13.35	Younger glacial striations—Showing bearing and direction of flow			
13.36	Older glacial striations—Showing bearing and direction of flow			
13.37	Younger glacial striations—Showing bearing of flow; flow direction unknown			
13.38	Older glacial striations—Showing bearing of flow; flow direction unknown			
13.39	Cirque headwall			For single cirque, hachures point into cirque. Along serrated ridge between two cirques, hachures point in both directions.
13.40	Cirque headwalls along serrated ridge			
13.41	Margin of glacially scoured basin—Certain			Hachures point into basin.
13.42	Margin of glacially scoured basin—Approximately located			
13.43	Margin of glacially scoured basin—Approximately located, queried			
13.44	Margin of glacially scoured basin—Concealed			
13.45	Margin of glacially scoured basin—Concealed, queried			
13.46	Glacial flow direction			Arrows point in direction of downstream flow.
13.47	Ice-contact slope—Lines point downslope			
13.48	Glacier—Showing glacial trend			

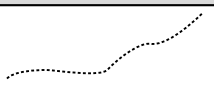
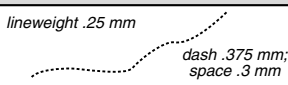
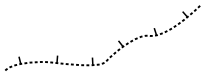
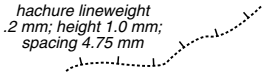
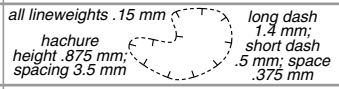
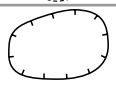
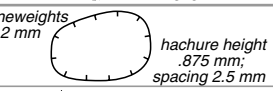
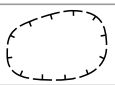
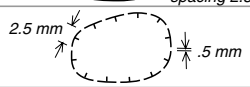
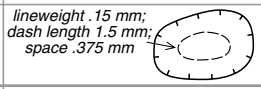
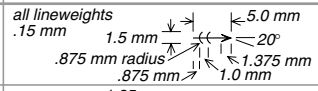
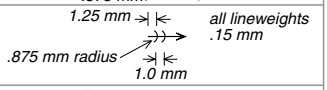
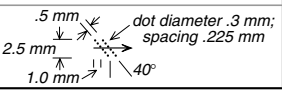
14—PERIGLACIAL FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
14.1	Pingo			
14.2	Periglacial patterned ground			
14.3	Polygonal patterned ground			
14.4	Sorted circles			
14.5	Stone stripe, fine debris			
14.6	Stone stripe, coarse debris			
14.7	Solifluction lobes			
14.8	Ice-wedge polygons			
14.9	Felsenmeer			
14.10	Thermokarst depression			
14.11	Kettle			
14.12	Aligned kettles			

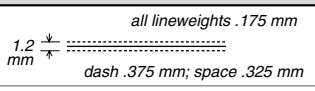
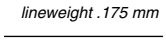
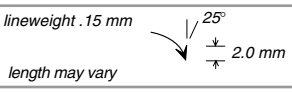
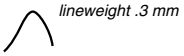
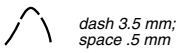
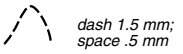
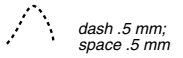
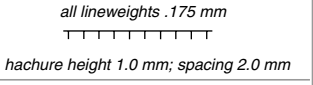
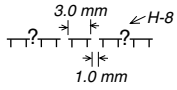
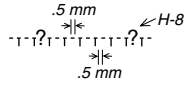
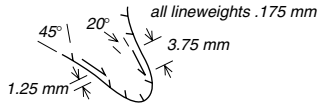
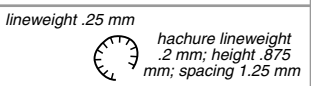
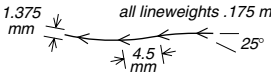
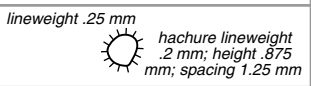
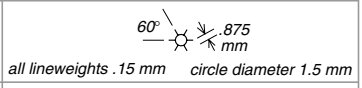
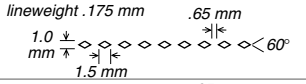
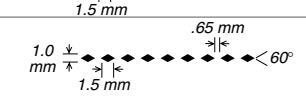
15—LACUSTRINE AND MARINE FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
15.1	Former shoreline or marine limit—Certain			
15.2	Former shoreline or marine limit—Approximately located			
15.3	Former shoreline or marine limit—Approximately located, queried			
15.4	Former shoreline or marine limit—Inferred			
15.5	Former shoreline or marine limit—Inferred, queried			
15.6	Former shoreline or marine limit—Concealed			
15.7	Former shoreline or marine limit—Concealed, queried			
15.8	Spit or bar—Certain			Trace follows axis.
15.9	Spit or bar—Approximately located			
15.10	Spit or bar—Approximately located, queried			
15.11	Shoreline cliff—Certain			Trace follows cliff top; hachures point down cliff.
15.12	Shoreline cliff—Approximately located			
15.13	Shoreline cliff—Approximately located, queried			
15.14	Beach ridges			Traces follow tops of ridges.
15.15	Aggradational shoreline—Certain			Trace follows shoreline; triangles are offshore.
15.16	Aggradational shoreline—Approximately located			
15.17	Aggradational shoreline—Approximately located, queried			
15.18	Erosional shoreline—Certain			Trace follows shoreline; triangles are offshore.
15.19	Erosional shoreline—Approximately located			
15.20	Erosional shoreline—Approximately located, queried			
15.21	Marine-abrasion platform			

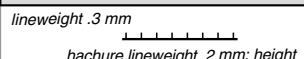
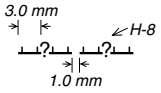
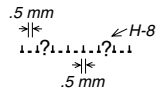
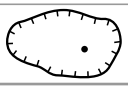
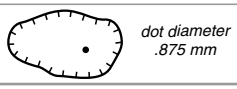
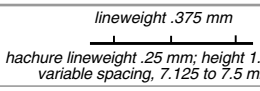
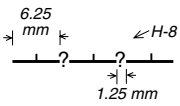
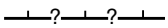
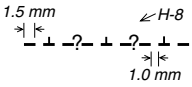
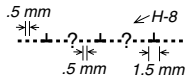
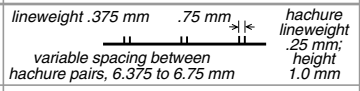
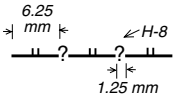
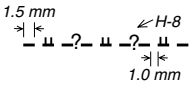
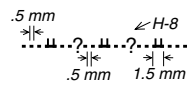
16—EOLIAN FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
16.1	Dune crest			Dune forms shown by traces of dune crests. Add hachures to show scarp caused by slip; hachures point down slip face of dune.
16.2	Scarp on dune crest			
16.3	Blowout rim around closed depression of eolian origin in dune field			Hachures point into closed depression.
16.4	Blowout rim around closed depression of eolian origin in bedrock—Certain			Hachures point into closed depression. Floor of closed depression, shown here as a dry lakebed, may be mapped as appropriate to individual feature.
16.5	Blowout rim around closed depression of eolian origin in bedrock—Approximately located			
16.6	Edge of dry lakebed within closed depression of eolian origin in bedrock			
16.7	Sediment transport direction—Determined from dune forms			
16.8	Sediment transport direction—Determined from dune bedding in horizontal section			
16.9	Sediment transport direction—Determined from eolian crossbedding in vertical or near-vertical section			

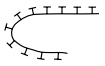
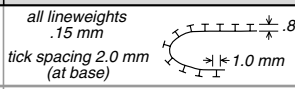
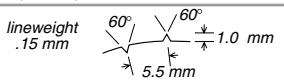
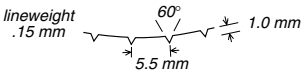
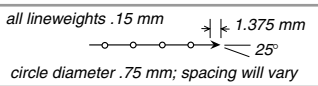
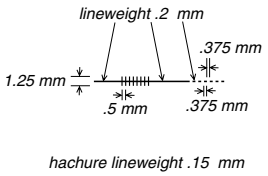
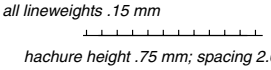
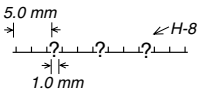
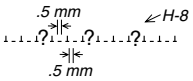
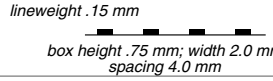
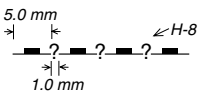
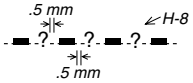
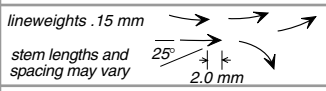
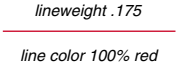
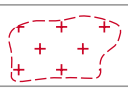
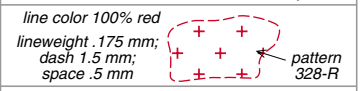
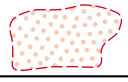
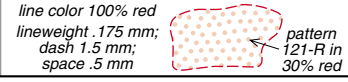
17—LANDSLIDE AND MASS-WASTING FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
17.1	Major tension crack, related to landslide, slump, or mass movement			Patterned lines emphasize major tension cracks; minor cracks may be shown by undecorated lines.
17.2	Minor tension crack, related to landslide, slump, or mass movement			
17.3	Direction of downslope movement of landslide			May be shown singly or in pairs.
17.4	Slip surface of landslide, rotational or Toreva block, block-slump fault, or land-slip fault—Certain			Use to show trace of slip surface at head of landslide mass and not to show mapped boundary of landslide deposits (use contact instead). Downhill edge of slip surface that is concealed by debris is rarely shown.
17.5	Slip surface of landslide, rotational or Toreva block, block-slump fault, or land-slip fault—Approximately located			
17.6	Slip surface of landslide, rotational or Toreva block, block-slump fault, or land-slip fault—Inferred			
17.7	Slip surface of landslide, rotational or Toreva block, block-slump fault, or land-slip fault—Concealed			
17.8	Landslide scarp—Certain			Use to show physiographic scarp or toe feature and not to show mapped boundary of landslide deposits (use contact instead). Hachures point into landslide.
17.9	Landslide scarp—Approximately located			
17.10	Landslide scarp—Approximately located, queried			
17.11	Landslide scarp—Concealed			
17.12	Landslide scarp—Concealed, queried			
17.13	Landslide toe, downslope to right			
17.14	Landslide toe, downslope to left			
17.15	Sag pond on landslide			Hachures point into sag pond.
17.16	Path of gully on landslide			
17.17	Hummock on landslide			Hachures point away from hummock.
17.18	Hummock on landslide (shown as point symbol when too small to outline at map scale)			
17.19	Aligned hummocks on landslide (shown as point symbols when too small to outline at map scale)			
17.20	Crest line of lateral levee, type 1			
17.21	Crest line of lateral levee, type 2			

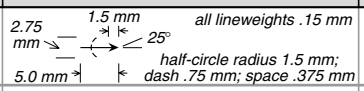
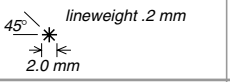
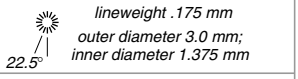
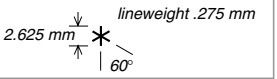
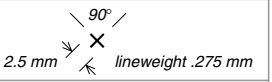
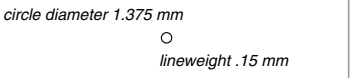
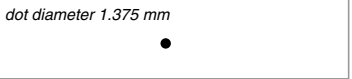
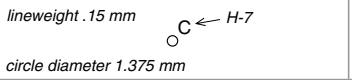
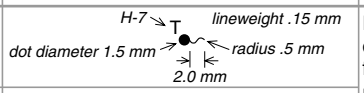
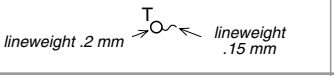
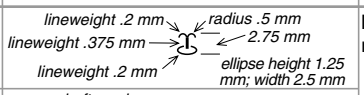
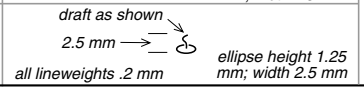
18—VOLCANIC FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
18.1	Rim of volcanic crater—Certain			Use to show outline of topographic wall. Hachures point into crater. Rim may not outline crater completely.
18.2	Rim of volcanic crater—Approximately located			
18.3	Rim of volcanic crater—Approximately located, queried			
18.4	Rim of volcanic crater—Concealed			
18.5	Rim of volcanic crater—Concealed, queried			
18.6	Rim of volcanic crater—Showing low point of crater (dot)			
18.7	Caldera margin 1—Certain			Hachures point into caldera. May also be shown in red or other colors.
18.8	Caldera margin 1—Approximately located			
18.9	Caldera margin 1—Approximately located, queried			
18.10	Caldera margin 1—Inferred			
18.11	Caldera margin 1—Inferred, queried			
18.12	Caldera margin 1—Concealed			
18.13	Caldera margin 1—Concealed, queried			
18.14	Caldera margin 2—Certain			Hachures point into caldera. May also be shown in red or other colors.
18.15	Caldera margin 2—Approximately located			
18.16	Caldera margin 2—Approximately located, queried			
18.17	Caldera margin 2—Inferred			
18.18	Caldera margin 2—Inferred, queried			
18.19	Caldera margin 2—Concealed			
18.20	Caldera margin 2—Concealed, queried			

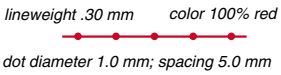
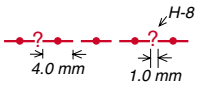
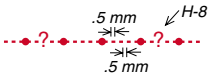
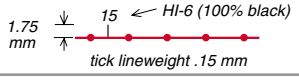
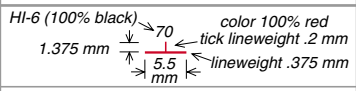
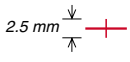
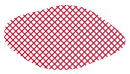
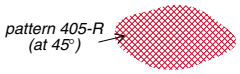
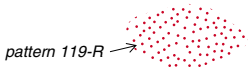
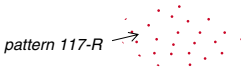
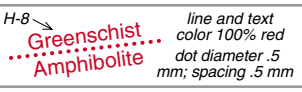
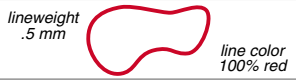
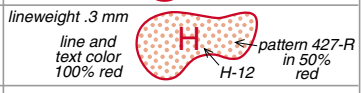
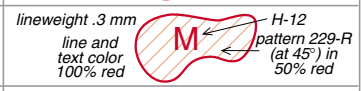
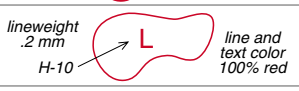
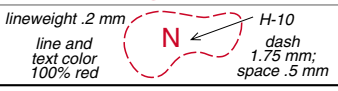
18—VOLCANIC FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
18.21	Outline of basalt-filled lava pond that is bounded by levees.			T-shaped ticks point toward lava pond.
18.22	Crest line of pressure ridge or tumulus on lava flow			Draw on axis of ridge.
18.23	Pressure ridge on lava flow			Form lines are normal to local flow directions.
18.24	Lava tube			Line shows position beneath surface; circles show skylights.
18.25	Volcanic fissure—Certain			
18.26	Volcanic fissure—Concealed			
18.27	Volcanic fissure—Hachures show location where lava was emitted			
18.28	Flow lobe—Certain			Line follows foot of lobe of lava flow; hachures point into lobe.
18.29	Flow lobe—Approximately located			
18.30	Flow lobe—Approximately located, queried			
18.31	Flow lobe—Concealed			
18.32	Flow lobe—Concealed, queried			
18.33	Ice-contact flow margin—Certain			Boxes on flow edge that shows ice-contact fabric.
18.34	Ice-contact flow margin—Approximately located			
18.35	Ice-contact flow margin—Approximately located, queried			
18.36	Ice-contact flow margin—Concealed			
18.37	Ice-contact flow margin—Concealed, queried			
18.38	Flow lines on lava flow			
18.39	Contact separating individual flows within map unit, erupted either from same vent or from different vents			May also be printed in magenta or other colors.
18.40	Cracks on surface of lava flow			
18.41	Rootless vent area on lava flow			
18.42	Thermal area			

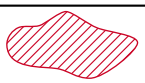
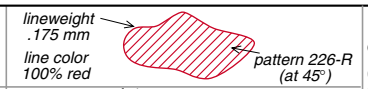
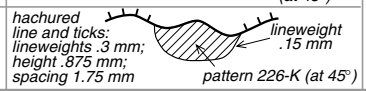
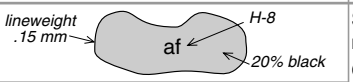
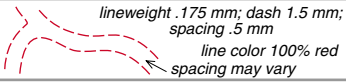
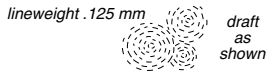
18—VOLCANIC FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
18.43	Flow direction at base of ash deposits formed in surges			Identified from antidune bed forms.
18.44	Small cone, cinder cone, or spatter cone (hornito) on surface of lava flow			May also be shown in red or other colors.
18.45	Recent volcano on small-scale maps			Usually reserved for maps at scales of 1:250,000 or smaller. May also be shown in red or other colors.
18.46	Active volcano on small-scale maps			
18.47	Inactive volcano on small-scale maps			
18.48	Cinder cone on small-scale maps			
18.49	Diatreme			
18.50	Breccia pipe			
18.51	Collapse structure—Indicating breccia pipe at depth			
18.52	Thermal spring, type 1			Rotate tail to point in downhill direction of flow. May also be shown in red or other colors.
18.53	Thermal spring, type 2			
18.54	Geyser			May also be shown in red or other colors.
18.55	Fumarole or steam vent			

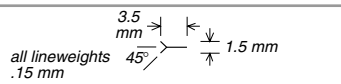
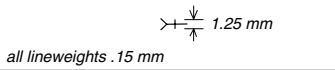
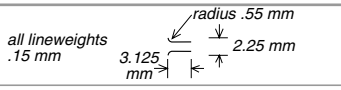
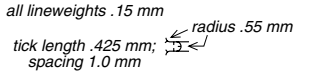
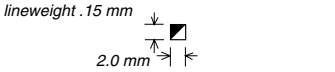
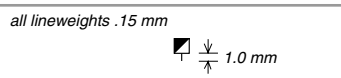
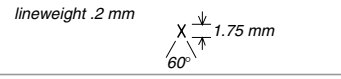
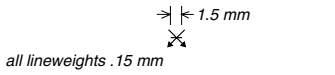
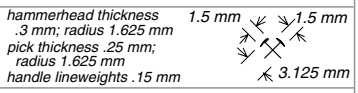
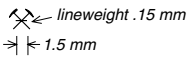
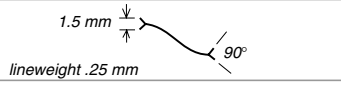
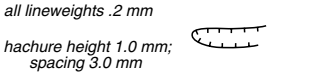
19—NATURAL RESOURCES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
19.1—Veins and mineralized areas; metamorphic facies boundary; mineral resource areas				
19.1.1	Vein—Certain			May also be shown in black or other colors.
19.1.2	Vein—Approximately located			
19.1.3	Vein—Approximately located, queried			
19.1.4	Vein—Concealed			
19.1.5	Vein—Concealed, queried			
19.1.6	Vein—Showing type of mineral occurrence			Place symbols where observation was made. Dip value indicates a measured dip direction and magnitude.
19.1.7	Vein—Showing dip where known			
19.1.8	Mineralized stringers, veinlets			May also be shown in black or other colors.
19.1.9	Minor inclined vein—Showing strike and dip			May also be shown in black or other colors.
19.1.10	Minor vertical or near-vertical vein—Showing strike			
19.1.11	Zone of mineralized or altered rock, type 1			Add labels to show specific types of alteration. May be used alone or may overprint other mapped units. May also be shown in black or other colors.
19.1.12	Zone of mineralized or altered rock, type 2—High level of mineralization			
19.1.13	Zone of mineralized or altered rock, type 2—Low level of mineralization			
19.1.14	Metamorphic facies boundary—Showing approximate boundary between diagnostic mineral assemblages			May also be shown in black or other colors.
19.1.15	Area of identified resources			Usually reserved for use on special-purpose maps, not on general-purpose geologic maps. Generally shown in red, but may also be shown in black or other colors.
19.1.16	Area of high mineral resource potential			
19.1.17	Area of moderate mineral resource potential			
19.1.18	Area of low mineral resource potential			
19.1.19	Area considered to have mineral resource potential but not evaluated, mostly because of inadequate data			

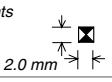
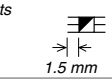
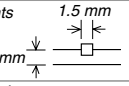
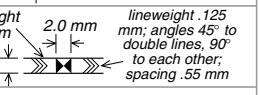
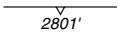
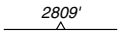
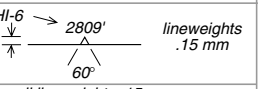
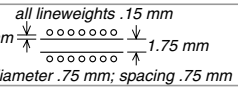
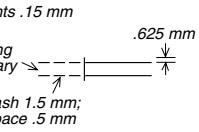
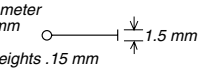
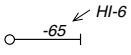
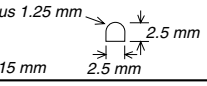
19—NATURAL RESOURCES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
19.2—Areas of extensively disturbed ground and workings as mapped units				
19.2.1	Graded area—Extensive amount of mapped geologic unit has been removed			Patterns should overlay other mapped units. Generally shown in black or red, but may also be shown in other colors.
19.2.2	Strip mine			
19.2.3	Artificial fill—Earth materials			Show as separately mapped units. Generally shown in black or red, but may also be shown in other colors.
19.2.4	Artificial fill—Human-generated refuse (landfill)			
19.2.5	Open pit mine or quarry (surface view)			Symbols should overlay other mapped units. Generally shown in black or red, but may also be shown in other colors.
19.2.6	Subsurface workings (projected to surface)			
19.2.7	Tailings, including tailings pond (surface view)			Show as separately mapped units. Generally shown in black, but may also be shown in red or other colors.
19.2.8	Mine dump (surface view)			

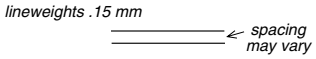
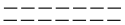
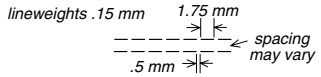
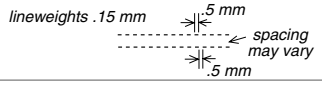
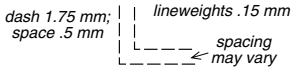
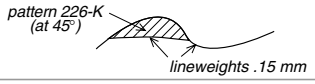
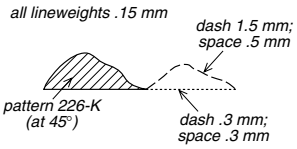
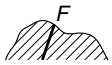
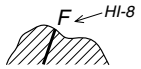
19—NATURAL RESOURCES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
19.3—Mining and mineral-exploration symbology				
19.3.1	Drill hole for mineral exploration			
19.3.2	Inclined tunnel or adit			Rotate symbol so that long line indicates azimuth of adit; place intersection of long line and two shorter ones at map position of adit.
19.3.3	Inclined tunnel or adit, inaccessible			
19.3.4	Portal			Rotate symbol so that long lines indicate azimuth of portal; place curved ends of long lines at map position of portal.
19.3.5	Portal and open cut			
19.3.6	Vertical mine shaft			
19.3.7	Multiple vertical mine shafts			
19.3.8	Vertical mine shaft—Abandoned or inaccessible			
19.3.9	Inclined mine shaft			Orientation indicates location of entry at surface.
19.3.10	Inclined mine shaft—Abandoned or inaccessible			
19.3.11	Prospect (pit or small open cut)			
19.3.12	Sand, gravel, clay, or placer pit			
19.3.13	Sand, gravel, clay, or placer pit—Abandoned			
19.3.14	Open pit, quarry, or glory hole			
19.3.15	Open pit, quarry, or glory hole—Abandoned			
19.3.16	Trench (surface view)—Generalized trace			For generalized trace, bar follows direction of trench; length of bar may vary.
19.3.17	Trench (surface view)—Drawn to scale			

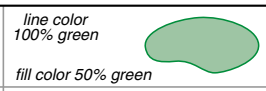
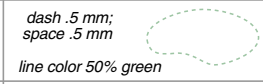
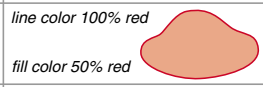
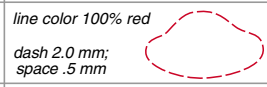
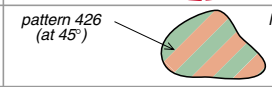
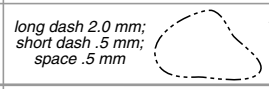
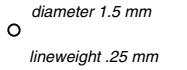
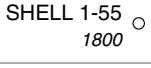
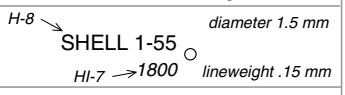
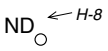
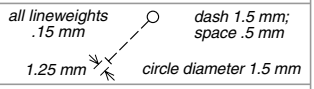
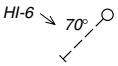
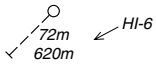
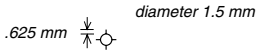
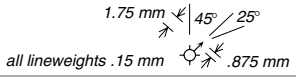
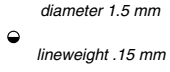
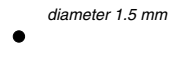
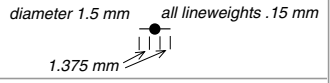
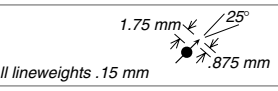
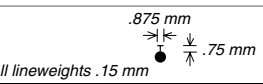
19—NATURAL RESOURCES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
19.4—Mines and underground workings				
19.4.1	Mine shaft—Above and below level			
19.4.2	Inclined mine shaft—Above and below level			
19.4.3	Bottom of mine shaft			
19.4.4	Winze or head of raise			
19.4.5	Raise or foot of winze			
19.4.6	Raise or winze extending through level			
19.4.7	Ore chute			Orientation indicates azimuth of feature.
19.4.8	Inclined workings—Above and below level. Chevrons point down incline			
19.4.9	Elevation of roof or back			
19.4.10	Elevation of floor or sill			
19.4.11	Lagging or cribbing along drift			
19.4.12	Caved or otherwise inaccessible workings—Below ground			
19.4.13	Caved or otherwise inaccessible workings—Above ground			
19.4.14	Diamond drill hole			
19.4.15	Diamond drill hole—Showing angle of inclination. Negative angles show downward slope			
19.4.16	Crosscut tunnel			

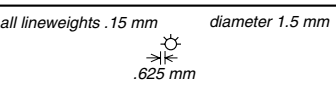
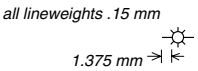
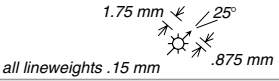
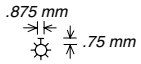
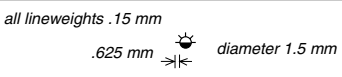
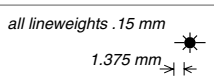
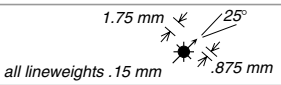
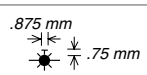
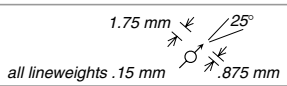
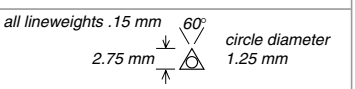
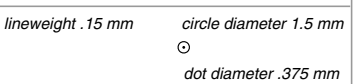
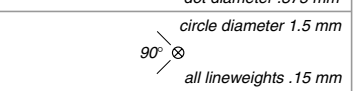
19—NATURAL RESOURCES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
19.4—Mines and underground workings (continued)				
19.4.17	Mine tunnel and workings (section view)—High certainty			Orientation indicates azimuth of tunnel.
19.4.18	Mine tunnel and workings (section view)—Medium certainty			
19.4.19	Mine tunnel and workings (section view)—Low certainty			
19.4.20	Shaft and tunnel—Near line of section (projected to section)			
19.4.21	Mine dump (section view)			
19.4.22	Rubble (section view)			
19.4.23	Stoped area (section view)—Certain			Different patterns may be used to indicate type of rock or ore removed.
19.4.24	Stoped area (section view)—Inferred			
19.4.25	Backfilled stope (section view)			

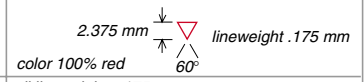
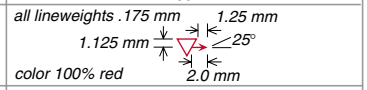
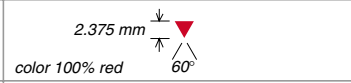
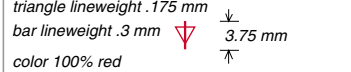
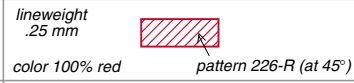
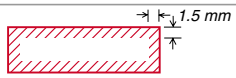
19—NATURAL RESOURCES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
19.5—Oil and gas fields; wells drilled for hydrocarbon exploration or exploitation				
19.5.1	Oil field—Extent defined			Patterned areas (extent defined) should be shown as separately mapped units. Outlined areas (extent not yet defined) should overlay other mapped units. Generally shown in red and (or) green, but may also be shown in other colors or patterns.
19.5.2	Oil field—Extent not yet defined			
19.5.3	Gas field—Extent defined			
19.5.4	Gas field—Extent not yet defined			
19.5.5	Oil and gas field—Extent defined			
19.5.6	Oil and gas field—Extent not yet defined			
19.5.7	Drilling well (hydrocarbon exploration)			On general-purpose maps, show in black. On energy or other special-purpose maps, may show water wells in cyan, oil wells in green, and gas wells in red.
19.5.8	Drill hole—Showing operator number and total depth (in feet)			
19.5.9	Drill hole—No geologic data			
19.5.10	Trace of inclined drill hole			
19.5.11	Trace of inclined drill hole—Showing inclination			
19.5.12	Trace of inclined drill hole—Showing collar altitude (72 m) and total depth (620 m)			
19.5.13	Dry hole—Unsuccessful hole drilled during hydrocarbon exploration			
19.5.14	Dry hole converted to water well			
19.5.15	Dry hole converted to injection well			
19.5.16	Show of oil			
19.5.17	Oil well			
19.5.18	Shut-in oil well			
19.5.19	Abandoned oil well			
19.5.20	Abandoned oil well—Converted to water well			
19.5.21	Abandoned oil well—Converted to injection well			
19.5.22	Capped oil well			

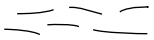
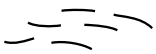
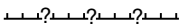
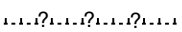
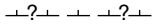
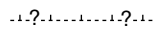
19—NATURAL RESOURCES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
19.5—Oil and gas fields; wells drilled for hydrocarbon exploration and exploitation (continued)				
19.5.23	Show of gas			On general-purpose maps, show in black. On energy or other special-purpose maps, may show water wells in cyan, oil wells in green, and gas wells in red.
19.5.24	Gas well			
19.5.25	Shut-in gas well			
19.5.26	Abandoned gas well			
19.5.27	Abandoned gas well—Converted to water well			
19.5.28	Abandoned gas well—Converted to injection well			
19.5.29	Capped gas well			
19.5.30	Show of oil and gas			
19.5.31	Oil and gas well			
19.5.32	Shut-in oil and gas well			
19.5.33	Abandoned oil and gas well			
19.5.34	Abandoned oil and gas well—Converted to water well			
19.5.35	Abandoned oil and gas well—Converted to injection well			
19.5.36	Capped oil and gas well			
19.5.37	Abandoned well—Converted to water well			
19.5.38	Abandoned well—Converted to injection well			
19.5.39	Salt-water disposal well			
19.5.40	Water-injection well			
19.5.41	Water-input well			

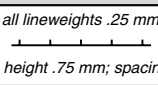
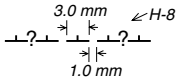
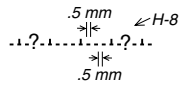
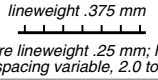
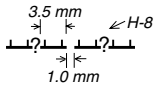
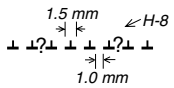
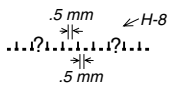
20—HAZARDOUS WASTE SITES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
20.1	Hazardous waste site			Generally shown in red, but may also be shown in black or other colors.
20.2	Hazardous waste site—Showing direction of surface-leachate flow from site			
20.3	Active (operating) hazardous waste site			
20.4	Inactive (closed) hazardous waste site			
20.5	Hazardous waste site—Clean-up activities are in progress			
20.6	Hazardous waste site—Clean-up activities have been completed			
20.7	Hazardous waste site—Showing smaller restricted area			
20.8	Hazardous waste site—Showing larger restricted area			

21—NEOTECTONIC AND EARTHQUAKE-HAZARD FEATURES

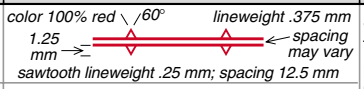
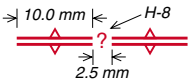
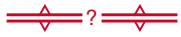
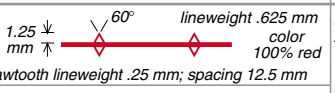
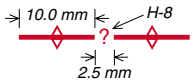
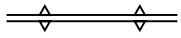
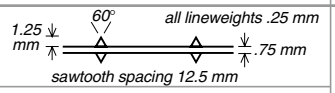
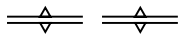
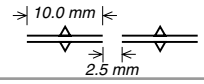
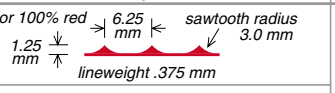
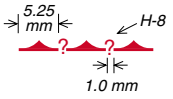
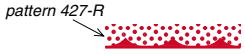
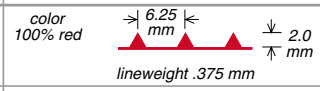
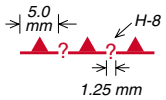
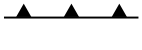
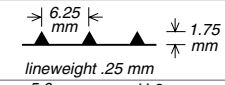
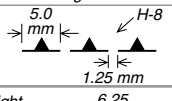
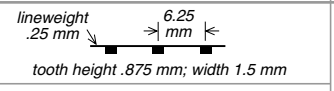
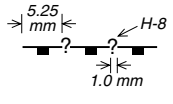
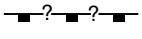
REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
21.1	Earthquake epicenter, magnitude 7.5 or larger		color 100% violet lineweight .275 mm dot diameter 4.5 mm outer circle diameter 7.0 mm inner circle diameter 5.75 mm	May also be shown in black or other colors.
21.2	Earthquake epicenter, magnitude 7–7.49		color 100% violet dot diameter 4.25 mm	
21.3	Earthquake epicenter, magnitude 6.5–6.99		color 100% violet lineweight .25 mm dot diameter 2.375 mm circle diameter 4.0 mm	
21.4	Earthquake epicenter, magnitude 6–6.49		color 100% violet dot diameter 2.25 mm	
21.5	Earthquake epicenter, magnitude 5.5–5.99		color 100% violet lineweight .25 mm circle diameter 2.25 mm	
21.6	Earthquake epicenter, magnitude 4–5.49		color 100% violet lineweight .2 mm circle diameter 1.4 mm	
21.7	Earthquake epicenter, magnitude less than 4		color 100% violet lineweight .175 mm circle diameter .875 mm	
21.8	Fissures or cracks, formed in ground by earthquake		lineweights .175 mm lengths and spacing may vary	May also be shown in magenta or other colors.
21.9	Fissures and sand and (or) other material ejected during earthquake		lineweights .3 mm lengths and spacing may vary	
21.10	Rim crest or crater with rim, formed by shock or sand blowouts—Certain		all lineweights .25 mm hachure height .75 mm; spacing 2.0 mm	Hachures point into crater. May also be shown in magenta or other colors.
21.11	Rim crest or crater with rim, formed by shock or sand blowouts—Approximately located		5.0 mm H-8 1.0 mm	
21.12	Rim crest or crater with rim, formed by shock or sand blowouts—Approximately located, queried			
21.13	Rim crest or crater with rim, formed by shock or sand blowouts—Concealed		.5 mm H-8 .5 mm	
21.14	Rim crest or crater with rim, formed by shock or sand blowouts—Concealed, queried			
21.15	Sinkhole or crater without rim, formed by shock—Certain		all lineweights .175 mm hachure height .75 mm; spacing 4.0 mm	Hachures point into sinkhole. May also be shown in magenta or other colors.
21.16	Sinkhole or crater without rim, formed by shock—Approximately located		3.0 mm H-8 1.0 mm	
21.17	Sinkhole or crater without rim, formed by shock—Approximately located, queried			
21.18	Sinkhole or crater without rim, formed by shock—Concealed		.5 mm H-8 .5 mm	
21.19	Sinkhole or crater without rim, formed by shock—Concealed, queried			

21—NEOTECTONIC AND EARTHQUAKE-HAZARD FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
21.20	Outer limit of subsidence—Certain			Hachures point into subsided area. May also be shown in magenta or other colors.
21.21	Outer limit of subsidence—Approximately located			
21.22	Outer limit of subsidence—Approximately located, queried			
21.23	Outer limit of subsidence—Concealed			
21.24	Outer limit of subsidence—Concealed, queried			
21.25	Fault scarp—Certain			Hachures point downscarp. May also be shown in magenta or other colors.
21.26	Fault scarp—Approximately located			
21.27	Fault scarp—Approximately located, queried			
21.28	Fault scarp—Inferred			
21.29	Fault scarp—Inferred, queried			
21.30	Fault scarp—Concealed			
21.31	Fault scarp—Concealed, queried			

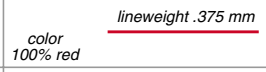
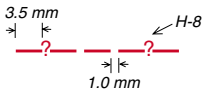
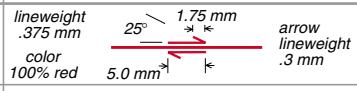
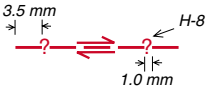
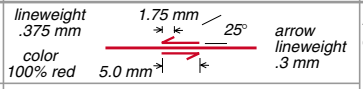
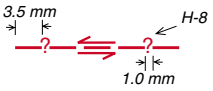
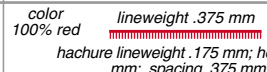
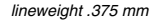
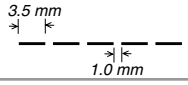
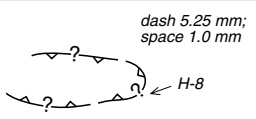
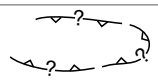
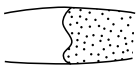
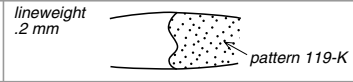
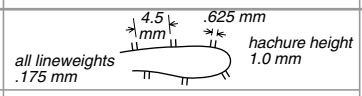
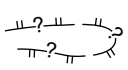
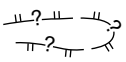
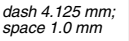
22—PLATE-TECTONIC FEATURES

[Symbols for plate-tectonic features are usually reserved for maps at scales of 1:500,000 or smaller]

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
22.1	Active spreading axis or mid-oceanic ridge, with rift—Certain			Sawteeth point in direction of spreading. May also be shown in black or other colors.
22.2	Active spreading axis or mid-oceanic ridge, with rift—Approximately located			
22.3	Active spreading axis or mid-oceanic ridge, with rift—Approximately located, queried			
22.4	Active spreading axis or mid-oceanic ridge, without rift—Certain			Sawteeth point in direction of spreading. May also be shown in black or other colors.
22.5	Active spreading axis or mid-oceanic ridge, without rift—Approximately located			
22.6	Active spreading axis or mid-oceanic ridge, without rift—Approximately located, queried			
22.7	Ancient spreading axis or mid-oceanic ridge—Certain			Sawteeth point in direction of spreading.
22.8	Ancient spreading axis or mid-oceanic ridge—Uncertain			
22.9	Surface trace of active deep-seismofocal or subduction zone—Certain			Sawteeth on upper plate. May also be shown in black or other colors.
22.10	Surface trace of active deep-seismofocal or subduction zone—Approximately located			
22.11	Surface trace of active deep-seismofocal or subduction zone—Approximately located, queried			
22.12	Surface trace of active deep-seismofocal or subduction zone—Showing fore-arc sediments			
22.13	Active convergent plate boundary—Certain			Sawteeth on upper plate. May also be shown in black or other colors.
22.14	Active convergent plate boundary—Approximately located			
22.15	Active convergent plate boundary—Approximately located, queried			
22.16	Active convergent plate boundary—Showing accretionary prism			
22.17	Ancient convergent plate boundary—Certain			Sawteeth on upper plate.
22.18	Ancient convergent plate boundary—Approximately located			
22.19	Continental slope—Certain			Teeth point toward slope.
22.20	Continental slope—Approximately located			
22.21	Continental slope—Approximately located, queried			
22.22	Continental slope—Showing margin			

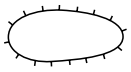
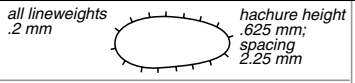
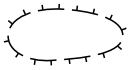
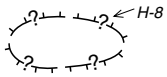
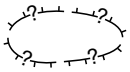
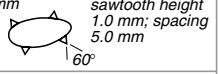
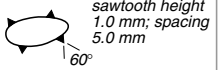
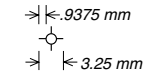
22—PLATE-TECTONIC FEATURES (continued)

[Symbols for plate-tectonic features are usually reserved for maps at scales of 1:500,000 or smaller]

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
22.23	Active transform fault, sense of offset unspecified—Certain			May be shown in other colors. May also be shown in black, but the distinction between "active" and "ancient" transform faults will be lost.
22.24	Active transform fault, sense of offset unspecified—Approximately located			
22.25	Active transform fault, sense of offset unspecified—Approximately located, queried			
22.26	Active transform fault, right-lateral offset—Certain			Arrows show direction of relative offset. May be shown in other colors. May also be shown in black, but the distinction between "active" and "ancient" transform faults will be lost.
22.27	Active transform fault, right-lateral offset—Approximately located			
22.28	Active transform fault, right-lateral offset—Approximately located, queried			
22.29	Active transform fault, left-lateral offset—Certain			Arrows show direction of relative offset. May be shown in other colors. May also be shown in black, but the distinction between "active" and "ancient" transform faults will be lost.
22.30	Active transform fault, left-lateral offset—Approximately located			
22.31	Active transform fault, left-lateral offset—Approximately located, queried			
22.32	Active transform fault, normal offset—Certain			Hachures on down-thrown side. May be shown in other colors. May also be shown in black, but the distinction between "active" and "ancient" transform faults will be lost.
22.33	Active transform fault, normal offset—Approximately located			
22.34	Active transform fault, normal offset—Approximately located, queried			
22.35	Ancient transform fault, sense of offset unspecified—Certain			
22.36	Ancient transform fault, sense of offset unspecified—Approximately located			
22.37	Outline of basin—Certain			Sawteeth point into basin.
22.38	Outline of basin—Approximately located			
22.39	Outline of basin—Approximately located, queried			
22.40	Deep-sea trench—Showing margin filled by sedimentation			
22.41	Margin of oceanic rise—Certain			Hachures point downslope.
22.42	Margin of oceanic rise—Approximately located			
22.43	Margin of oceanic rise—Approximately located, queried			

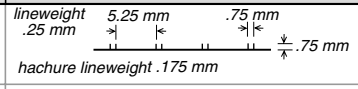
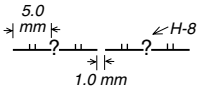
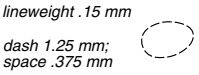
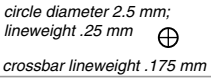
22—PLATE-TECTONIC FEATURES (continued)

[Symbols for plate-tectonic features are usually reserved for maps at scales of 1:500,000 or smaller]

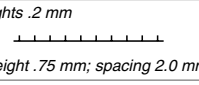
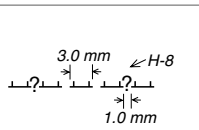
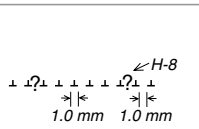
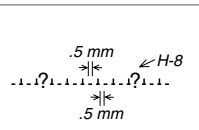
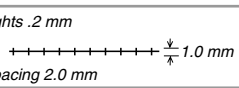
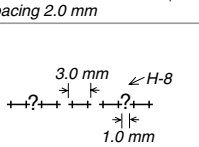
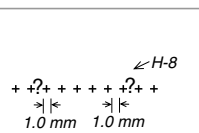
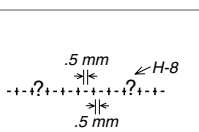
REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
22.44	Volcanic ridge or edifice—Certain			Hachures point downslope.
22.45	Volcanic ridge or edifice—Approximately located			
22.46	Volcanic ridge or edifice—Approximately located, queried		dash 3.5 mm; space 1.0 mm	
22.47	Guyot			Hachures point downslope.
22.48	Seamount, nonvolcanic origin			Sawteeth point downslope.
22.49	Seamount, volcanic origin			
22.50	Seamount, nonvolcanic origin (shown as point symbol when too small to outline at map scale)			Hachures point downslope.
22.51	Seamount, volcanic origin (shown as point symbol when too small to outline at map scale)			

23—MISCELLANEOUS UPLIFT AND COLLAPSE FEATURES

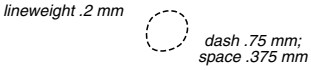
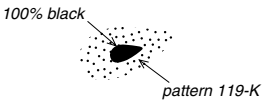
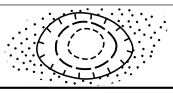
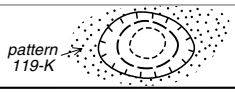
[Symbols for miscellaneous uplift and collapse features are usually reserved for maps at scales of 1:250,000 or smaller]

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
23.1	Outline of metamorphic core complex—Certain			Hachures point toward downdropped body.
23.2	Outline of metamorphic core complex—Approximately located			
23.3	Outline of metamorphic core complex—Approximately located, queried			
23.4	Collapse structure or sinkhole			Hachures point into sinkhole.
23.5	Crater outline, unspecified origin			
23.6	Uplift—Local, intensely disturbed			
23.7	Salt dome			
23.8	Possible salt dome			
23.9	Salt and (or) shale diapirs			

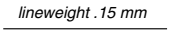
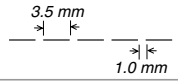
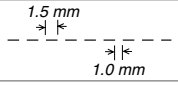
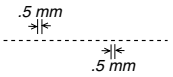
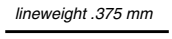
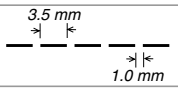
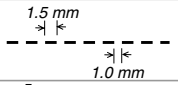
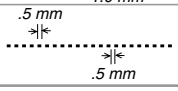
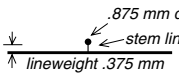
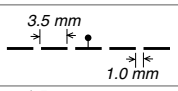
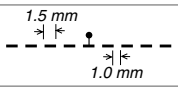
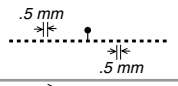
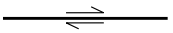
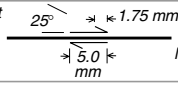
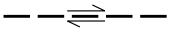
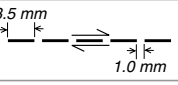
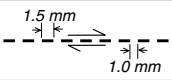
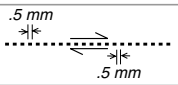
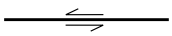
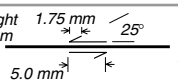
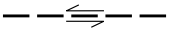
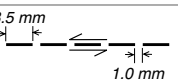
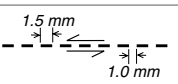
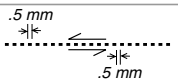
24—TERRESTRIAL IMPACT-CRATER FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
24.1	Primary terrestrial impact crater, type 1			Use to show crater that is too small to outline at map scale.
24.2	Secondary terrestrial impact crater, type 1—Formed by debris thrown from primary crater			
24.3	Primary terrestrial impact crater, type 2			Use to show crater that is too small to outline at map scale.
24.4	Secondary terrestrial impact crater, type 2—Formed by debris thrown from primary crater			
24.5	Terrestrial impact crater without raised rim—Certain			Hachures point into crater.
24.6	Terrestrial impact crater without raised rim—Approximately located			
24.7	Terrestrial impact crater without raised rim—Approximately located, queried			
24.8	Terrestrial impact crater without raised rim—Inferred			
24.9	Terrestrial impact crater without raised rim—Inferred, queried			
24.10	Terrestrial impact crater without raised rim—Concealed			
24.11	Terrestrial impact crater without raised rim—Concealed, queried			
24.12	Terrestrial impact crater with raised rim—Certain			
24.13	Terrestrial impact crater with raised rim—Approximately located			
24.14	Terrestrial impact crater with raised rim—Approximately located, queried			
24.15	Terrestrial impact crater with raised rim—Inferred			
24.16	Terrestrial impact crater with raised rim—Inferred, queried			
24.17	Terrestrial impact crater with raised rim—Concealed			
24.18	Terrestrial impact crater with raised rim—Concealed, queried			

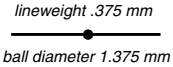
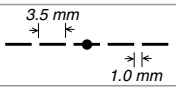
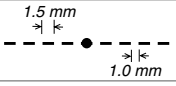
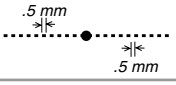
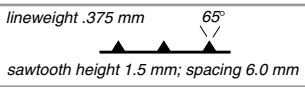
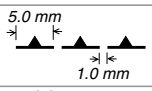
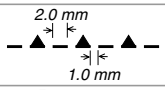
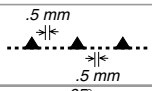
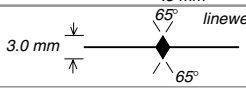
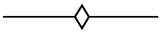
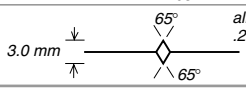
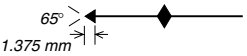
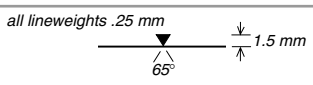
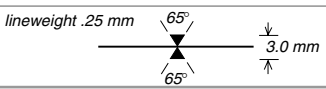
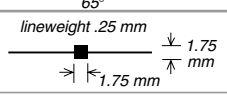
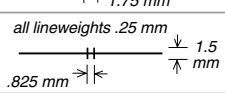
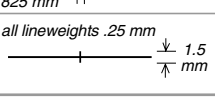
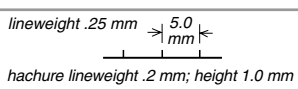
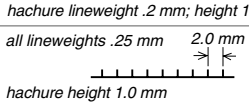
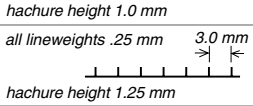
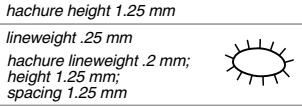
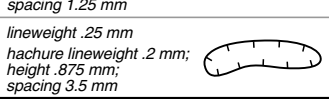
24—TERRESTRIAL IMPACT-CRATER FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
24.19	Outer boundary, floor of terrestrial impact crater			
24.20	Outer boundary, central mound of complex terrestrial impact crater			
24.21	Terrestrial palimpsest area			
24.22	Terrestrial impact ejecta			
24.23	Palimpsest area around complex terrestrial impact feature—Ejecta obscures morphology of area surrounding crater			

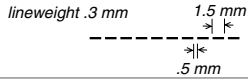
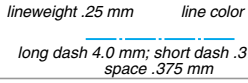
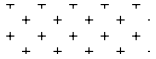
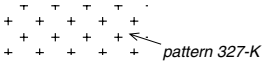
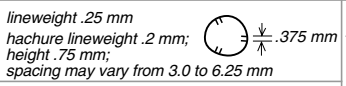
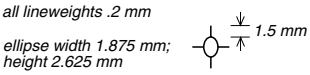
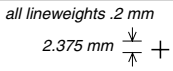
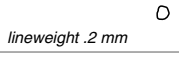
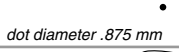
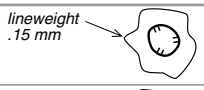
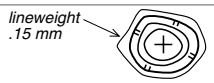
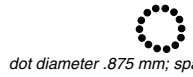
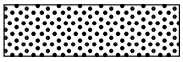
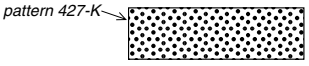
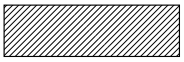
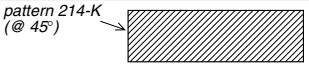
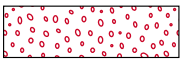
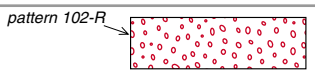
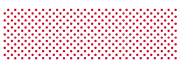
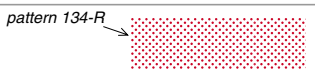
25—PLANETARY GEOLOGY FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
25.1	Contact, planetary—Certain			
25.2	Contact, planetary—Approximate			
25.3	Contact, planetary—Inferred			
25.4	Contact, planetary—Concealed			
25.5	Fault, planetary, sense of offset unspecified—Certain			
25.6	Fault, planetary, sense of offset unspecified—Approximate			
25.7	Fault, planetary, sense of offset unspecified—Inferred			
25.8	Fault, planetary, sense of offset unspecified—Concealed			
25.9	Fault, planetary, normal offset—Certain			Ball and bar on down-thrown block.
25.10	Fault, planetary, normal offset—Approximate			
25.11	Fault, planetary, normal offset—Inferred			
25.12	Fault, planetary, normal offset—Concealed			
25.13	Fault, planetary, right-lateral offset—Certain			Arrows show direction of relative offset.
25.14	Fault, planetary, right-lateral offset—Approximate			
25.15	Fault, planetary, right-lateral offset—Inferred			
25.16	Fault, planetary, right-lateral offset—Concealed			
25.17	Fault, planetary, left-lateral offset—Certain			Arrows show direction of relative offset.
25.18	Fault, planetary, left-lateral offset—Approximate			
25.19	Fault, planetary, left-lateral offset—Inferred			
25.20	Fault, planetary, left-lateral offset—Concealed			

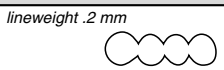
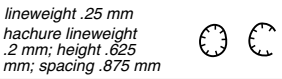
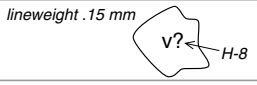
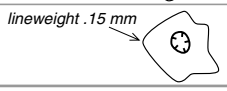
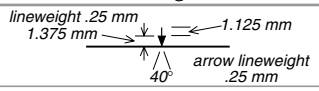
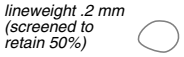
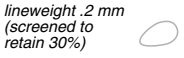
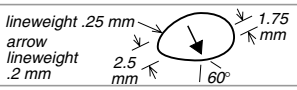
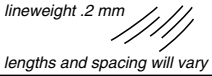
25—PLANETARY GEOLOGY FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
25.21	Graben trace, planetary—Certain (shown as single line where bounding normal faults cannot be mapped separately)			
25.22	Graben trace, planetary—Approximately located (shown as single line where bounding normal faults cannot be mapped separately)			
25.23	Graben trace, planetary—Inferred (shown as single line where bounding normal faults cannot be mapped separately)			
25.24	Graben trace, planetary—Concealed (shown as single line where bounding normal faults cannot be mapped separately)			
25.25	Thrust fault, planetary—Certain			Sawteeth on upper plate.
25.26	Thrust fault, planetary—Approximately located			
25.27	Thrust fault, planetary—Inferred			
25.28	Thrust fault, planetary—Concealed			
25.29	Ridge crest, type 1, planetary			Barbs point downslope.
25.30	Ridge crest, type 2, planetary			
25.31	Ridge crest, type 1, planetary—Arrowhead shows abrupt termination of ridge			Line end without arrowhead indicates gradual termination of ridge.
25.32	Scarp base, planetary			Barbs point downslope.
25.33	Trough or narrow depression, planetary			
25.34	Furrow, planetary			
25.35	Sharp groove, planetary			
25.36	Subdued groove, planetary			
25.37	Scarp top, planetary			Hachures point downslope.
25.38	Lobate scarp, planetary			
25.39	Basal scarp, planetary			
25.40	Dome or circular scarp, planetary			
25.41	Depression, planetary			

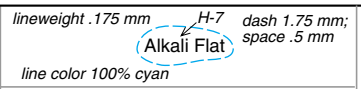
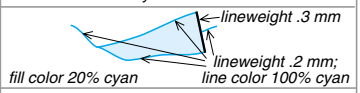
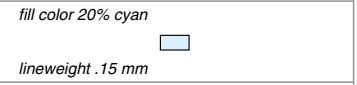
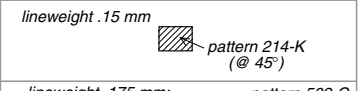
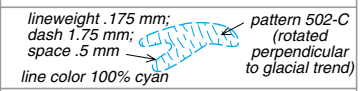
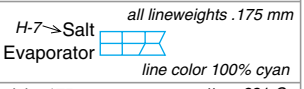
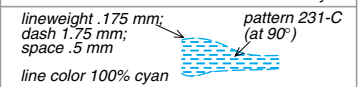
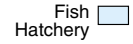
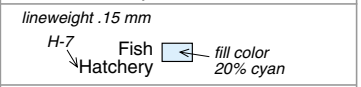
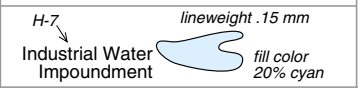
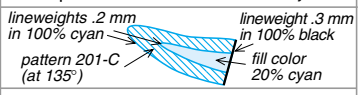
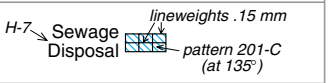
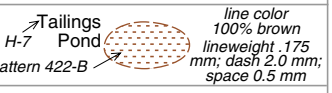
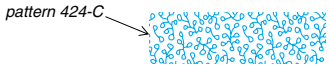
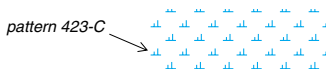
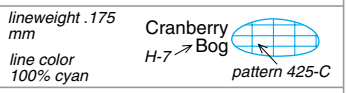
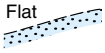
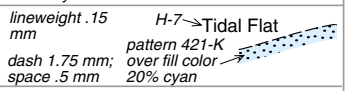
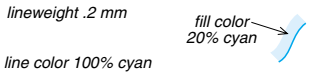
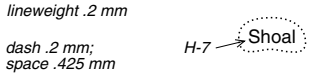
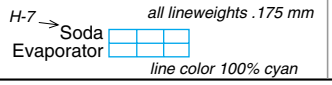
25—PLANETARY GEOLOGY FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
25.42	Lineament, planetary			
25.43	Shallow or linear depression, valley, or channel, planetary			
25.44	Joint or fracture pattern, planetary			
25.45	Area of reticulate grooves, planetary—Showing trend			
25.46	Crest of crater rim, planetary			Hachures point into crater.
25.47	Crest of buried crater rim, planetary			
25.48	Crater, planetary—Showing central peak			Hachures point downslope.
25.49	Crater, planetary—Showing central peak (shown as 'plus' when too small to outline at map scale)			
25.50	Crater floor, planetary—Showing pit			
25.51	Crater floor, planetary—Showing pit (shown as 'dot' when too small to outline at map scale)			
25.52	Impact crater, planetary—Having a raised rim and a visible ejecta blanket			Hachures point into crater.
25.53	Complex impact crater, planetary—Peak at center, surrounded by floor, rim crest, and rough rim or continuous ejecta or field of secondary craters			
25.54	Palimpsest ring, planetary			
25.55	Dark-colored ejecta, planetary			May be shown in red or other colors.
25.56	Light-colored ejecta, planetary			
25.57	Terrace deposits, planetary			May be shown in red or other colors.
25.58	Dark-colored mantling material, planetary			
25.59	Secondary crater field, planetary			May be shown in black or other colors.
25.60	Diffuse highland-lowland boundary scarp, planetary			

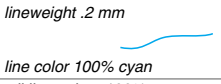
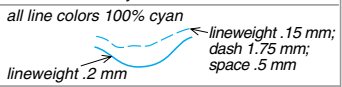
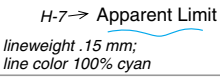
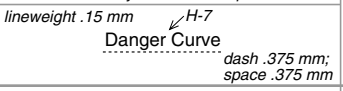
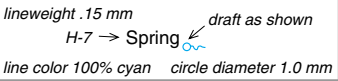
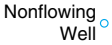
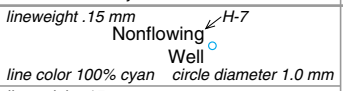
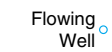
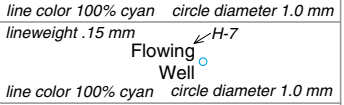
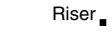
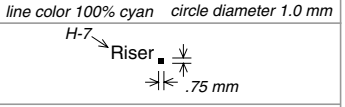
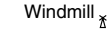
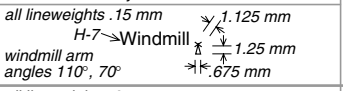
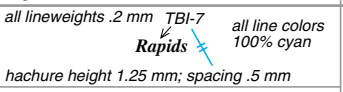
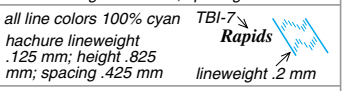
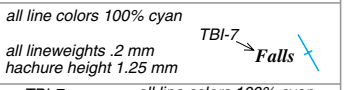
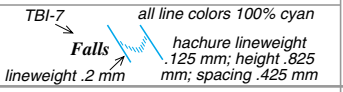
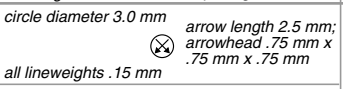
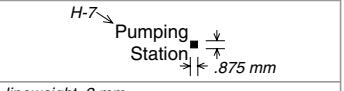
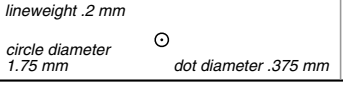
25—PLANETARY GEOLOGY FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
25.61	Chain craters or collapsed lava tube, planetary			Hachures point into crater.
25.62	Caldera, planetary			
25.63	Volcano, planetary, without summit crater—Queried if origin is conjectural			
25.64	Volcano, planetary, with summit crater			
25.65	Flow front, planetary—Arrow indicates flow direction			
25.66	Mountain (rugged), planetary—Origin uncertain			
25.67	Channel bars, planetary—May be erosional or depositional			
25.68	Slide or slump material, planetary—Arrow indicates direction of movement			
25.69	Layering in canyon wall, planetary			

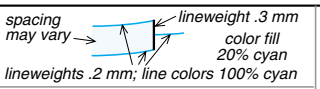
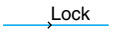
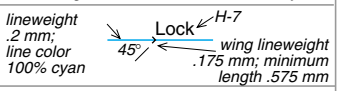
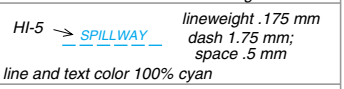
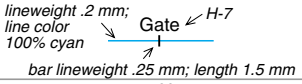
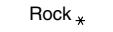
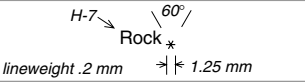
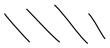
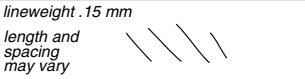
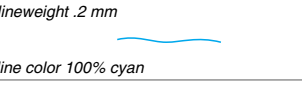
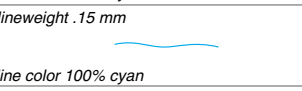
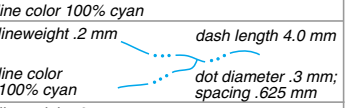
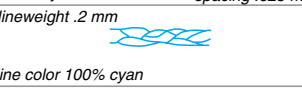
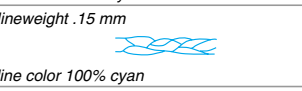
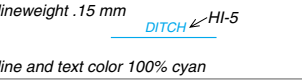
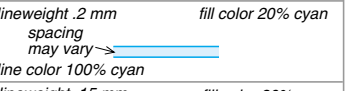
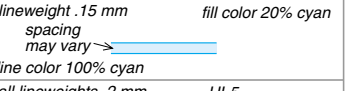
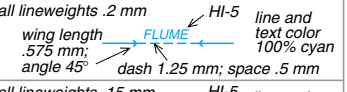
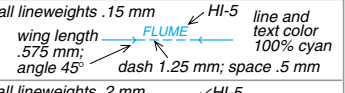
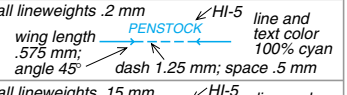
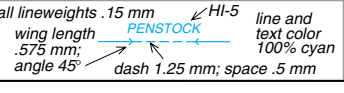
26—HYDROLOGIC FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
26.1—Hydrography and hydrologic feature indentification symbology				
26.1.1	Alkali flat			
26.1.2	Large, dammed reservoir			
26.1.3	Small reservoir			
26.1.4	Covered reservoir			
26.1.5	Glacier or permanent snowfield—Showing glacial trend			
26.1.6	Salt evaporator			
26.1.7	Inundation area			
26.1.8	Fish hatchery or farm			
26.1.9	Industrial water impoundment			
26.1.10	Area to be submerged			
26.1.11	Sewage disposal or filtration pond			
26.1.12	Tailings pond			
26.1.13	Marsh, wetland, swamp, or bog			
26.1.14	Mangrove area			
26.1.15	Rice field			
26.1.16	Cranberry bog			
26.1.17	Tidal, mud, sand, or gravel flats			
26.1.18	Coastline of bay, estuary, gulf, ocean, or sea			
26.1.19	Shoal			
26.1.20	Soda evaporator			

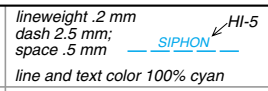
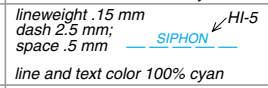
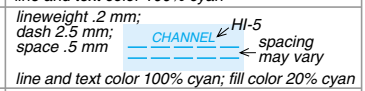
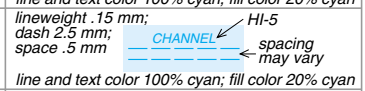
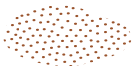
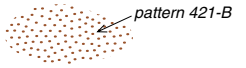
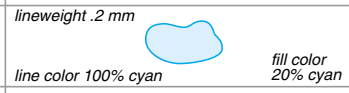
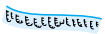
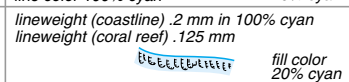
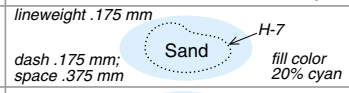
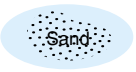
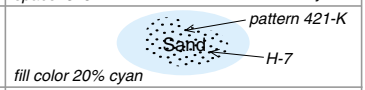
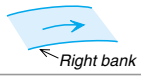
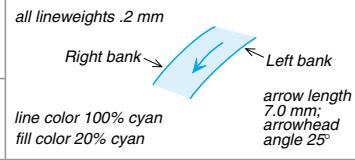
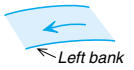
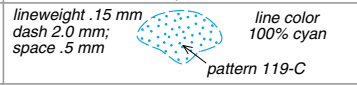
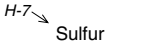
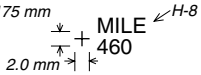
26—HYDROLOGIC FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
26.1—Hydrography and hydrologic feature indentification symbology (continued)				
26.1.21	Shoreline			
26.1.22	Manmade shoreline			
26.1.23	Indefinite shoreline			
26.1.24	Apparent limit of water body			
26.1.25	Outline of a Carolina bay			
26.1.26	Danger curve			
26.1.27	Spring, as shown on general-purpose or smaller scale maps			Rotate tail to point in downhill direction of flow.
26.1.28	Nonflowing well, as shown on general-purpose or smaller scale maps			
26.1.29	Flowing well, as shown on general-purpose or smaller scale maps			
26.1.30	Riser			
26.1.31	Geyser, as shown on general-purpose or smaller scale maps			
26.1.32	Windmill			
26.1.33	Rapids on single-line drainage			
26.1.34	Rapids on double-line drainage			
26.1.35	Falls on single-line drainage			
26.1.36	Falls on double-line drainage			
26.1.37	Gravel pit or quarry filled with water			
26.1.38	Gaging station, as shown on general-purpose or smaller scale maps			
26.1.39	Pumping station			
26.1.40	Water intake			

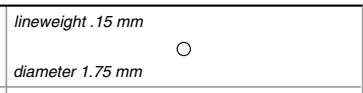
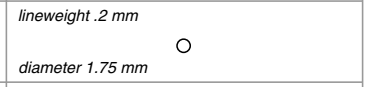
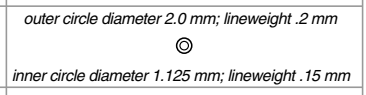
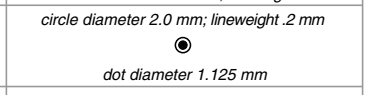
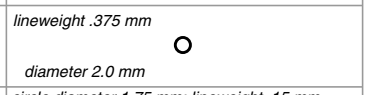
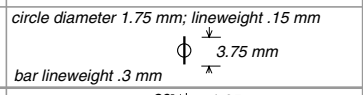
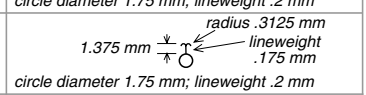
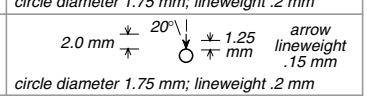
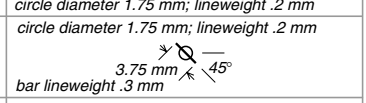
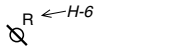
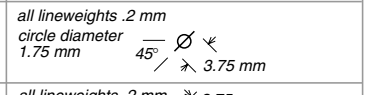
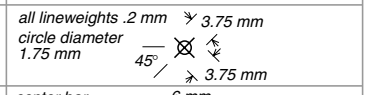
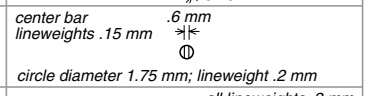
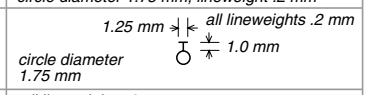
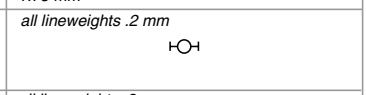
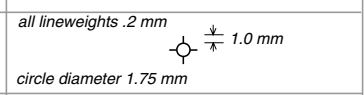
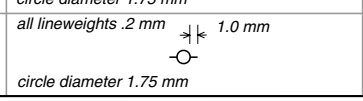
26—HYDROLOGIC FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
26.1—Hydrography and hydrologic feature indentification symbology (continued)				
26.1.41	Dam or weir			
26.1.42	Canal lock or sluice gate			
26.1.43	Spillway			
26.1.44	Gate (flood, tidal, head, or check)			
26.1.45	Rock			
26.1.46	Crevasse			
26.1.47	Stream—Perennial			
26.1.48	Stream—Intermittent, type 1			
26.1.49	Stream—Intermittent, type 2			
26.1.50	Braided stream—Perennial			
26.1.51	Braided stream—Intermittent			
26.1.52	Ditch—Perennial			
26.1.53	Ditch—Intermittent			
26.1.54	Aqueduct—Perennial			
26.1.55	Aqueduct—Intermittent			
26.1.56	Flume—Perennial			
26.1.57	Flume—Intermittent			
26.1.58	Penstock—Perennial			
26.1.59	Penstock—Intermittent			

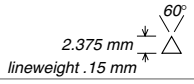
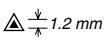
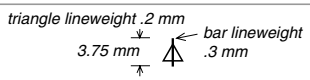
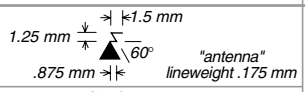
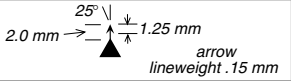
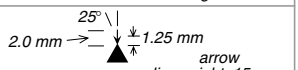
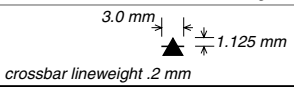
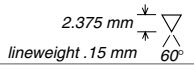
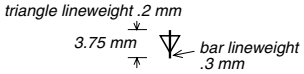
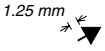
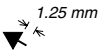
26—HYDROLOGIC FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
26.1—Hydrography and hydrologic feature indentification symbology (continued)				
26.1.60	Siphon—Perennial			
26.1.61	Siphon—Intermittent			
26.1.62	Channel in open water—Perennial			
26.1.63	Channel in open water—Intermittent			
26.1.64	Wash or ephemeral drain			
26.1.65	Lake or pond			
26.1.66	Coral reef			
26.1.67	Sand in open water, type 1			
26.1.68	Sand in open water, type 2			
26.1.69	Spoil area in open water			
26.1.70	Right bank			
26.1.71	Left bank			
26.1.72	Submerged or sunken hydrologic feature			
26.1.73	Dry hydrologic feature			
26.1.74	Salt	Salt		
26.1.75	Mineral or hot spring (such as sulfur or alkali)	Sulfur		
26.1.76	Water surface elevation	*ELEVATION 127*		
26.1.77	River mile	+ MILE 460		

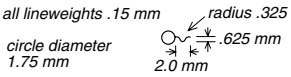
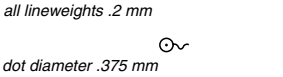
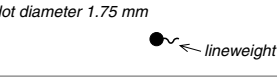
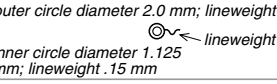
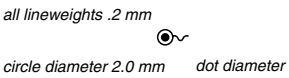
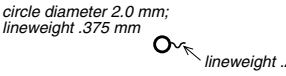
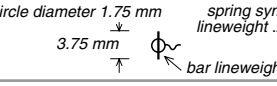
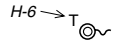
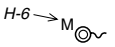
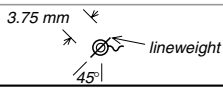
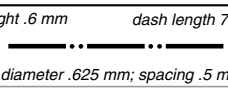
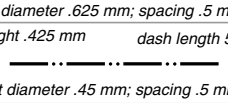
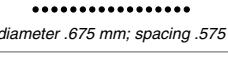
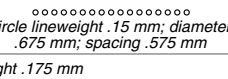
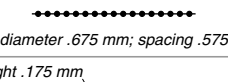
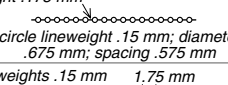
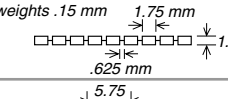
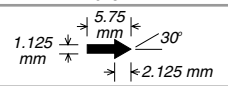
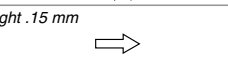
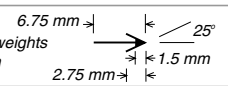
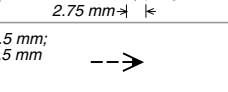
26—HYDROLOGIC FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	26.2—Water wells			
26.2.1	Water well—Type of use unspecified			Circle indicates specific type of water-supply well; may be used alone or in combination with various ornamentations shown below. May also be drawn in cyan or other colors.
26.2.2	Well—Used for domestic-water supply			
26.2.3	Well—Used for stock-water supply			
26.2.4	Well—Used for irrigation-water supply			
26.2.5	Well—Used for industrial-water supply			
26.2.6	Well—Used for public-water supply			
26.2.7	Water well—Unused			
26.2.8	Artesian well			Although only shown with symbol used for stock-water supply well, ornamentation may be added to any type of water-supply well symbol. May also be drawn in cyan or other colors.
26.2.9	Nonflowing artesian well			
26.2.10	Water recharge or waste-injection well			
26.2.11	Observation water well			
26.2.12	Observation water well—Equipped with recorder			
26.2.13	Abandoned water well			
26.2.14	Destroyed water well			
26.2.15	Test hole for water			
26.2.16	Water well—Capped			
26.2.17	Water well—Shut-in			
26.2.18	Dry hole—Water exploration			
26.2.19	Well—Used for collection of water data			

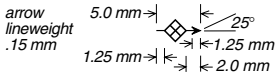
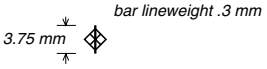
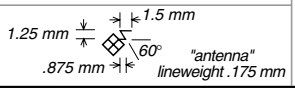
26—HYDROLOGIC FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	26.3—Water gaging stations			
26.3.1	Gaging station—Type of measurement unspecified			Triangle indicates specific type of gaging station; may be used alone or in combination with various ornamentations shown below. May be combined with symbols for quality-of-water sites; place triangle above and adjoining quality-of-water site symbol. Usually reserved for use on larger scale, special-purpose maps.
26.3.2	Gaging station—Continuous-record			
26.3.3	Gaging station—Partial-record			
26.3.4	Measurement station without a gage			
26.3.5	Discontinued gaging station			
26.3.6	Gaging station—Equipped with a telephone or radio			Although only shown with symbol used for continuous-record gaging station, ornamentation may be added to any type of gaging station symbol.
26.3.7	Peak-flow measurement station			
26.3.8	Low-flow measurement station			
26.3.9	Stage-measurement station			
	26.4—Quality-of-water sites			
26.4.1	Quality-of-water site—Type of measurement unspecified			Inverted triangle indicates specific type of quality-of-water site; may be used alone or in combination with various ornamentations shown below. May be combined with symbols for gaging stations; place inverted triangle below and adjoining gaging station symbol.
26.4.2	Active quality-of-water site			
26.4.3	Active quality-of-water site—Equipped with a monitor			
26.4.4	Inactive quality-of-water site			
26.4.5	Quality-of-water site—Chemical measurement			Although only shown with symbol used for active quality-of-water site, ornamentation may be added to any type of quality-of-water site symbol.
26.4.6	Quality-of-water site—Temperature measurement			
26.4.7	Quality-of-water site—Biological measurement			
26.4.8	Quality-of-water site—Sediment measurement			

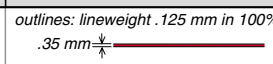
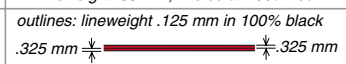
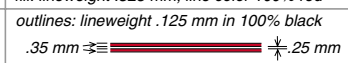
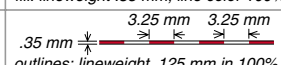
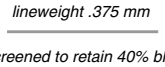
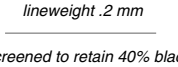
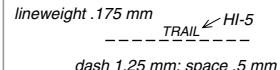
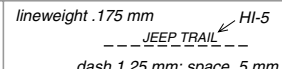
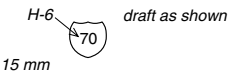
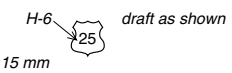
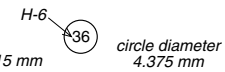
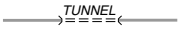
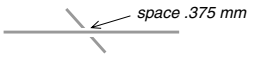
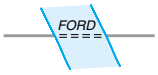
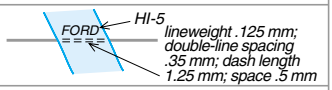
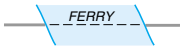
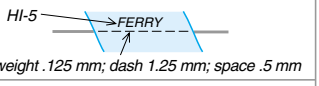
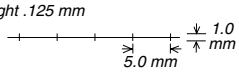
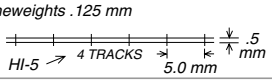
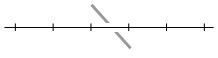
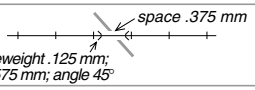
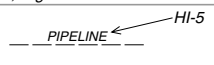
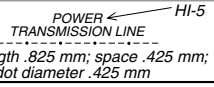
26—HYDROLOGIC FEATURES (continued)

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	26.5—Springs			
26.5.1	Spring—Type of use unspecified			Circle and tail indicate specific type of spring; may be used alone or in combination with various ornamentations shown below. Rotate tail to point in downhill direction of flow. May also be drawn in cyan or other colors.
26.5.2	Spring—Used for collection of water-quality data			
26.5.3	Spring—Used for domestic-water supply			
26.5.4	Spring—Used for irrigation-water supply			
26.5.5	Spring—Used for industrial-water supply			
26.5.6	Spring—Used for public-water supply			
26.5.7	Unused spring			
26.5.8	Thermal spring			Although only shown with symbol used for irrigation-water supply spring, ornamentation may be added to any type of spring symbol.
26.5.9	Mineral spring			
26.5.10	Extinct spring			
	26.6—Miscellaneous hydrologic symbols			
26.6.1	Surface-water basin boundary			May also be drawn in cyan or other colors.
26.6.2	Surface-water subbasin boundary			
26.6.3	Ground-water divide—Certain			
26.6.4	Ground-water divide—Approximately located			
26.6.5	Ground-water barrier—Certain			
26.6.6	Ground-water barrier—Approximately located			
26.6.7	Infiltration gallery			
26.6.8	Direction of ground-water flow, type 1—Certain			Use open or dashed arrows when more than one type or generation of ground-water flow is shown. May also be drawn in cyan or other colors.
26.6.9	Direction of ground-water flow, type 2—Certain			
26.6.10	Direction of ground-water flow, type 1—Approximate			
26.6.11	Direction of ground-water flow, type 2—Approximate			

27—WEATHER STATIONS

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
27.1	Weather station—Type of measurement unspecified			Diamond indicates specific type of weather station; may be used alone or in combination with various ornamentations shown below.
27.2	Weather station—Complete			
27.3	Snow-survey course			
27.4	Weather station—Precipitation measurement			
27.5	Weather station—Evaporation measurement			
27.6	Weather station—Temperature measurement			
27.7	Weather station—Humidity measurement			
27.8	Weather station—Solar-radiation measurement			
27.9	Weather station—Wind-velocity measurement			
27.10	Weather station—Discontinued			
27.11	Weather station—Equipped with a recorder			Although only shown with symbol used for snow-survey course, ornamentation may be added to any type of weather station symbol.
27.12	Weather station—Equipped with a telephone or radio			

28—TRANSPORTATION FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
28.1	Primary route—Class 1, undivided			
28.2	Primary route—Class 1, divided by centerline			
28.3	Primary route—Class 1, divided, lanes separated			
28.4	Secondary route—Class 2, divided, lanes separated			
28.5	Road or street—Class 3			
28.6	Road or street—Class 4			
28.7	Trail—Class 5, other than 4-wheel-drive vehicles			
28.8	Trail—Class 5, 4-wheel-drive vehicles			
28.9	Interstate route number			
28.10	U.S. route number			
28.11	State route number			
28.12	Road, street, or highway in tunnel			
28.13	Road, street, or highway overpass or bridge			
28.14	Road, street, or highway submerged or in a ford			
28.15	Ferry crossing			
28.16	Railroad (one track)			
28.17	Railroad (one track)—Showing name			
28.18	Railroad (more than one track)—Showing number of tracks			
28.19	Railroad overpass or bridge			
28.20	Pipeline			
28.21	Power transmission line			

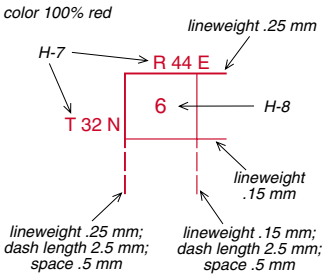
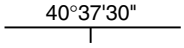
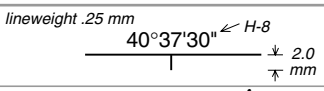
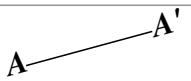
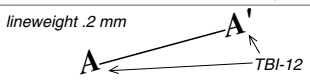
29—BOUNDARIES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
29.1	International boundary	CANADA UNITED STATES	H-8 → CANADA UNITED STATES *long dash 5.0 mm; short dash 1.75 mm; space .75 mm* *lineweight .4 mm*	
29.2	State boundary		*lineweight .3 mm* *long dash 5.0 mm; short dash 1.75 mm; space .75 mm*	
29.3	County boundary		*lineweight .25 mm* *long dash 3.0 mm; short dash 1.5 mm; space .75 mm*	
29.4	Boundary—Civil township, district, precinct, or barrio		*lineweight .2 mm* *short dash 1.5 mm; long dash 4.0 mm; space 1.0 mm*	
29.5	Boundary—Incorporated city, village, town, borough, or hamlet		*lineweight .2 mm* *long dash 3.0 mm; short dash 1.0 mm; space .5 mm*	
29.6	Boundary—National park, monument, lakeshore, seashore, parkway, battlefield, or recreation area		*lineweight .25 mm* *dash length 3.5 mm; space 3.0 mm* *dot diameter .375 mm*	
29.7	Boundary—National forest or grassland		*lineweight .25 mm* *dash length 3.5 mm; space 3.0 mm* *dot diameter .375 mm*	
29.8	Boundary—National wildlife refuge, game preserve, or fish hatchery		*lineweight .25 mm* *dash length 3.5 mm; space 3.0 mm* *dot diameter .375 mm*	
29.9	Boundary—National scenic waterway or wilderness area		*lineweight .25 mm* *dash length 3.5 mm; space 3.0 mm* *dot diameter .375 mm*	
29.10	Boundary—Indian reservation		*lineweight .25 mm* *dash length 3.5 mm; space 3.0 mm* *dot diameter .375 mm*	
29.11	Boundary—Military reservation		*lineweight .25 mm* *dash length 3.5 mm; space 3.0 mm* *dot diameter .375 mm*	
29.12	Boundary—Small park		*lineweight .2 mm* *dash length 1.0 mm; space .75 mm*	
29.13	Continental Divide		*lineweight .3 mm* *dash 10.0 mm; space 2.5 mm*	
29.14	State Federal Information Processing Standards (FIPS) code		*lineweight .3 mm* *long dash 6.25 mm; short dash 1.75 mm; space .825 mm*	
29.15	County or county-equivalent FIPS code		*lineweight .25 mm* *long dash 6.25 mm; short dash 1.75 mm; space .825 mm*	

30—TOPOGRAPHIC FEATURES

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
30.1	Topographic contour—Index		 *lineweight .25 mm* *color 40% black*	May also be drawn in either brown or a lighter or darker shade of black, depending on contour density.
30.2	Topographic contour—Intermediate		*lineweight .15 mm*	
30.3	Bathymetric contour—Index		 *lineweight .25 mm* *color 100% cyan*	Bathymetric contour values are given in "below sea-level" units and so should not be preceded by a minus (–) sign.
30.4	Bathymetric contour—Intermediate		*lineweight .15 mm*	

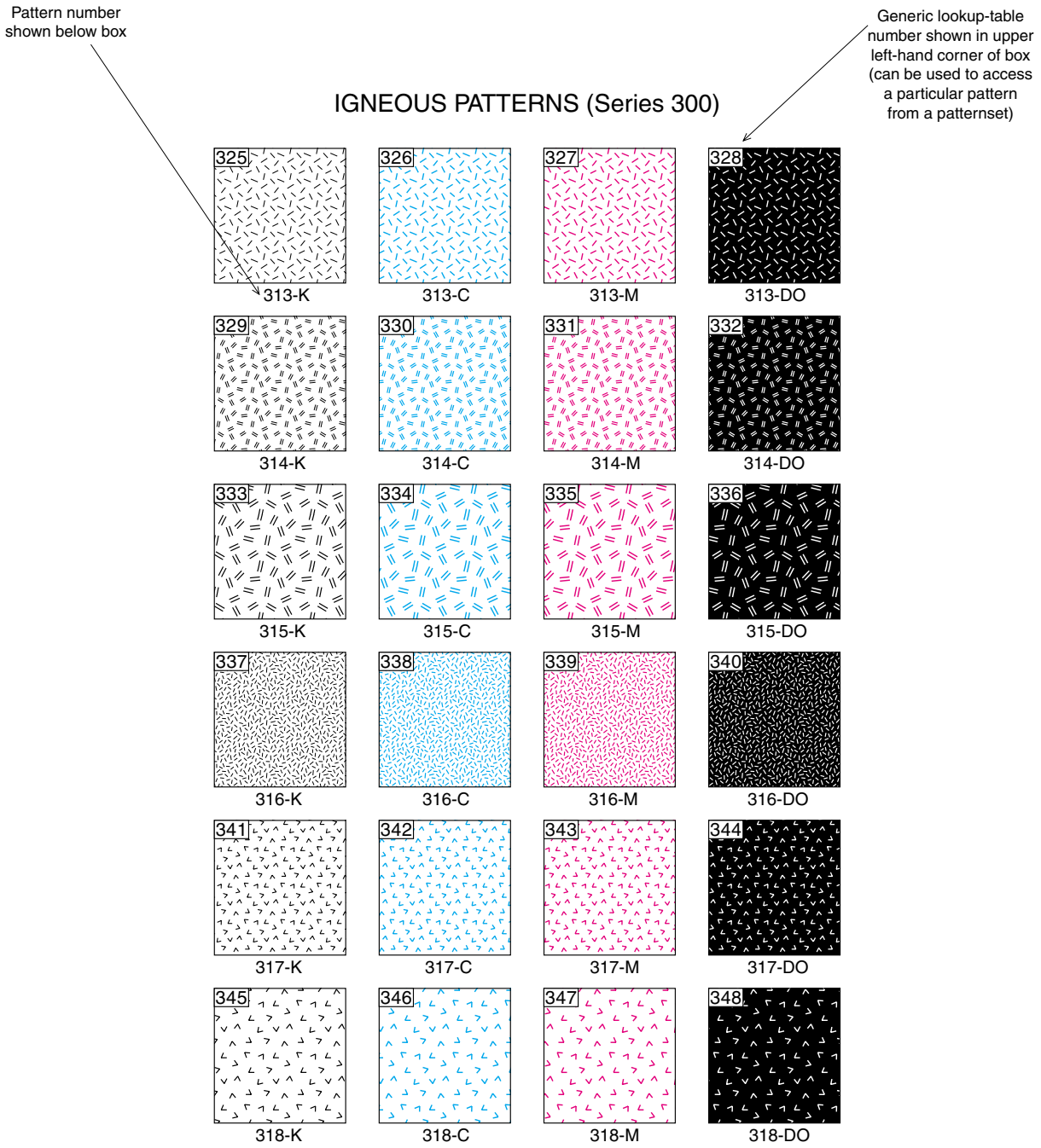
31—MISCELLANEOUS MAP ELEMENTS

REF NO	DESCRIPTION	SYMBOL	CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
31.1	Township and range line—Location certain. Showing township and range numbers			On larger scale maps (for example, 1:24,000 scale), every section is usually labeled; on smaller scale maps (for example, 1:100,000 scale), usually only the corner sections (nos. 1, 6, 31, and 36) are labeled. All townships and ranges, regardless of scale, should be labeled.
31.2	Township and range line—Location uncertain			
31.3	Section line—Location certain. Showing section number			
31.4	Section line—Location uncertain			
31.5	Map neatline and latitude/longitude tick and value			
31.6	Cross section line and label			
31.7	Map unit label and leader			
31.8	Map unit label (containing geologic age characters) and leader			

32—EXPLANATION FOR PATTERN CHART (PLATE B)

DISCUSSION
The Pattern Chart (Plate B) was designed to closely replicate the series of patterns in the informally named "Technical Cartographic Standards" volume (U.S. Geological Survey, ca.1975). They were designed in Adobe Illustrator 8.0 (Macintosh) for 1800 dpi output, and so some patterns may not plot or print correctly if output at at lower resolutions. For general information on the use of color and patterns on geologic maps, see Section 5 entitled "Guidelines for Color Design" in the accompanying introductory text.

DESCRIPTION	
Patterns with white background	• White background is transparent (underlying map-unit color will be visible) • Pattern is in front; one bounding box (having Fill and Stroke set to 'None') is in back
Patterns with black background	• Black background is opaque (underlying map-unit color will not be visible) • Pattern is in front; two bounding boxes are in back (box directly beneath pattern has 100% black Fill and Stroke set to 'None'; box to rear has Fill and Stroke set to 'None')



33—SUGGESTED STRATIGRAPHIC-AGE AND VOLCANIC MAP-UNIT COLORS

CMYK values: A = 8%; 1 = 13%; 2 = 20%; 3 = 30%; 4 = 40%; 5 = 50%; 6 = 60%; 7 = 70%; X = 100%

33.1—Stratigraphic-age map-unit colors

Q 0070	0010	0A60	0050	0030		
T 0370	0A30	A4X0	A370	0260	0140	A250	0240
K 5070	1040	5170	4150	4060	3050		
J 6040	2020	7050	5040	3030		
Tr 6020	20A0	6A30	4020	3010		
P 6000	3000	7010	5010	40A0		
PP 6200	4A00	72A0	61A0	5100		
M 4310	21A0	5310	42A0	32A0		
D 5400	2200	6500	4400	3300		
S 3500	A200	4600	34A0	2300		
O 0510	02A0	A510	0410	0310		
Є 0540	0220	A540	0430	A330		
pЄ 4460	A110	4550	3440	2330	1220	1210
	A120	4570	3460	2350	1240	A130
	1A30	5370	4360	3260	3240	2140
	1AA0	5330	4330	4220	3220	2110

33.2—Volcanic map-unit colors

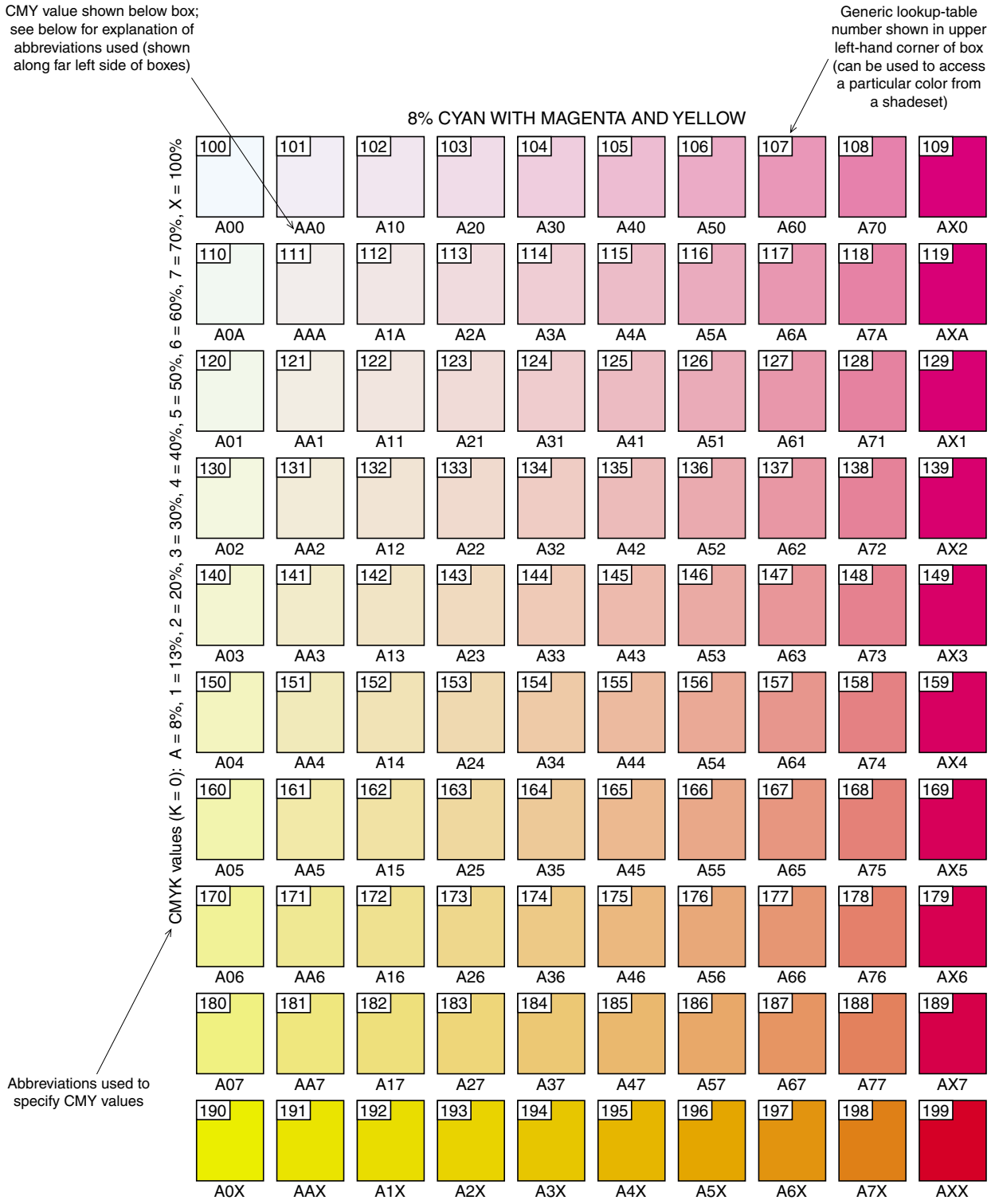
5X00	1500	3X00	0X00	0400	0550	0XX0	07X0	0470	05X0

34—EXPLANATION FOR CMYK COLOR CHART (PLATE A)

DISCUSSION

The CMYK Color Chart (Plate A) was designed to reproduce the colors shown on the U.S. Geological Survey's offset-printed process-ink color chart, "Printing Colors and Screens in Use by the U.S. Geological Survey for Geologic and Hydrologic Maps" (yellow/magenta/cyan version), which has long been used at the USGS for choosing unit colors on geologic maps. Plate A nearly exactly reproduces the offset-printed USGS color chart, except that the original color codes indicating the YMC (yellow/magenta/cyan) values have been converted to CMYK (cyan/magenta/yellow, with K = 0) to conform to industry standards.

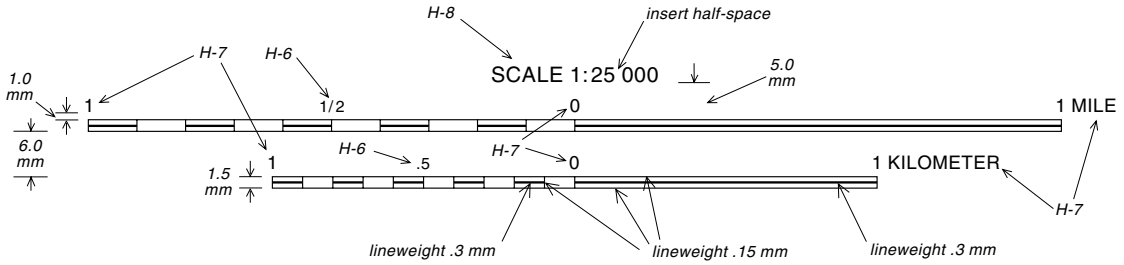
For general information on the use of color and patterns on geologic maps, see Section 5 entitled "Guidelines for Color Design" in the accompanying introductory text.



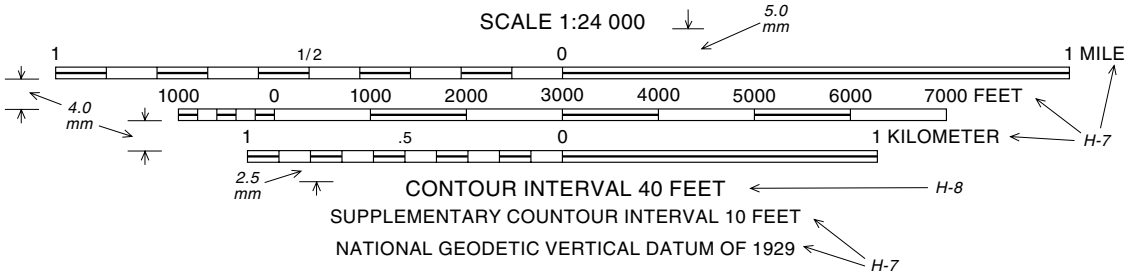
35—BAR SCALES

CARTOGRAPHIC SPECIFICATIONS

2 UNITS OF MEASUREMENT:



3 UNITS OF MEASUREMENT:



NOTES ON USAGE

Bar scales shown have been designed to use with a quadrangle-sized (1:24,000-scale) map. For other sizes and scales of maps, bar scales should be approximately one-third of the width of the map area, but usually not longer than 180 mm. See accompanying tables for various bar-scale calculations, as well as how to draw scales not shown.

DISTANCE MEASURES

1 mile (mi)	= 63,360 inches (in) = 5,280 feet (ft)
1 kilometer (km)	= 3,280.833 ft = 0.62137 mi

MEASUREMENT EQUIVALENTS

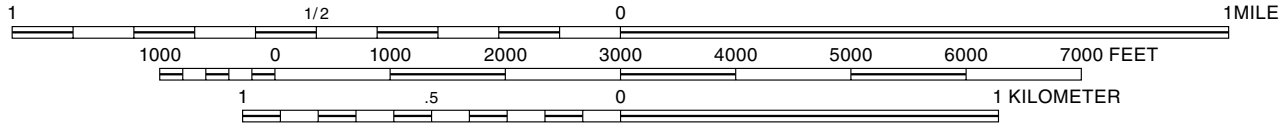
Metric		English
1 millimeter (mm)	= 1/10 cm = 1/1000 m	= 0.039 in
1 centimeter (cm)	= 10 mm = 1/100 m	= 0.393 in
1 meter (m)	= 100 cm = 1,000 mm = 1/1,000 km	= 39.37 in or 3.28 ft or 0.00062 mi
1 kilometer (km)	= 1,000 m = 100,000 cm = 1,000,000 mm	= 3,280.833 ft or 0.62137 mi

35—BAR SCALES (continued)

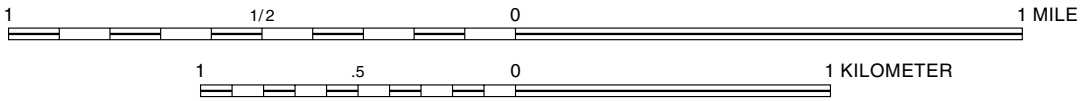
1:20 000, 1:24 000, 1:25 000, 1:31 250, 1:31 680

SCALE 1:20 000

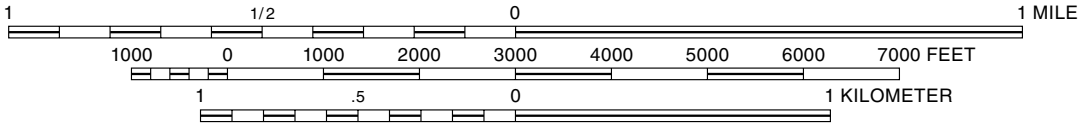
SCALE 1:20 000



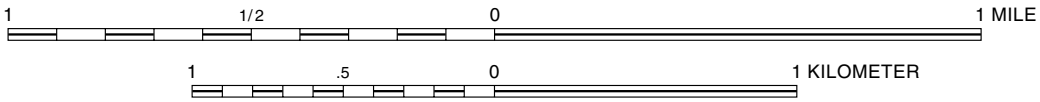
SCALE 1:24 000



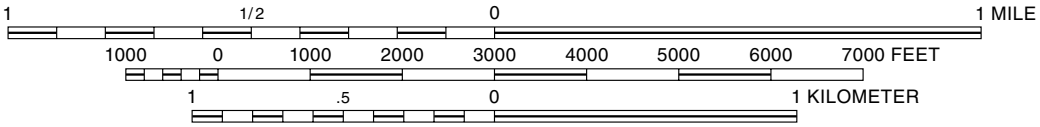
SCALE 1:24 000



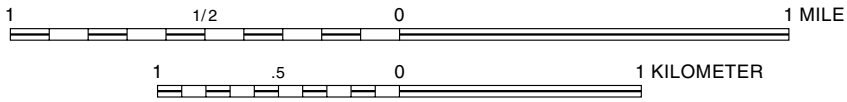
SCALE 1:25 000



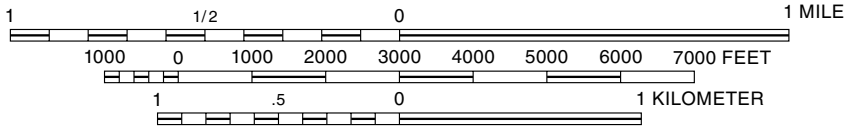
SCALE 1:25 000



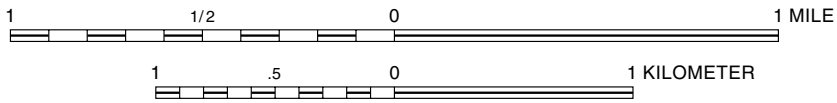
SCALE 1:31 250



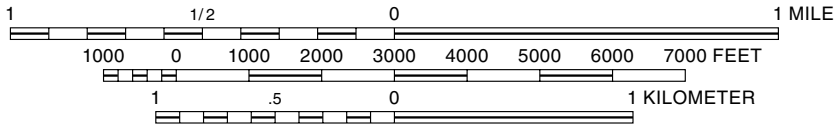
SCALE 1:31 250



SCALE 1:31 680



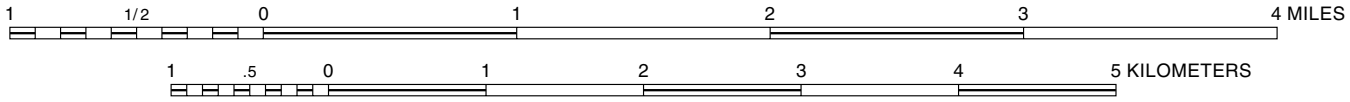
SCALE 1:31 680



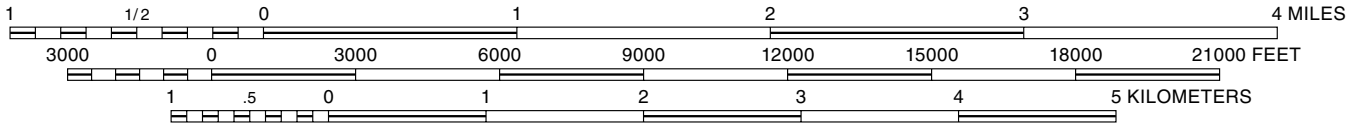
35—BAR SCALES (continued)

1:48 000, 1:50 000, 1:62 500, 1:63 360, 1:72 000

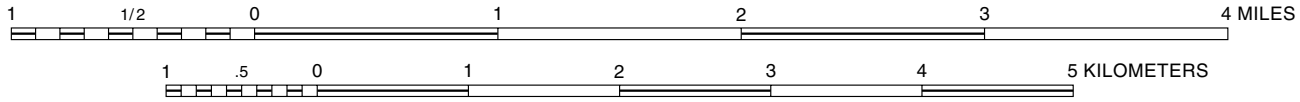
SCALE 1:48 000



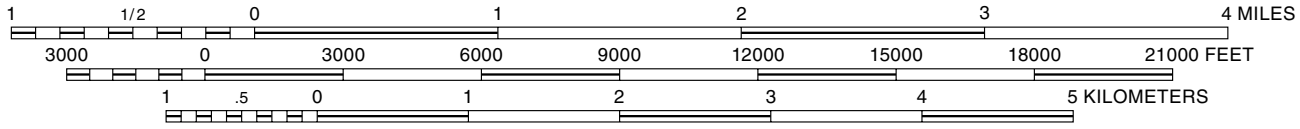
SCALE 1:48 000



SCALE 1:50 000

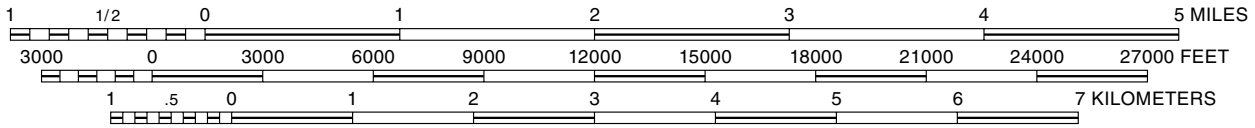


SCALE 1:50 000



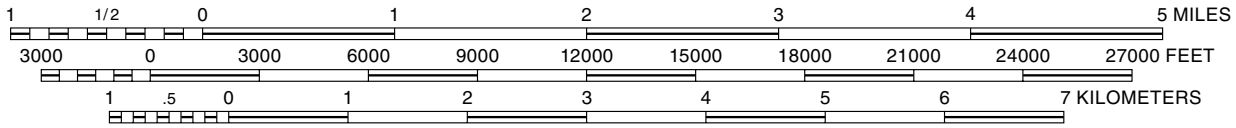
SCALE 1:62 500

SCALE 1:62 500

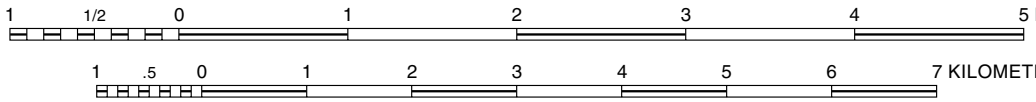


SCALE 1:63 360

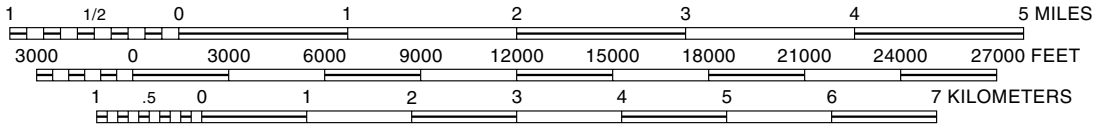
SCALE 1:63 360



SCALE 1:72 000



SCALE 1:72 000

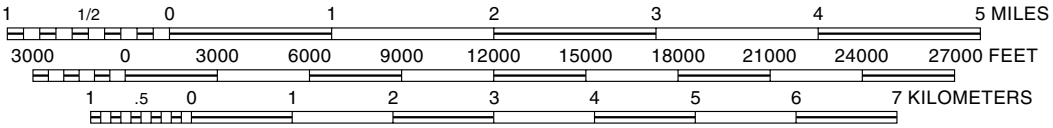


35—BAR SCALES (continued)

1:75 000, 1:96 000, 1:100 000, 1:125 000, 1:150 000, 1:250 000, 1:400 000, 1:500 000, 1:750 000

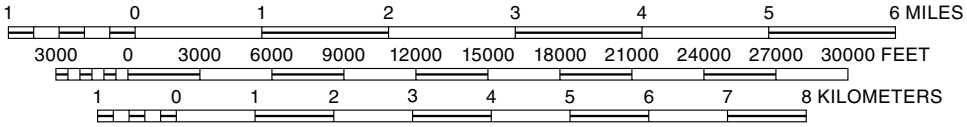
SCALE 1:75 000

SCALE 1:75 000



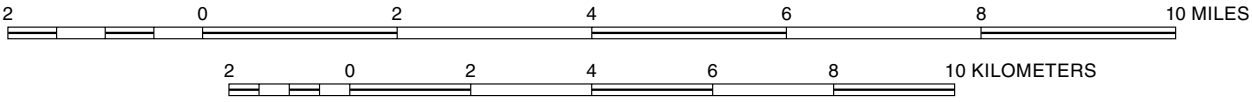
SCALE 1:96 000

SCALE 1:96 000



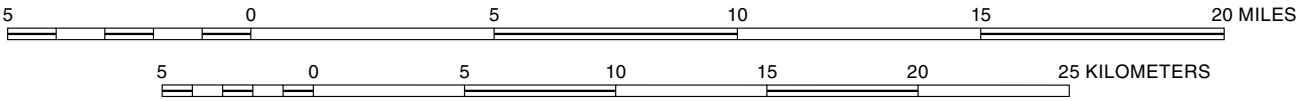
SCALE 1:100 000

SCALE 1:125 000

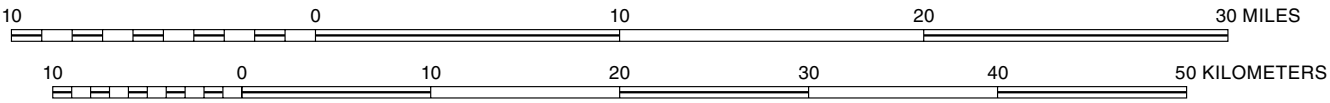


SCALE 1:150 000

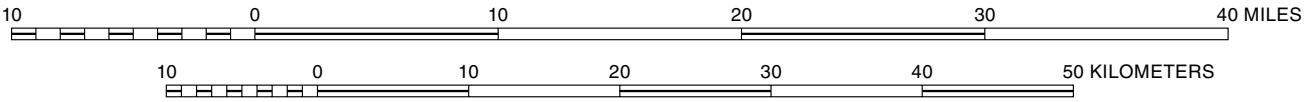
SCALE 1:250 000



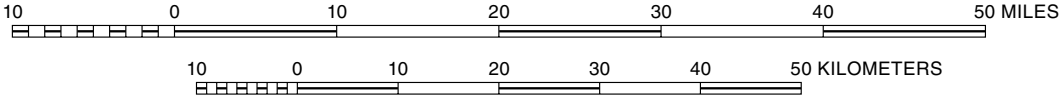
SCALE 1:400 000



SCALE 1:500 000

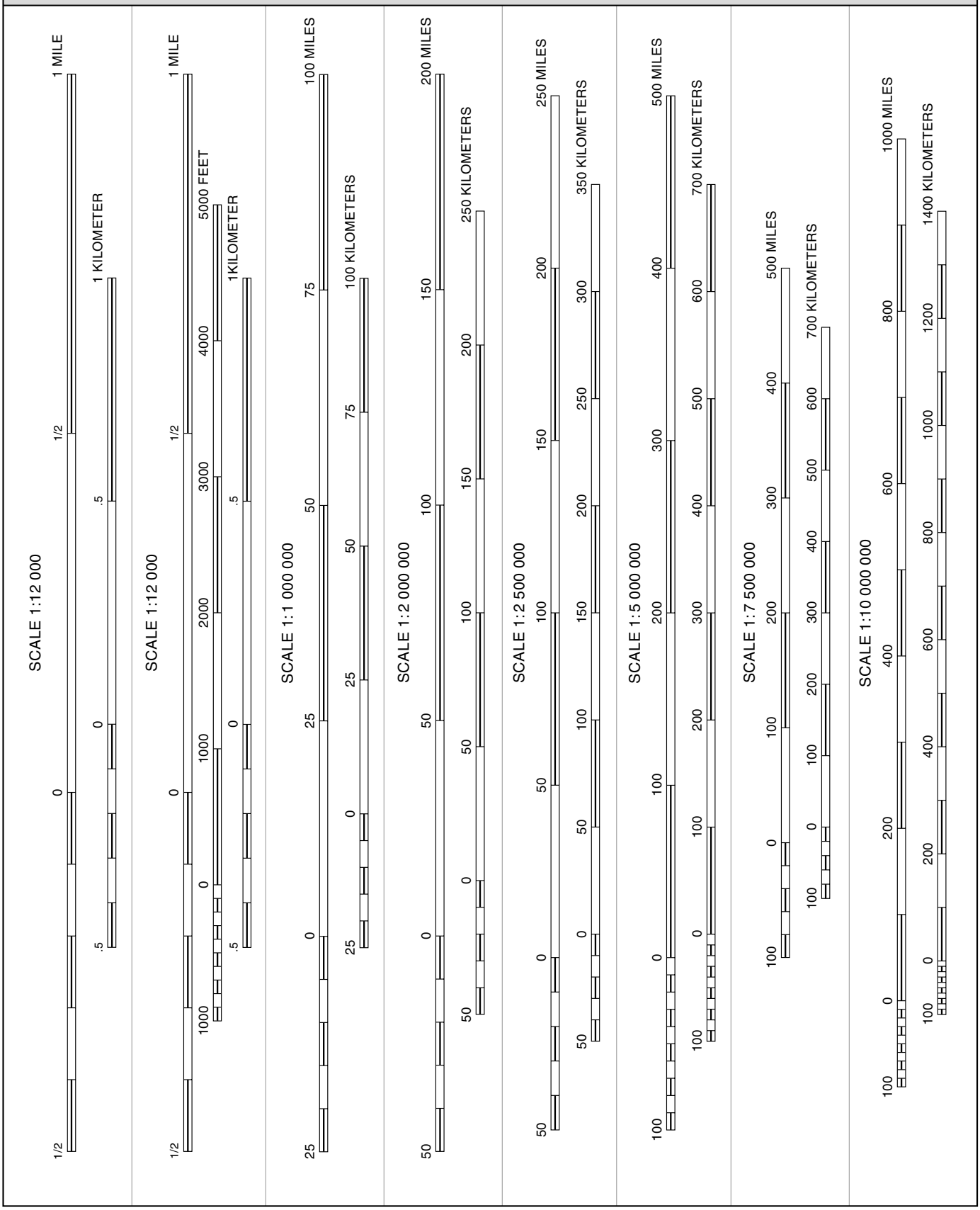


SCALE 1:750 000



35—BAR SCALES (continued)

1:12 000, 1:1 000 000, 1:2 000 000, 1:2 500 000, 1:5 000 000, 1:7 500 000, 1:10 000 000



35—BAR SCALES (continued)

BAR SCALE CALCULATIONS — MILES (1 mile = 63,360 inches)

FRACTIONAL SCALE	SCALE TO MAP REPRESENTATION: Scale Unit :	represents Map Unit	TO FIND MILES PER INCH (x in ratio) Use ratio below or SCALE / 63 360	MILES PER INCH	TOTAL MILES ON SCALE	TO FIND TOTAL SCALE LENGTH IN INCHES (y in ratio) Use ratio below or Miles on scale / Miles per inch	TOTAL SCALE LENGTH (INCHES)
1:12 000	1inch	12 000 in	$\frac{63\,360}{1} = \frac{12\,000}{x}$	0.1893939	1.5	$\frac{0.1893939}{1} = \frac{1.5}{y}$	7.920
1:20 000	1inch	20 000 in	$\frac{63\,360}{1} = \frac{20\,000}{x}$	0.3156565	2	$\frac{0.3156565}{1} = \frac{2}{y}$	6.336
1:24 000	1inch	24 000 in	$\frac{63\,360}{1} = \frac{24\,000}{x}$	0.3787878	2	$\frac{0.3787878}{1} = \frac{2}{y}$	5.280
1:25 000	1inch	25 000 in	$\frac{63\,360}{1} = \frac{25\,000}{x}$	0.3945707	2	$\frac{0.3945707}{1} = \frac{2}{y}$	5.068
1:31 250	1inch	31 250 in	$\frac{63\,360}{1} = \frac{31\,250}{x}$	0.4932133	2	$\frac{0.4932133}{1} = \frac{2}{y}$	4.055
1:31 680	1inch	31 680 in	$\frac{63\,360}{1} = \frac{31\,680}{x}$	0.500	2	$\frac{0.500}{1} = \frac{2}{y}$	4.000
1:48 000	1inch	48 000 in	$\frac{63\,360}{1} = \frac{48\,000}{x}$	0.7575757	5	$\frac{0.7575757}{1} = \frac{5}{y}$	6.600
1:50 000	1inch	50 000 in	$\frac{63\,360}{1} = \frac{50\,000}{x}$	0.7891414	5	$\frac{0.7891414}{1} = \frac{5}{y}$	6.336
1:62 500	1inch	62 500 in	$\frac{63\,360}{1} = \frac{62\,500}{x}$	0.9864267	6	$\frac{0.9864267}{1} = \frac{6}{y}$	6.082
1:63 360	1inch	63 360 in	$\frac{63\,360}{1} = \frac{63\,360}{x}$	1.000	6	$\frac{1.000}{1} = \frac{6}{y}$	6.000
1:72 000	1inch	72 000 in	$\frac{63\,360}{1} = \frac{72\,000}{x}$	1.1363636	6	$\frac{1.1363636}{1} = \frac{6}{y}$	5.280
1:75 000	1inch	75 000 in	$\frac{63\,360}{1} = \frac{75\,000}{x}$	1.1837121	6	$\frac{1.1837121}{1} = \frac{6}{y}$	5.068
1:96 000	1inch	96 000 in	$\frac{63\,360}{1} = \frac{96\,000}{x}$	1.5151515	7	$\frac{1.5151515}{1} = \frac{7}{y}$	4.620
1:100 000	1inch	100 000 in	$\frac{63\,360}{1} = \frac{100\,000}{x}$	1.5782828	9	$\frac{1.5782828}{1} = \frac{9}{y}$	5.702
1:125 000	1inch	125 000 in	$\frac{63\,360}{1} = \frac{125\,000}{x}$	1.9728535	12	$\frac{1.9728535}{1} = \frac{12}{y}$	6.082
1:150 000	1inch	150 000 in	$\frac{63\,360}{1} = \frac{150\,000}{x}$	2.3674242	12	$\frac{2.3674242}{1} = \frac{12}{y}$	5.068

To find miles per inch on 1: 12 000 map . . .

63,360 inches = 1 mile
Show in ratio as ...

$$\frac{63\,360}{1}\ \begin{matrix}\textit{inches}\\ \textit{miles}\end{matrix}$$

Let SCALE (12 000) be in inches
Fractional scale says 1 inch represents 12,000 in
Let **x** be miles that 1 inch represents on map
Show in ratio as ...

$$\frac{12\,000}{x}\ \begin{matrix}\textit{inches}\\ \textit{miles}\end{matrix}$$

Solution . . .

$$\frac{63\,360}{1} = \frac{12\,000}{x}$$

$$63\,360 \cdot x = 12\,000 \cdot 1$$
$$63\,360\,x = 12\,000$$
$$\frac{63\,360\,x}{63\,360} = \frac{12\,000}{63\,360}$$
$$x = \frac{12\,000}{63\,360}\ (\text{SCALE})$$
$$x = 0.1893939$$

35—BAR SCALES (continued)

BAR SCALE CALCULATIONS — MILES (1 mile = 63,360 inches)—continued

FRACTIONAL SCALE	SCALE TO MAP REPRESENTATION: Scale Unit	:	represents Map Unit	TO FIND MILES PER INCH (**x** in ratio) Use ratio below or SCALE / 63 360	MILES PER INCH	TOTAL MILES ON SCALE	TO FIND TOTAL SCALE LENGTH IN INCHES (**y** in ratio) Use ratio below or Miles on scale / Miles per inch	TOTAL SCALE LENGTH (INCHES)
1:250 000	1inch		250 000 in	$\frac{63\,360}{1} = \frac{250\,000}{\mathbf{x}}$	3.945707	25	$\frac{3.945707}{1} = \frac{25}{\mathbf{y}}$	6.336
1:400 000	1inch		400 000 in	$\frac{63\,360}{1} = \frac{400\,000}{\mathbf{x}}$	6.3131313	40	$\frac{6.3131313}{1} = \frac{40}{\mathbf{y}}$	6.336
1:500 000	1inch		500 000 in	$\frac{63\,360}{1} = \frac{500\,000}{\mathbf{x}}$	7.8914141	50	$\frac{7.8914141}{1} = \frac{50}{\mathbf{y}}$	6.336
1:750 000	1inch		750 000 in	$\frac{63\,360}{1} = \frac{750\,000}{\mathbf{x}}$	11.837121	60	$\frac{11.837121}{1} = \frac{60}{\mathbf{y}}$	5.068
1:1 000 000	1inch		1 000 000 in	$\frac{63\,360}{1} = \frac{1\,000\,000}{\mathbf{x}}$	15.782828	125	$\frac{15.782828}{1} = \frac{125}{\mathbf{y}}$	7.920
1:2 000 000	1inch		2 000 000 in	$\frac{63\,360}{1} = \frac{2\,000\,000}{\mathbf{x}}$	31.565656	250	$\frac{31.565656}{1} = \frac{250}{\mathbf{y}}$	7.920
1:2 500 000	1inch		2 500 000 in	$\frac{63\,360}{1} = \frac{2\,500\,000}{\mathbf{x}}$	39.45707	300	$\frac{39.45707}{1} = \frac{300}{\mathbf{y}}$	7.603
1:5 000 000	1inch		5 000 000 in	$\frac{63\,360}{1} = \frac{5\,000\,000}{\mathbf{x}}$	78.914141	600	$\frac{78.914141}{1} = \frac{600}{\mathbf{y}}$	7.603
1:7 500 000	1inch		7 500 000 in	$\frac{63\,360}{1} = \frac{7\,500\,000}{\mathbf{x}}$	118.37121	600	$\frac{118.37121}{1} = \frac{600}{\mathbf{y}}$	5.068
1:10 000 000	1inch		10 000 000 in	$\frac{63\,360}{1} = \frac{10\,000\,000}{\mathbf{x}}$	157.82828	1100	$\frac{157.82828}{1} = \frac{1100}{\mathbf{y}}$	6.969

To find miles per inch on 1: 250 000 map . . .

63,360 inches = 1 mile
Show in ratio as ...

$$\frac{63\,360 \text{ inches}}{1 \text{ miles}}$$

Let SCALE (250 000) be in inches
Fractional scale says 1 inch represents 250,000 in
Let **x** be miles that 1 inch represents on map
Show in ratio as ...

$$\frac{250\,000 \text{ inches}}{\mathbf{x} \text{ miles}}$$

Solution . . .

$$\frac{63\,360}{1} = \frac{250\,000}{\mathbf{x}}$$

$$63\,360 \cdot \mathbf{x} = 250\,000 \cdot 1$$

$$63\,360\,\mathbf{x} = 250\,000$$

$$\frac{63\,360\,\mathbf{x}}{63\,360} = \frac{250\,000}{63\,360}$$

$$\mathbf{x} = \frac{250\,000}{63\,360} \text{ (SCALE)}$$

$$\mathbf{x} = 3.945707$$

35—BAR SCALES (continued)

BAR SCALE CALCULATIONS — FEET (1 foot = 12 inches)

FRACTIONAL SCALE	SCALE TO MAP REPRESENTATION: Scale Unit :	represents Map Unit	TO FIND FEET PER INCH (**x** in ratio) Use ratio below or SCALE / 12	FEET PER INCH	TOTAL FEET ON SCALE	TO FIND TOTAL SCALE LENGTH IN INCHES (**y** in ratio) Use ratio below or Feet on scale / Feet per inch	TOTAL SCALE LENGTH (INCHES)
1:12 000	1inch	12 000 in	12 / 1 = 12 000 / **x**	1000.000	6000	1000.000 / 1 = 6000 / **y**	6.000
1:20 000	1inch	20 000 in	12 / 1 = 20 000 / **x**	1666.6666	8000	1666.6666 / 1 = 8000 / **y**	4.800
1:24 000	1inch	24 000 in	12 / 1 = 24 000 / **x**	2000.000	8000	2000.000 / 1 = 8000 / **y**	4.000
1:25 000	1inch	25 000 in	12 / 1 = 25 000 / **x**	2083.3333	8000	2083.3333 / 1 = 8000 / **y**	3.840
1:31 250	1inch	31 250 in	12 / 1 = 31 250 / **x**	2604.1666	8000	2604.1666 / 1 = 8000 / **y**	3.072
1:31 680	1inch	31 680 in	12 / 1 = 31 680 / **x**	2640.000	8000	2640.000 / 1 = 8000 / **y**	3.030
1:48 000	1inch	48 000 in	12 / 1 = 48 000 / **x**	4000.000	24 000	4000.000 / 1 = 24 000 / **y**	6.000
1:50 000	1inch	50 000 in	12 / 1 = 50 000 / **x**	4166.6666	24 000	4166.6666 / 1 = 24 000 / **y**	5.760
1:62 500	1inch	62 500 in	12 / 1 = 62 500 / **x**	5208.3333	30 000	5208.3333 / 1 = 30 000 / **y**	5.760
1:63 360	1inch	63 360 in	12 / 1 = 63 360 / **x**	5280.000	30 000	5280.000 / 1 = 30 000 / **y**	5.681
1:72 000	1inch	72 000 in	12 / 1 = 72 000 / **x**	6000.000	30 000	6000.000 / 1 = 30 000 / **y**	5.000
1:75 000	1inch	75 000 in	12 / 1 = 75 000 / **x**	6250.000	30 000	6250.000 / 1 = 30 000 / **y**	4.800
1:96 000	1inch	96 000 in	12 / 1 = 96 000 / **x**	8000.000	33 000	8000.000 / 1 = 33 000 / **y**	4.125

To find feet per inch on 1: 12 000 map . . .

12 inches = 1 foot
Show in ratio as ... 12 / 1 *inches / feet*

Let SCALE (12 000) be in inches
Fractional scale says 1 inch represents 12,000 inches
Let **x** be feet that 1 inch represents on map
Show in ratio as ... 12 000 / **x** *inches / feet*

Solution . . .

$\frac{12}{1} = \frac{12\,000}{\mathbf{x}}$

$12 \cdot \mathbf{x} = 12\,000 \cdot 1$

$12\,\mathbf{x} = 12\,000$

$\frac{12\,\mathbf{x}}{12} = \frac{12\,000}{12}$

$\mathbf{x} = \frac{12\,000}{12}$ (SCALE)

$\mathbf{x} = 1000.00$

35—BAR SCALES (continued)

BAR SCALE CALCULATIONS — KILOMETERS (1 kilometer = 100,000 centimeters)

FRACTIONAL SCALE	SCALE TO MAP REPRESENTATION: Scale Unit :	SCALE TO MAP REPRESENTATION: represents Map Unit	TO FIND KILOMETERS PER CENTIMETER (CM) (**x** in ratio) Use ratio below or SCALE / 100 000	KILOMETERS PER CM	TOTAL KILOMETERS ON SCALE	TO FIND TOTAL SCALE LENGTH IN CENTIMETERS (**y** in ratio) Use ratio below or Kilometers on scale / Kilometers per cm	TOTAL SCALE LENGTH IN: CENTIMETERS	TOTAL SCALE LENGTH IN: MILLIMETERS
1:12 000	1cm	12 000 cm	$\frac{100\,000}{1} = \frac{12\,000}{\mathbf{x}}$	0.120	1.5	$\frac{0.120}{1} = \frac{1.5}{\mathbf{y}}$	12.500	125.00
1:20 000	1cm	20 000 cm	$\frac{100\,000}{1} = \frac{20\,000}{\mathbf{x}}$	0.200	2	$\frac{0.200}{1} = \frac{2}{\mathbf{y}}$	10.000	100.00
1:24 000	1cm	24 000 cm	$\frac{100\,000}{1} = \frac{24\,000}{\mathbf{x}}$	0.240	2	$\frac{0.240}{1} = \frac{2}{\mathbf{y}}$	8.333	83.33
1:25 000	1cm	25 000 cm	$\frac{100\,000}{1} = \frac{25\,000}{\mathbf{x}}$	0.250	2	$\frac{0.250}{1} = \frac{2}{\mathbf{y}}$	8.000	80.00
1:31 250	1cm	31 250 cm	$\frac{100\,000}{1} = \frac{31\,250}{\mathbf{x}}$	0.3125	2	$\frac{0.3125}{1} = \frac{2}{\mathbf{y}}$	6.400	64.00
1:31 680	1cm	31 680 cm	$\frac{100\,000}{1} = \frac{31\,680}{\mathbf{x}}$	0.3168	2	$\frac{0.3168}{1} = \frac{2}{\mathbf{y}}$	6.313	63.13
1:48 000	1cm	48 000 cm	$\frac{100\,000}{1} = \frac{48\,000}{\mathbf{x}}$	0.480	6	$\frac{0.480}{1} = \frac{6}{\mathbf{y}}$	12.500	125.00
1:50 000	1cm	50 000 cm	$\frac{100\,000}{1} = \frac{50\,000}{\mathbf{x}}$	0.500	6	$\frac{0.500}{1} = \frac{6}{\mathbf{y}}$	12.000	120.00
1:62 500	1cm	62 500 cm	$\frac{100\,000}{1} = \frac{62\,500}{\mathbf{x}}$	0.625	8	$\frac{0.625}{1} = \frac{8}{\mathbf{y}}$	12.800	128.00
1:63 360	1cm	63 360 cm	$\frac{100\,000}{1} = \frac{63\,360}{\mathbf{x}}$	0.6336	8	$\frac{0.6336}{1} = \frac{8}{\mathbf{y}}$	12.626	126.26
1:72 000	1cm	72 000 cm	$\frac{100\,000}{1} = \frac{72\,000}{\mathbf{x}}$	0.720	8	$\frac{0.720}{1} = \frac{8}{\mathbf{y}}$	11.111	111.11
1:75 000	1cm	75 000 cm	$\frac{100\,000}{1} = \frac{75\,000}{\mathbf{x}}$	0.750	8	$\frac{0.750}{1} = \frac{8}{\mathbf{y}}$	10.666	106.66
1:96 000	1cm	96 000 cm	$\frac{100\,000}{1} = \frac{96\,000}{\mathbf{x}}$	0.960	9	$\frac{0.960}{1} = \frac{9}{\mathbf{y}}$	9.375	93.75
1:100 000	1cm	100 000 cm	$\frac{100\,000}{1} = \frac{100\,000}{\mathbf{x}}$	1.000	11	$\frac{1.000}{1} = \frac{11}{\mathbf{y}}$	11.000	110.00
1:125 000	1cm	125 000 cm	$\frac{100\,000}{1} = \frac{125\,000}{\mathbf{x}}$	1.250	12	$\frac{1.250}{1} = \frac{12}{\mathbf{y}}$	9.600	96.00
1:150 000	1cm	150 000 cm	$\frac{100\,000}{1} = \frac{150\,000}{\mathbf{x}}$	1.500	12	$\frac{1.500}{1} = \frac{12}{\mathbf{y}}$	8.000	80.00

To find kilometers per centimeter on 1: 12 000 map . . .

100 000 centimeters = 1 kilometer
Show in ratio as ...

$$\frac{100\,000}{1}\ \begin{matrix}\textit{centimeters}\\ \textit{kilometers}\end{matrix}$$

Let SCALE (12 000) be in centimeters
Fractional scale says 1 centimeter represents 12,000 centimeters
Let **x** be kilometers that 1 cm represents on map
Show in ratio as ...

$$\frac{12\,000}{\mathbf{x}}\ \begin{matrix}\textit{centimeters}\\ \textit{kilometers}\end{matrix}$$

Solution . . .

$$\frac{100\,000}{1} = \frac{12\,000}{\mathbf{x}}$$

$$100\,000 \cdot \mathbf{x} = 12\,000 \cdot 1$$

$$100\,000\,\mathbf{x} = 12\,000$$

$$\frac{100\,000\,\mathbf{x}}{100\,000} = \frac{12\,000}{100\,000}$$

$$\mathbf{x} = \frac{12\,000\ (\text{SCALE})}{100\,000}$$

$$\mathbf{x} = 0.120$$

35—BAR SCALES (continued)

BAR SCALE CALCULATIONS — KILOMETERS (1 kilometer = 100,000 centimeters)—continued

FRACTIONAL SCALE	SCALE TO MAP REPRESENTATION		TO FIND KILOMETERS PER CENTIMETER (CM) (**x** in ratio) Use ratio below or SCALE / 100 000	KILO-METERS PER CM	TOTAL KILOMETERS ON SCALE	TO FIND TOTAL SCALE LENGTH IN CENTIMETERS (**y** in ratio) Use ratio below or Kilometers on scale / Kilometers per cm	TOTAL SCALE LENGTH IN	
	Scale Unit :	represents Map Unit					CENTI-METERS	MILLI-METERS
1:250 000	1cm	250 000 cm	100 000 / 1 = 250 000 / **x**	2.500	30	2.500 / 1 = 30 / **y**	12.000	120.00
1:400 000	1cm	400 000 cm	100 000 / 1 = 400 000 / **x**	4.000	60	4.000 / 1 = 60 / **y**	15.000	150.00
1:500 000	1cm	500 000 cm	100 000 / 1 = 500 000 / **x**	5.000	60	5.000 / 1 = 60 / **y**	12.000	120.00
1:750 000	1cm	750 000 cm	100 000 / 1 = 750 000 / **x**	7.500	60	7.500 / 1 = 60 / **y**	8.000	80.00
1:1 000 000	1cm	1 000 000 cm	100 000 / 1 = 1 000 000 / **x**	10.000	125	10.000 / 1 = 125 / **y**	12.500	125.00
1:2 000 000	1cm	2 000 000 cm	100 000 / 1 = 2 000 000 / **x**	20.000	300	20.000 / 1 = 300 / **y**	15.000	150.00
1:2 500 000	1cm	2 500 000 cm	100 000 / 1 = 2 500 000 / **x**	25.000	400	25.000 / 1 = 400 / **y**	16.000	160.00
1:5 000 000	1cm	5 000 000 cm	100 000 / 1 = 5 000 000 / **x**	50.000	800	50.000 / 1 = 800 / **y**	16.000	160.00
1:7 500 000	1cm	7 500 000 cm	100 000 / 1 = 7 500 000 / **x**	75.000	800	75.000 / 1 = 800 / **y**	10.666	106.66
1:10 000 000	1cm	10 000 000 cm	100 000 / 1 = 10 000 000 / **x**	100.000	1500	100.000 / 1 = 1500 / **y**	15.000	150.00

To find kilometers per centimeter on 1: 250 000 map . . .

100 000 centimeters = 1 kilometer
Show in ratio as ...

$$\frac{100\,000}{1}\ \frac{\textit{centimeters}}{\textit{kilometers}}$$

Let SCALE (250 000) be in centimeters
Fractional scale says 1 centimeter represents 250,000 centimeters
Let **x** be kilometers that 1 cm represents on map
Show in ratio as ...

$$\frac{250\,000}{\mathbf{x}}\ \frac{\textit{centimeters}}{\textit{kilometers}}$$

Solution . . .

$$\frac{100\,000}{1} = \frac{250\,000}{\mathbf{x}}$$

$$100\,000 \cdot \mathbf{x} = 250\,000 \cdot 1$$

$$100\,000\,\mathbf{x} = 250\,000$$

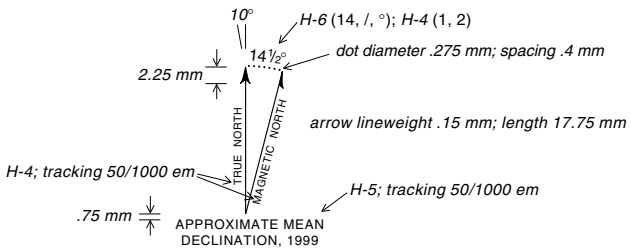
$$\frac{100\,000\,\mathbf{x}}{100\,000} = \frac{250\,000}{100\,000}$$

$$\mathbf{x} = \frac{250\,000}{100\,000}\ \text{(SCALE)}$$

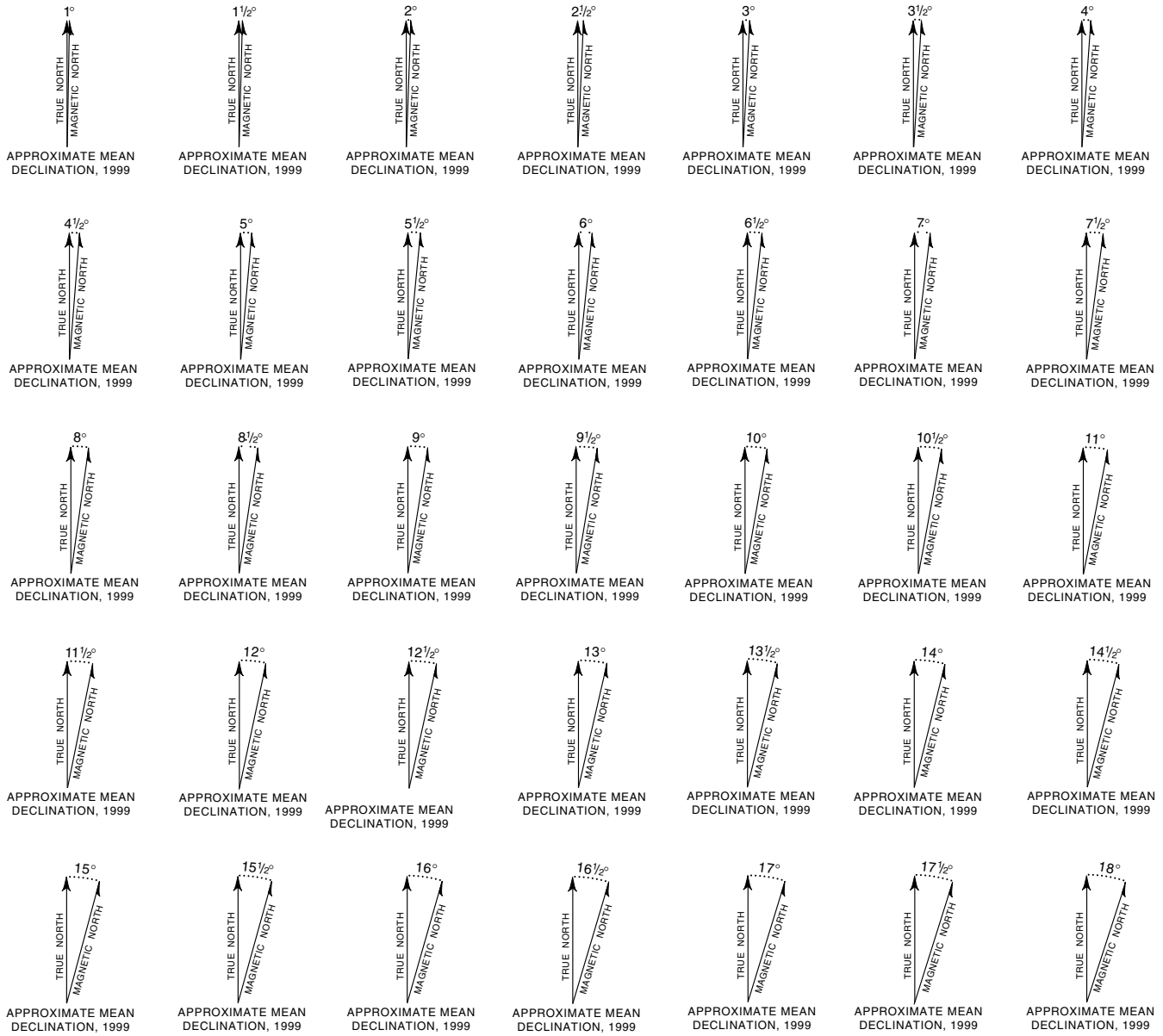
$$\mathbf{x} = 2.5$$

36—MEAN DECLINATION ARROWS

CARTOGRAPHIC SPECIFICATIONS



36.1—Magnetic north, east of true north



36—MEAN DECLINATION ARROWS (continued)

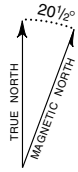
36.1—Magnetic north, east of true north (continued)

APPROXIMATE MEAN DECLINATION, 1999

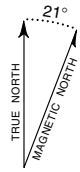
APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

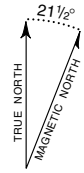
APPROXIMATE MEAN DECLINATION, 1999



APPROXIMATE MEAN DECLINATION, 1999

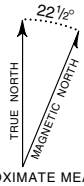


APPROXIMATE MEAN DECLINATION, 1999



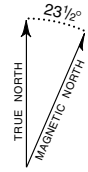
APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999



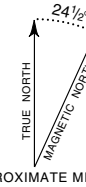
APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999



APPROXIMATE MEAN DECLINATION, 1999

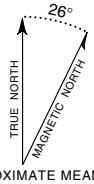
APPROXIMATE MEAN DECLINATION, 1999



APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999



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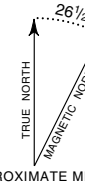
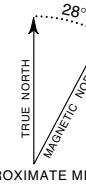


APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 2000

APPROXIMATE MEAN DECLINATION, 1999

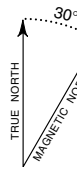


APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

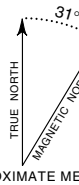
APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999



APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 2000



APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

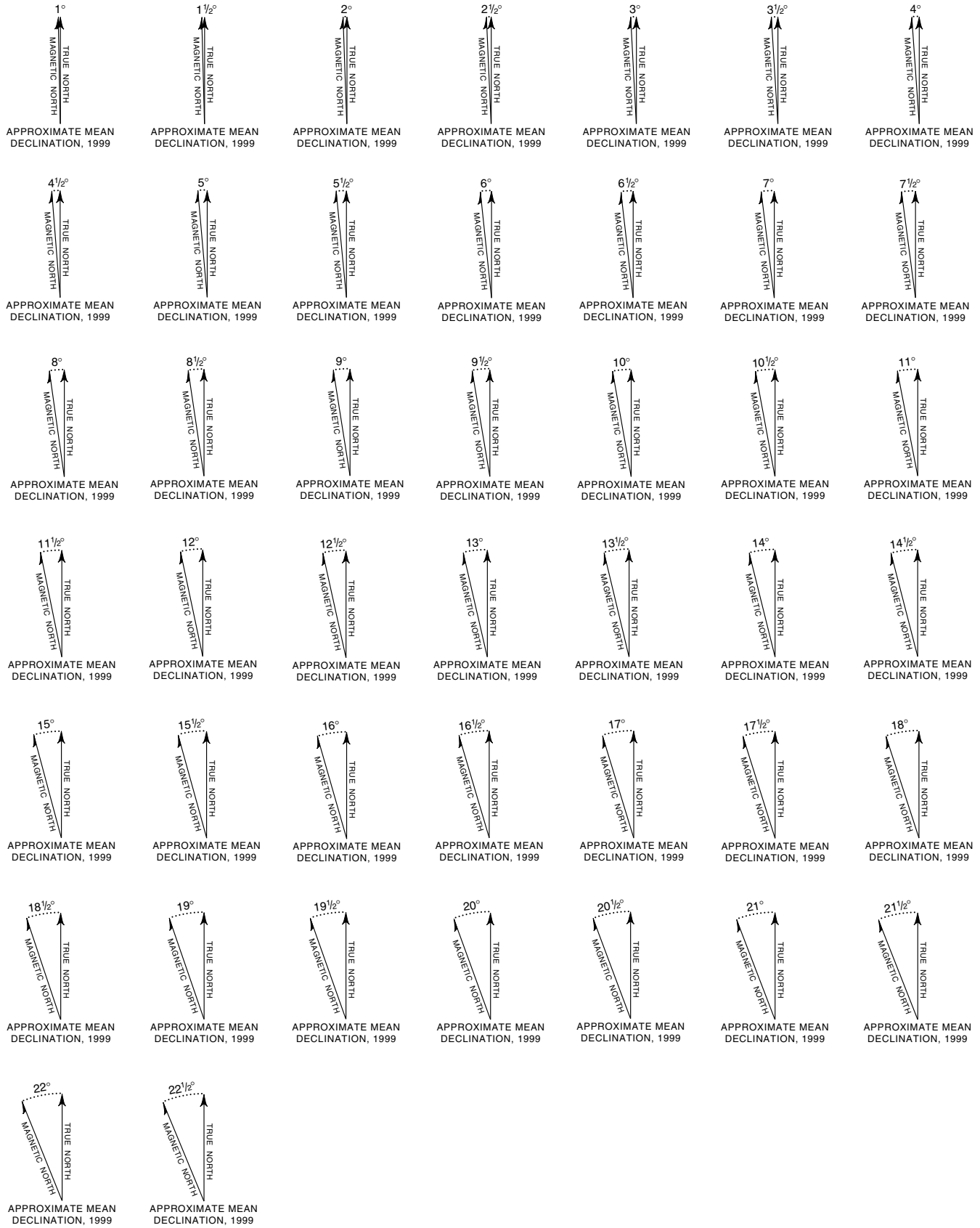
APPROXIMATE MEAN DECLINATION, 1999

APPROXIMATE MEAN DECLINATION, 1999

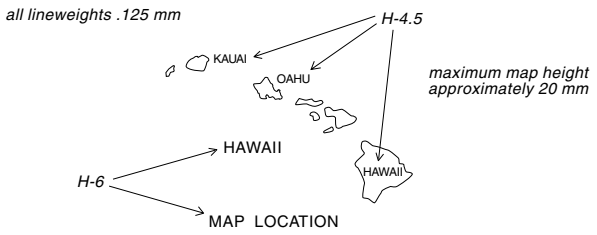
APPROXIMATE MEAN DECLINATION, 1999

36—MEAN DECLINATION ARROWS (continued)

36.2—Magnetic north, west of true north



37—QUADRANGLE LOCATION MAPS

CARTOGRAPHIC SPECIFICATIONS	NOTES ON USAGE
	Location maps are at various scales; projection is Albers Equal-Area, based on parallels 29 1/2° and 45 1/2°. Maps are modified from the United States Base Map (U.S. Geological Survey, 1965, scale 1:3,168,000) and the Digital Shaded-Relief Image of Alaska (J.R. Riehle and others, 1997, U.S. Geological Survey Miscellaneous Investigations Map I-2585, scale 1:2,500,000; see fig. 2, approximate scale 1:8,000,000). To show a quadrangle or map area location, place a small black-filled rectangle (■) to show actual size and location within state. Adjust shape accordingly. If a quadrangle or map area is in two or more states, show all states. Create a new location map that shows all states at the same scale (extract from location map of 48 conterminous states, Section 37.2). Resize new location map so that its height is approximately 20 mm.

37.1—Individual states; District of Columbia; Guam; Puerto Rico; U.S. Virgin Islands

37—QUADRANGLE LOCATION MAPS (continued)

37.1—Individual states; District of Columbia; Guam; Puerto Rico; U.S. Virgin Islands (continued)

37—QUADRANGLE LOCATION MAPS (continued)

37.2—Conterminous states

38—GEOLOGIC AGE SYMBOL FONT (StratagemAge)

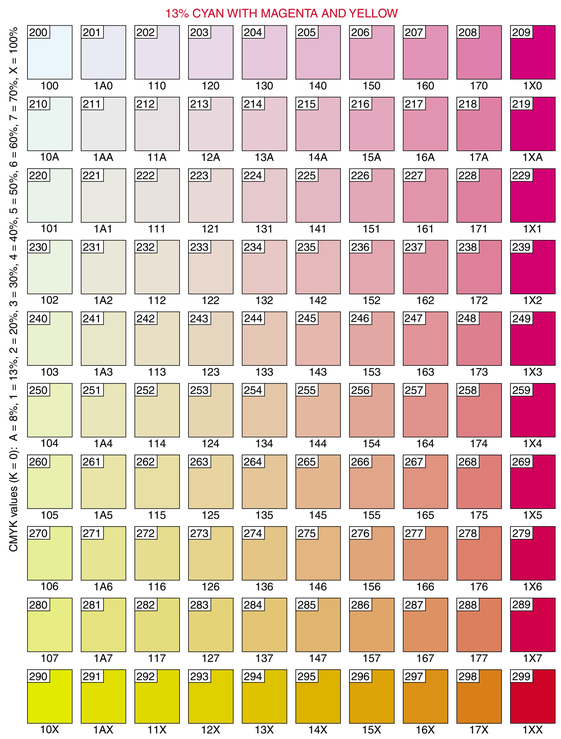
REF NO	STRATIGRAPHIC AGE	SUBDIVISION TYPE	AGE SYMBOL	KEYBOARD POSITION FOR StratagemAge FONT
38.1	Archean	Eon	A	Not applicable (use Helvetica instead)
38.2	Cambrian	Period	€	_ (underscore = shift-hyphen)
38.3	Carboniferous	Period	C	Not applicable (use Helvetica instead)
38.4	Cenozoic	Era	Cz	{ (left curly bracket = shift-left square bracket)
38.5	Cretaceous	Period	K	Not applicable (use Helvetica instead)
38.6	Devonian	Period	D	Not applicable (use Helvetica instead)
38.7	Early Archean (3,800(?)–3,400 Ma)	Era	U	Not applicable (use Helvetica instead)
38.8	Early Early Proterozoic (2,500–2,100 Ma)	Era	X^1	R (capital R = shift-r)
38.9	Early Middle Proterozoic (1,600–1,400 Ma)	Era	Y^1	G (capital G = shift-g)
38.10	Early Proterozoic	Era	X	Not applicable (use Helvetica instead)
38.11	Eocene	Epoch	Eo	# (pound sign = shift-3)
38.12	Holocene	Epoch	H	Not applicable (use Helvetica instead)
38.13	Jurassic	Period	J	Not applicable (use Helvetica instead)
38.14	Late Archean (3,000–2,500 Ma)	Era	W	Not applicable (use Helvetica instead)
38.15	Late Early Proterozoic (1,800–1,600 Ma)	Era	X^3	I (capital I = shift-i)
38.16	Late Middle Proterozoic (1,200–900 Ma)	Era	Y^3	E (capital E = shift-e)
38.17	Late Proterozoic	Era	Z	Not applicable (use Helvetica instead)
38.18	Mesozoic	Era	Mz	} (right curly bracket = shift-right square bracket)
38.19	Middle Archean (3,400–3,000 Ma)	Era	V	Not applicable (use Helvetica instead)
38.20	Middle Early Proterozoic (2,100–1,800 Ma)	Era	X^2	L (capital L = shift-l)
38.21	Middle Middle Proterozoic (1,400–1,200 Ma)	Era	Y^2	F (capital F = shift-f)
38.22	Middle Proterozoic	Era	Y	Not applicable (use Helvetica instead)

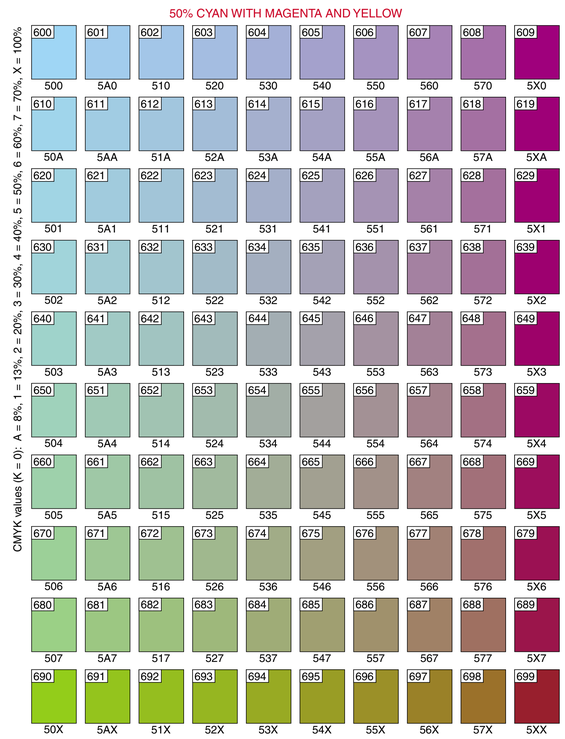
38—GEOLOGIC AGE SYMBOL FONT (StratagemAge) (continued)

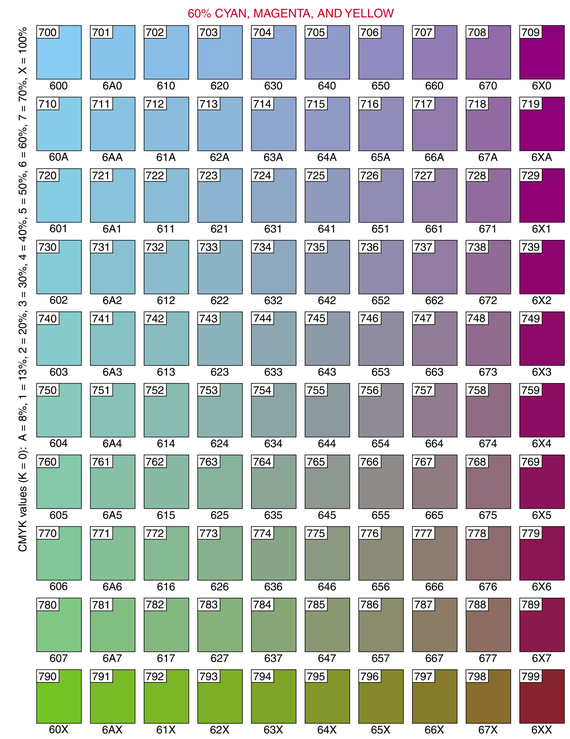
REF NO	STRATIGRAPHIC AGE	SUBDIVISION TYPE	AGE SYMBOL	KEYBOARD POSITION FOR StratagemAge FONT
38.23	Miocene	Epoch	M_{II}	! (exclamation point = shift-1)
38.24	Mississippian	Period	M	Not applicable (use Helvetica instead)
38.25	Neogene	Subperiod	N	Not applicable (use Helvetica instead)
38.26	Oligocene	Epoch	O_G	@ ("at" sign = shift-2)
38.27	Ordovician	Period	O	Not applicable (use Helvetica instead)
38.28	Paleocene	Epoch	P_E	$ (dollar sign = shift-4)
38.29	Paleogene	Subperiod	P_G	/ (slash)
38.30	Paleozoic	Era	P_Z	| (vertical line = shift-backslash)
38.31	Pennsylvanian	Period	IP	& (ampersand = shift-7)
38.32	Permian	Period	P	Not applicable (use Helvetica instead)
38.33	Phanerozoic	Eon	P_H	: (colon = shift-semicolon)
38.34	Pleistocene	Epoch	P_S	` (accent grave)
38.35	Pliocene	Epoch	P_O	~ (tilde = shift-accent grave)
38.36	pre-Archean (>3,800(?) Ma)	Eon	pA	> ("greater than" sign = shift-period)
38.37	Precambrian	Era	pC	= (equal sign)
38.38	Proterozoic	Eon	P	< ("less than" sign = shift-comma)
38.39	Quaternary	Period	Q	Not applicable (use Helvetica instead)
38.40	Silurian	Period	S	Not applicable (use Helvetica instead)
38.41	Tertiary	Period	T	Not applicable (use Helvetica instead)
38.42	Triassic	Period	T_R	^ (caret = shift-6)

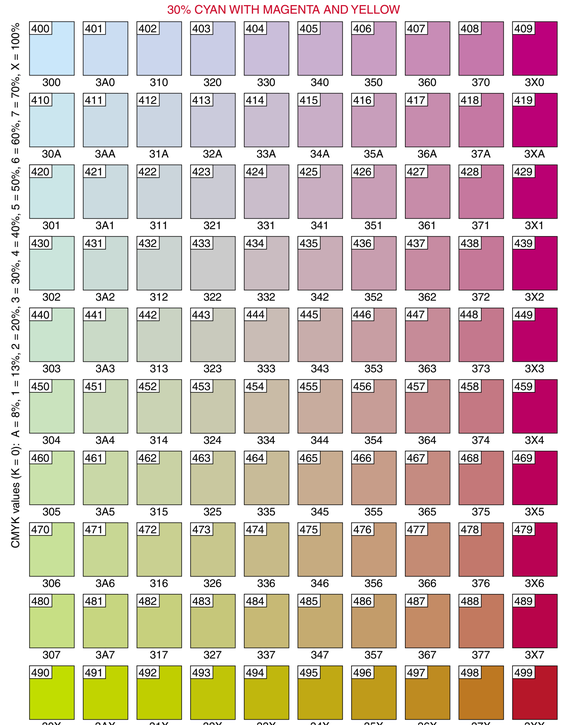
CMYK Color Chart

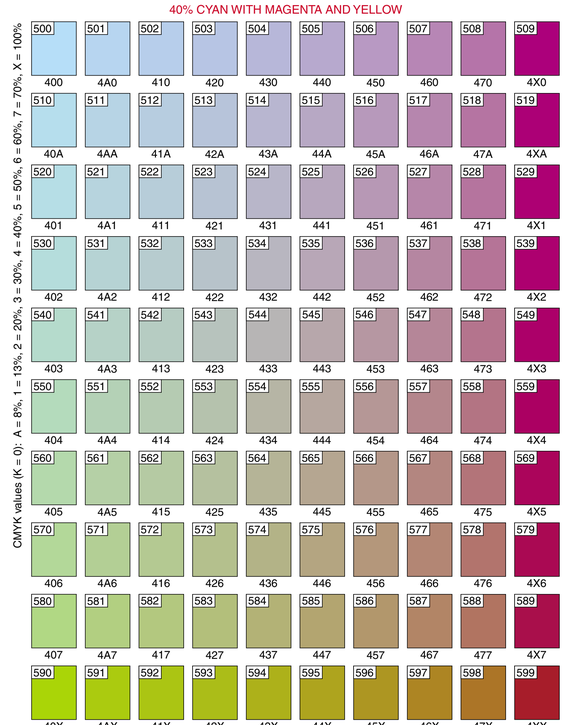
[CMYK (K = 0) value below color box; lookup table symbol number in upper left-hand corner of color box]

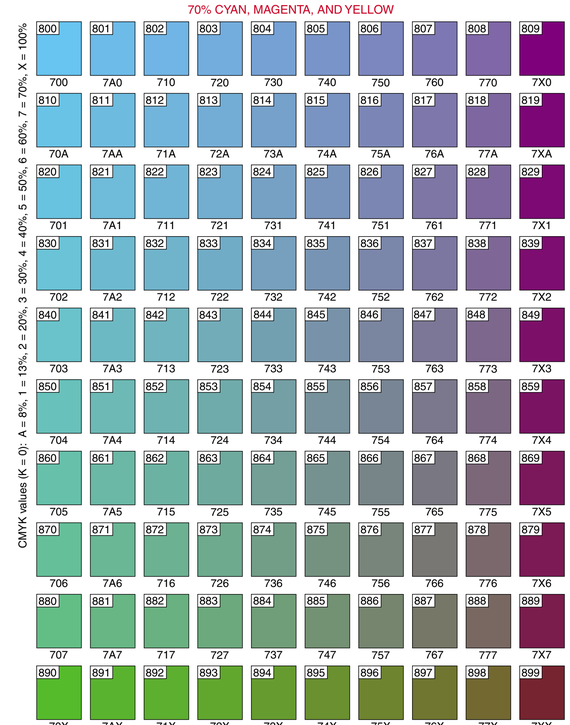


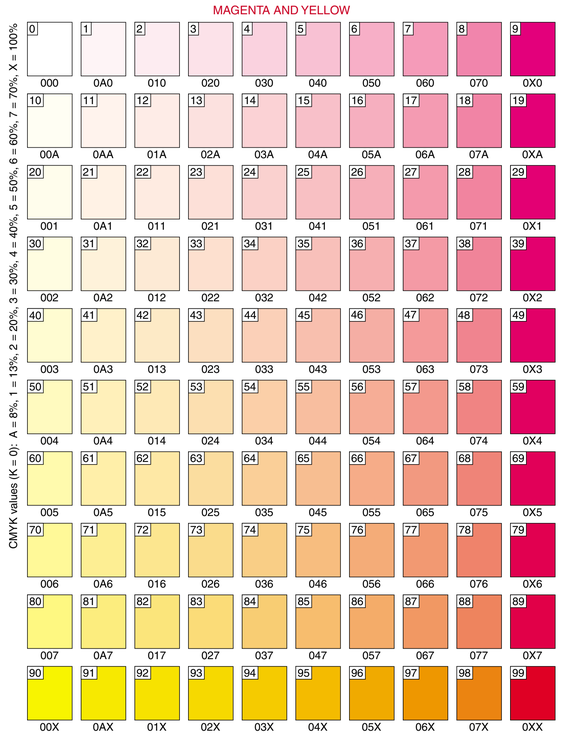


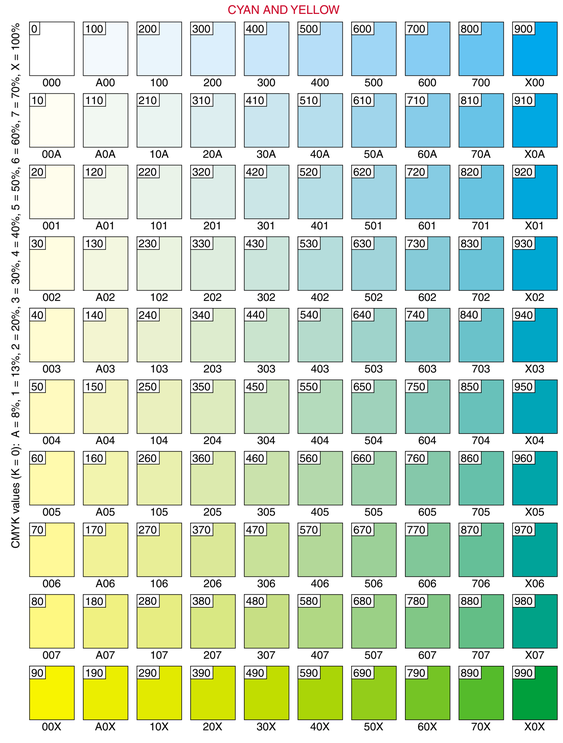


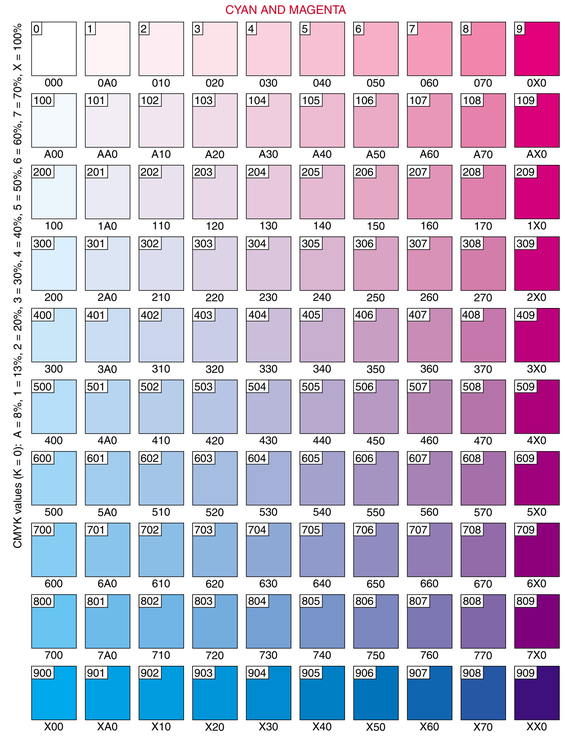


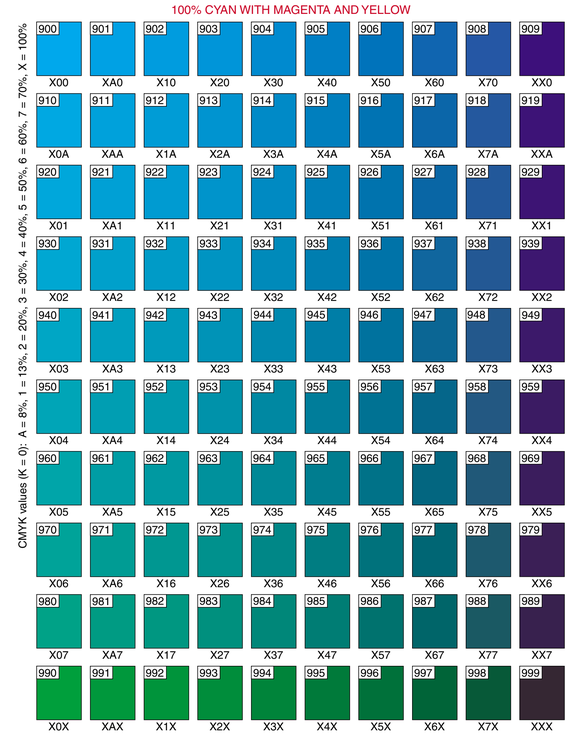








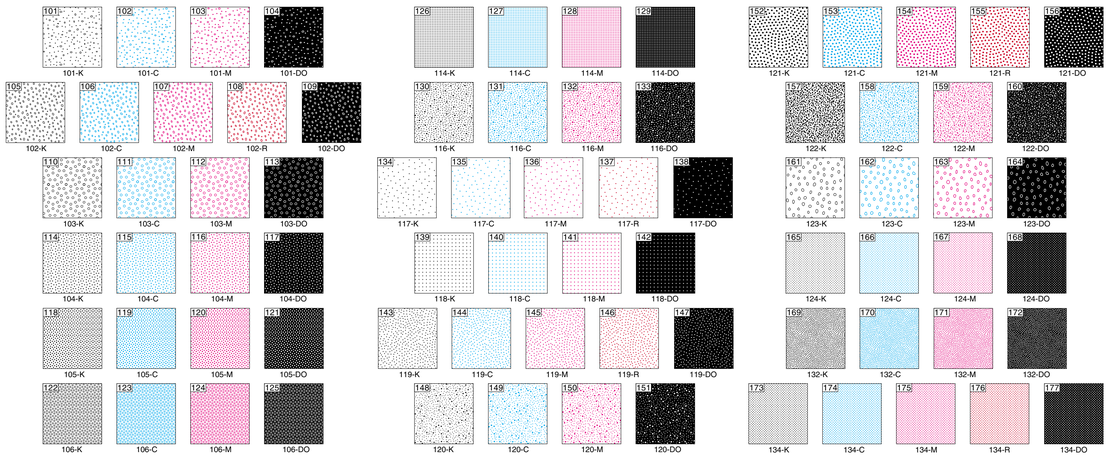




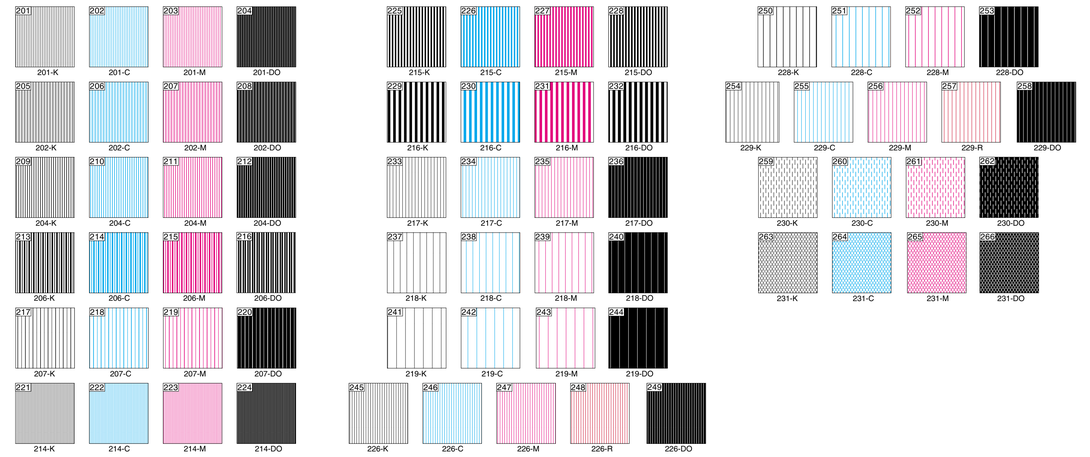
Pattern Chart

[Pattern number below pattern box; lookup table symbol number in upper left-hand corner of color box]

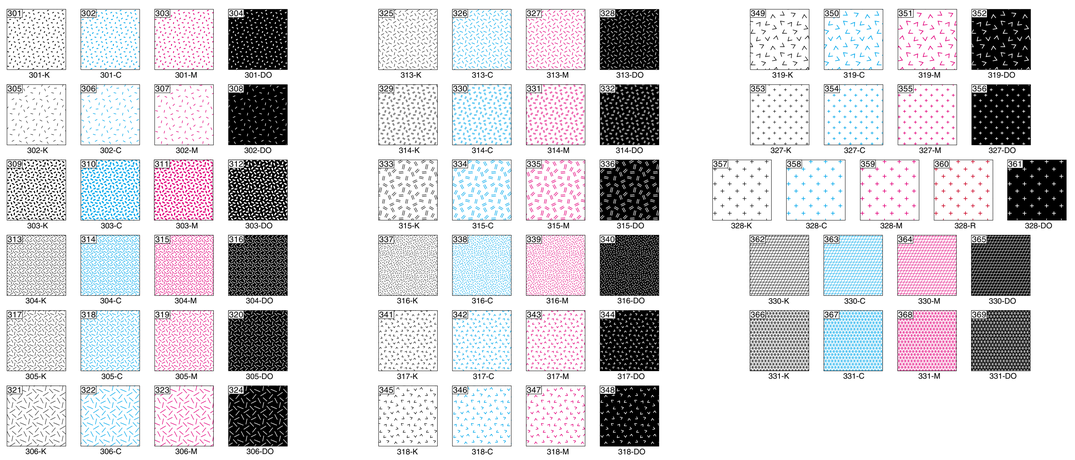
SURFICIAL PATTERNS (Series 100)



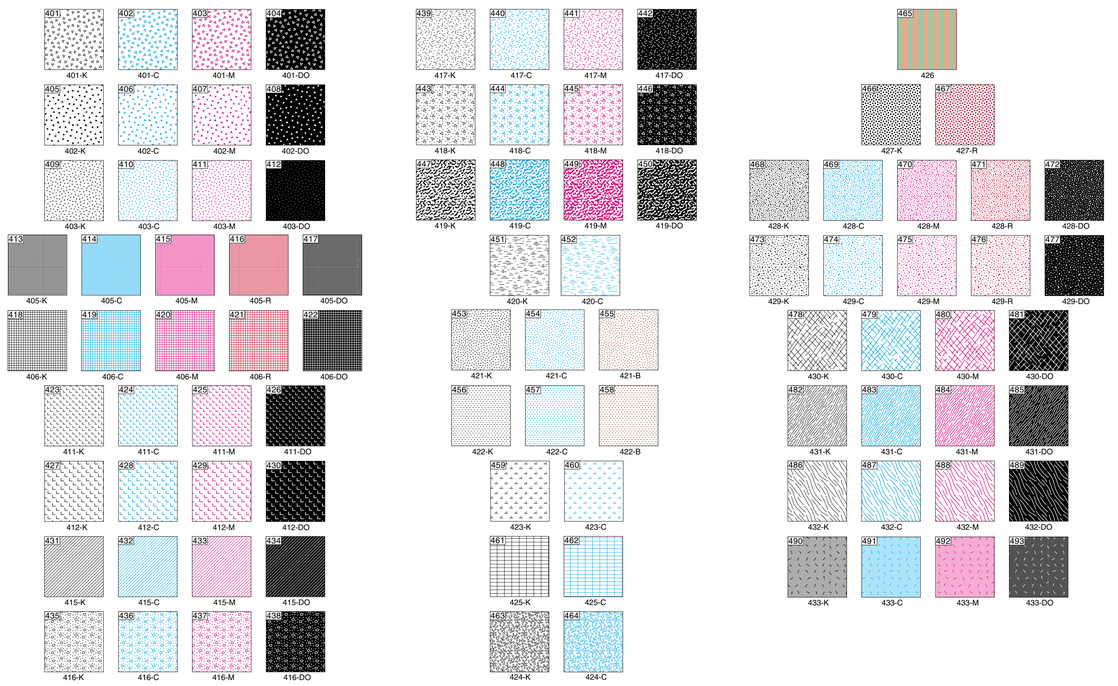
SEDIMENTARY PATTERNS (Series 200)



IGNEOUS PATTERNS (Series 300)

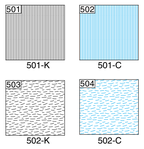


MISCELLANEOUS AND METAMORPHIC PATTERNS (Series 400)

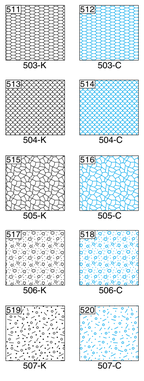


GLACIAL AND PERIGLACIAL PATTERNS (Series 500)

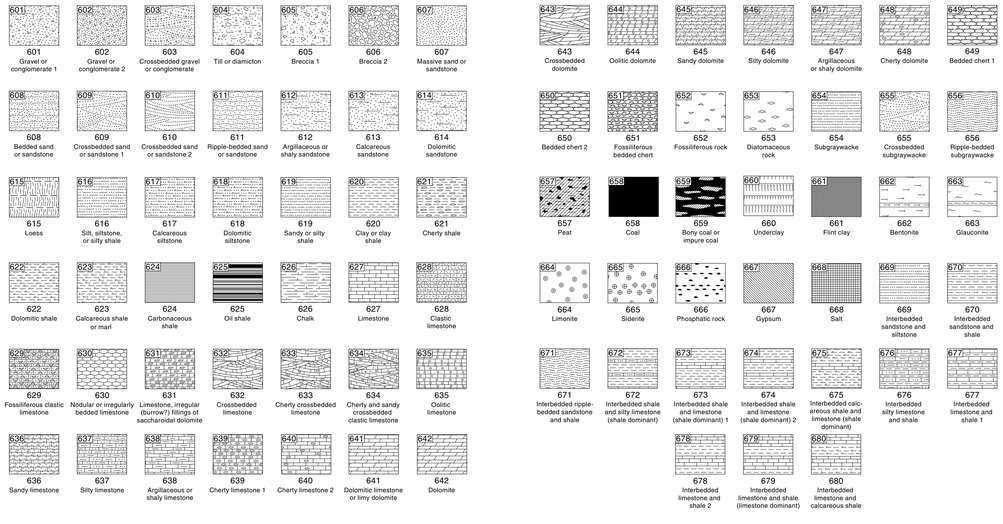
Glacial patterns (501–502)



Periglacial patterns (503–507)

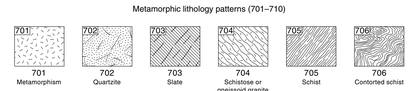


SEDIMENTARY LITHOLOGY PATTERNS (Series 600)

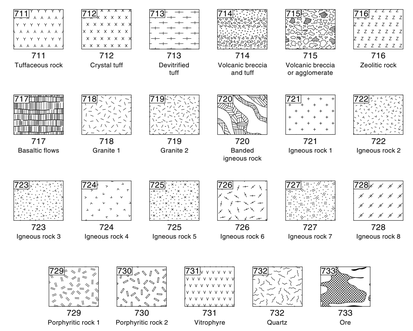


METAMORPHIC, IGNEOUS, AND VEIN-MATTER LITHOLOGY PATTERNS (Series 700)

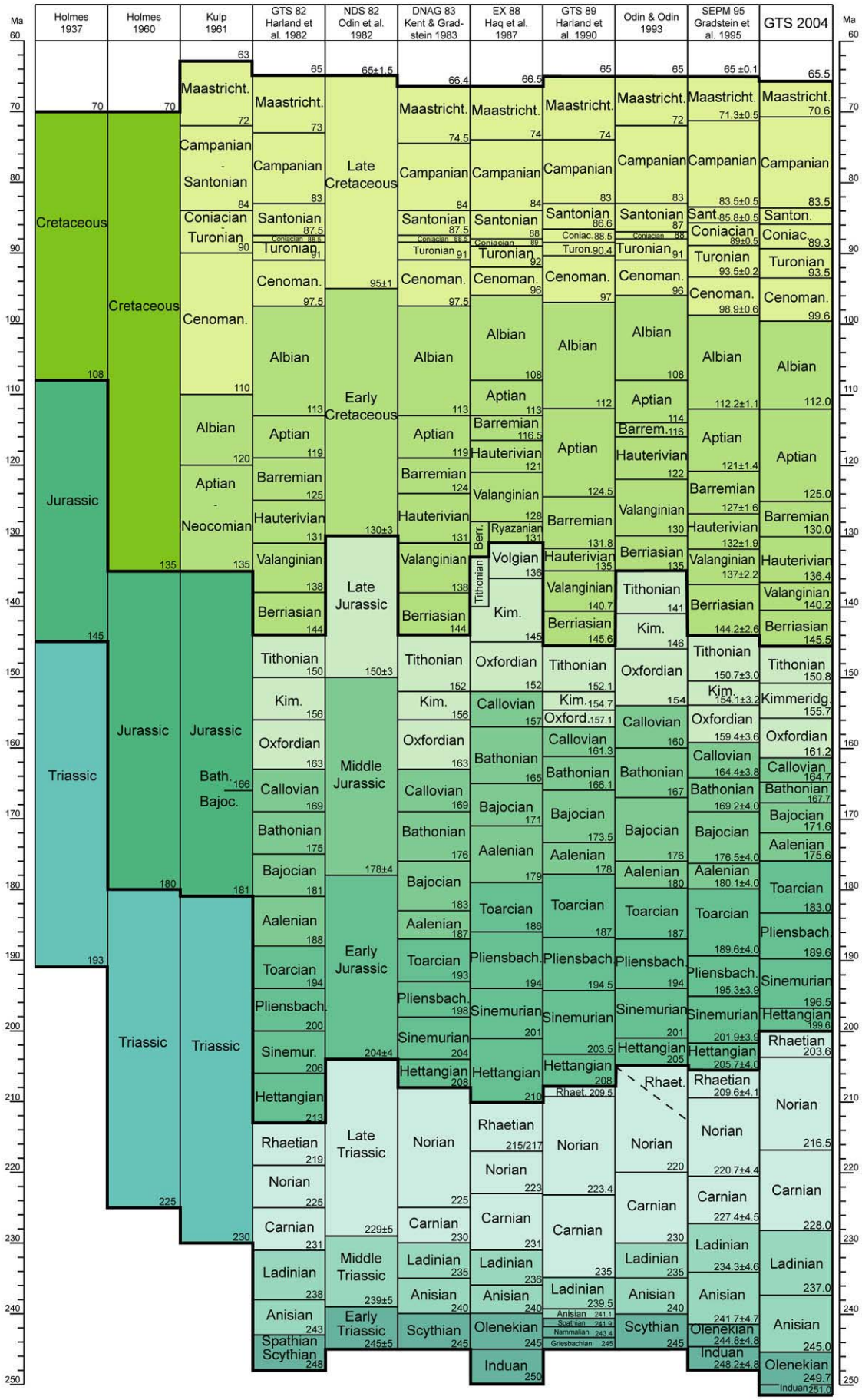
Metamorphic lithology patterns (701–710)



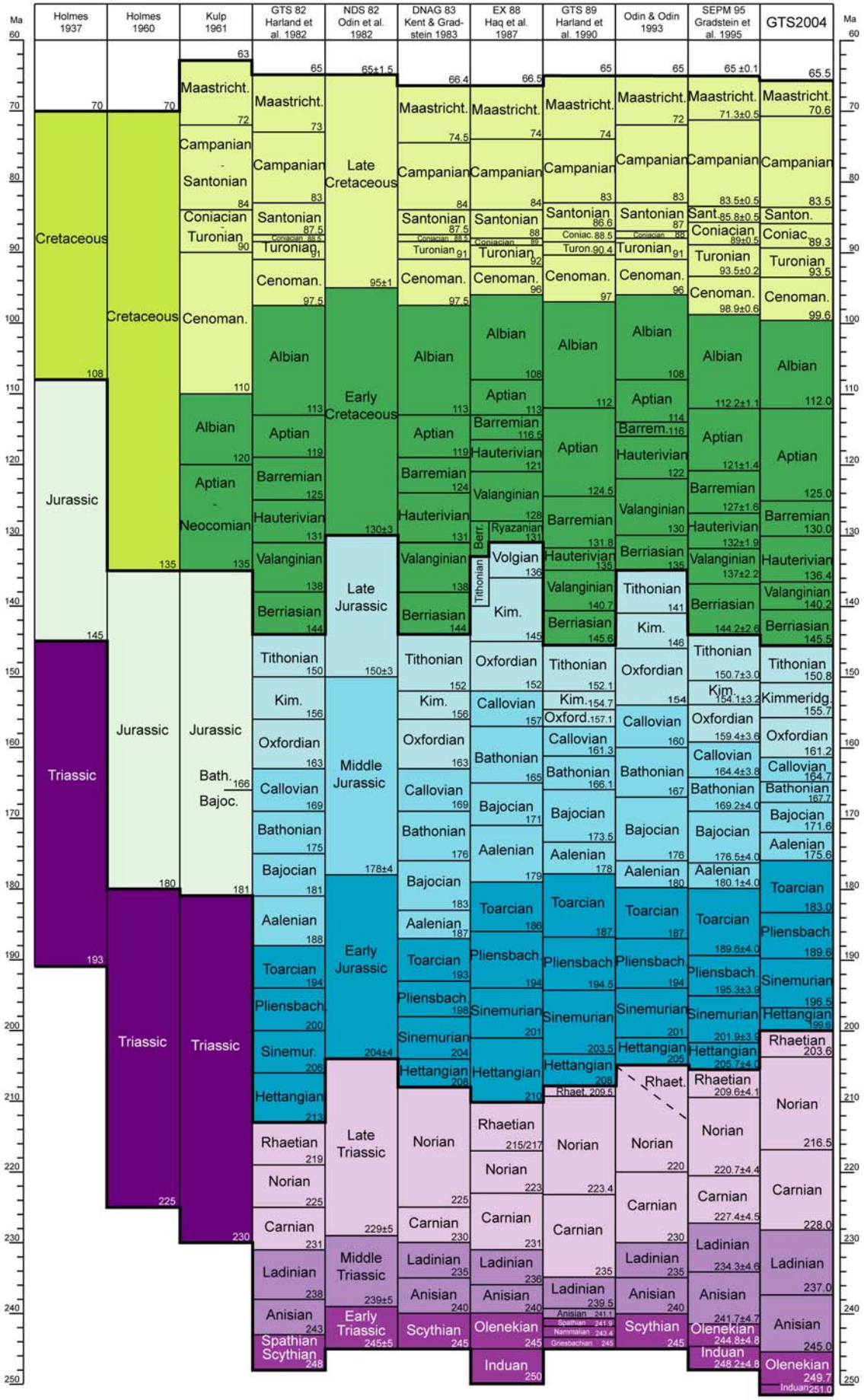
Igneous and vein-matter lithology patterns (711–33)



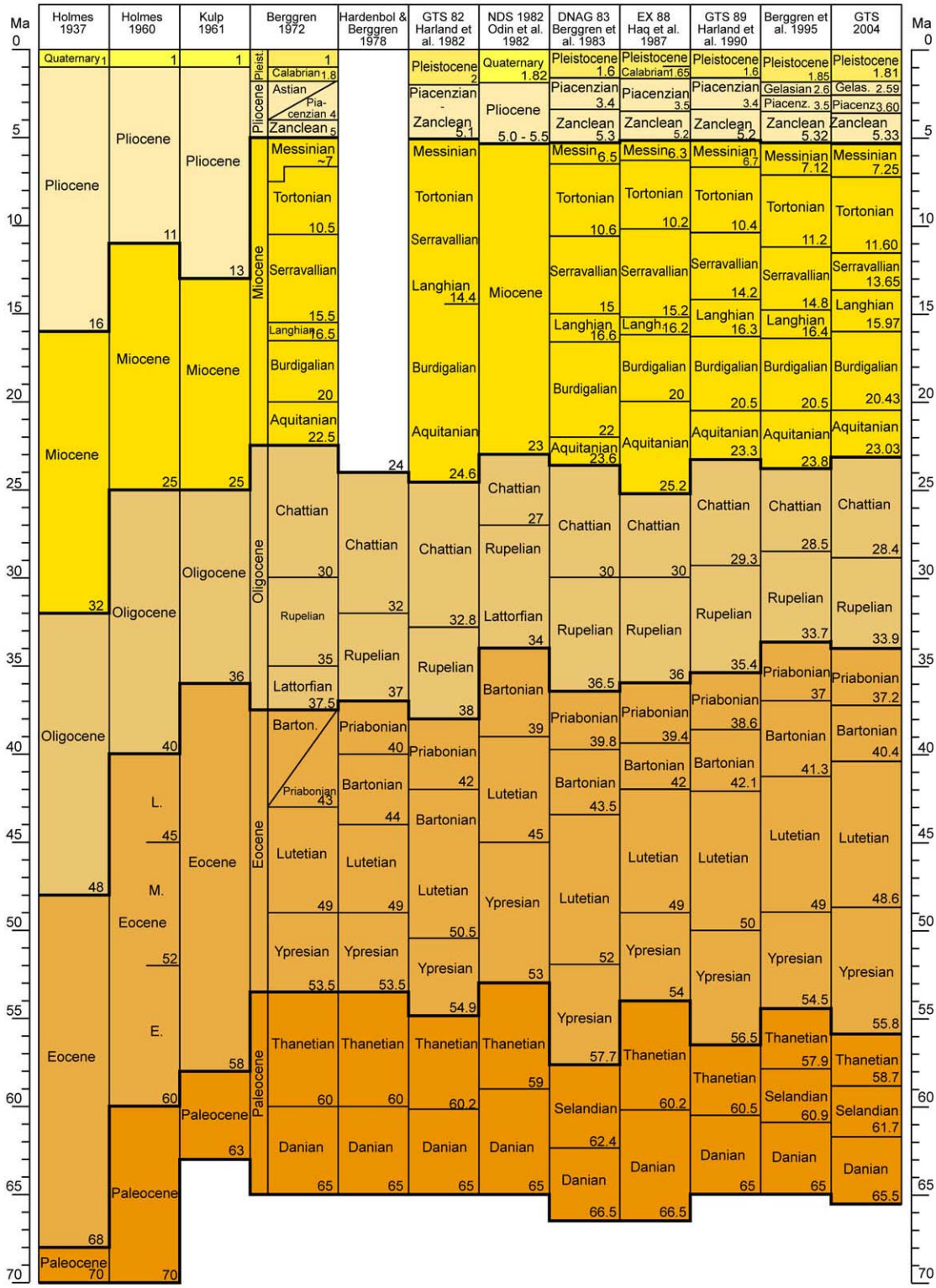
Mesozoic comparison chart
(color code according to the United States Geological Survey)



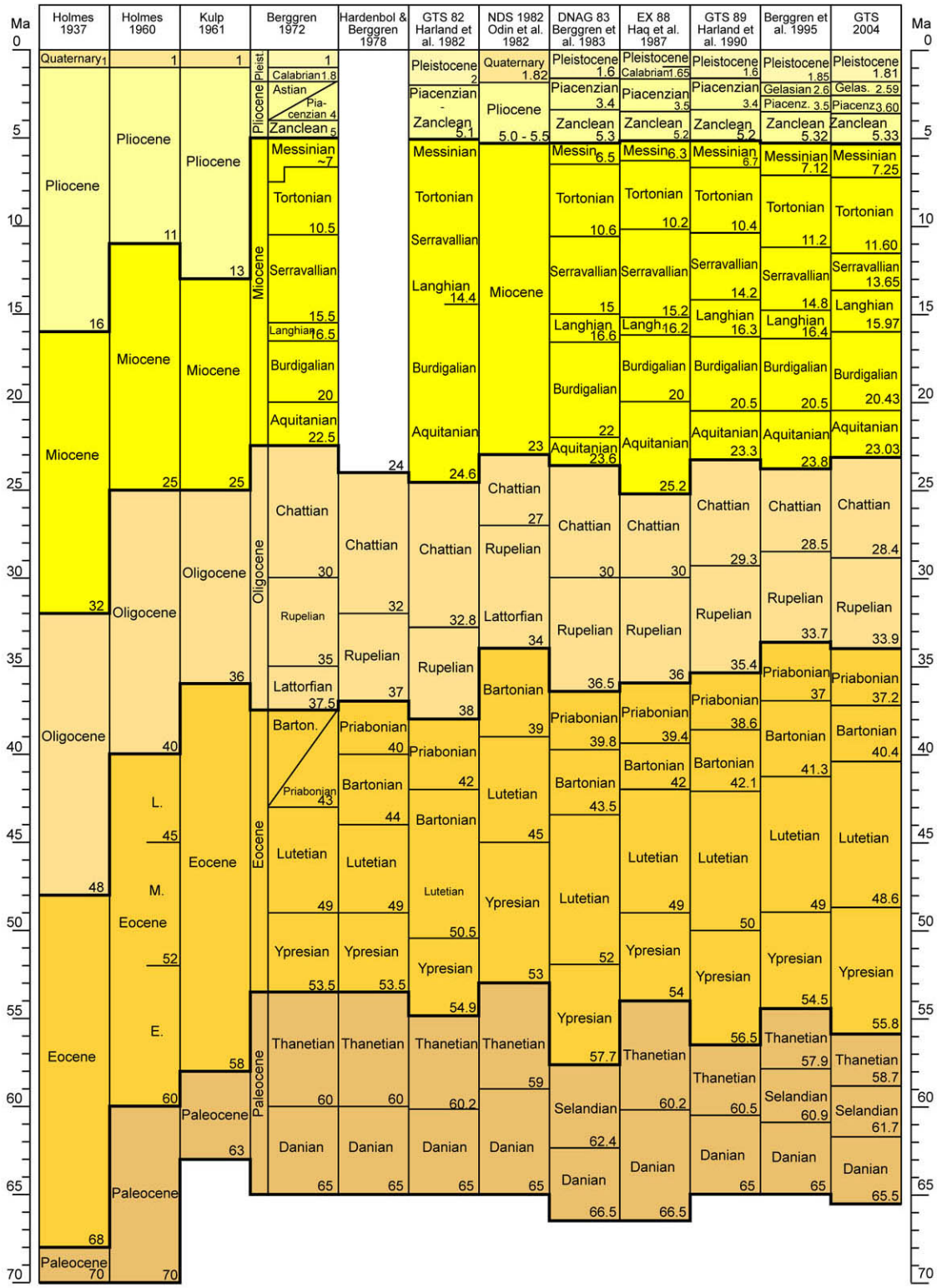
Mesozoic comparison chart
(color code according to the Commision de la Carte Geologique de Monde, Paris)



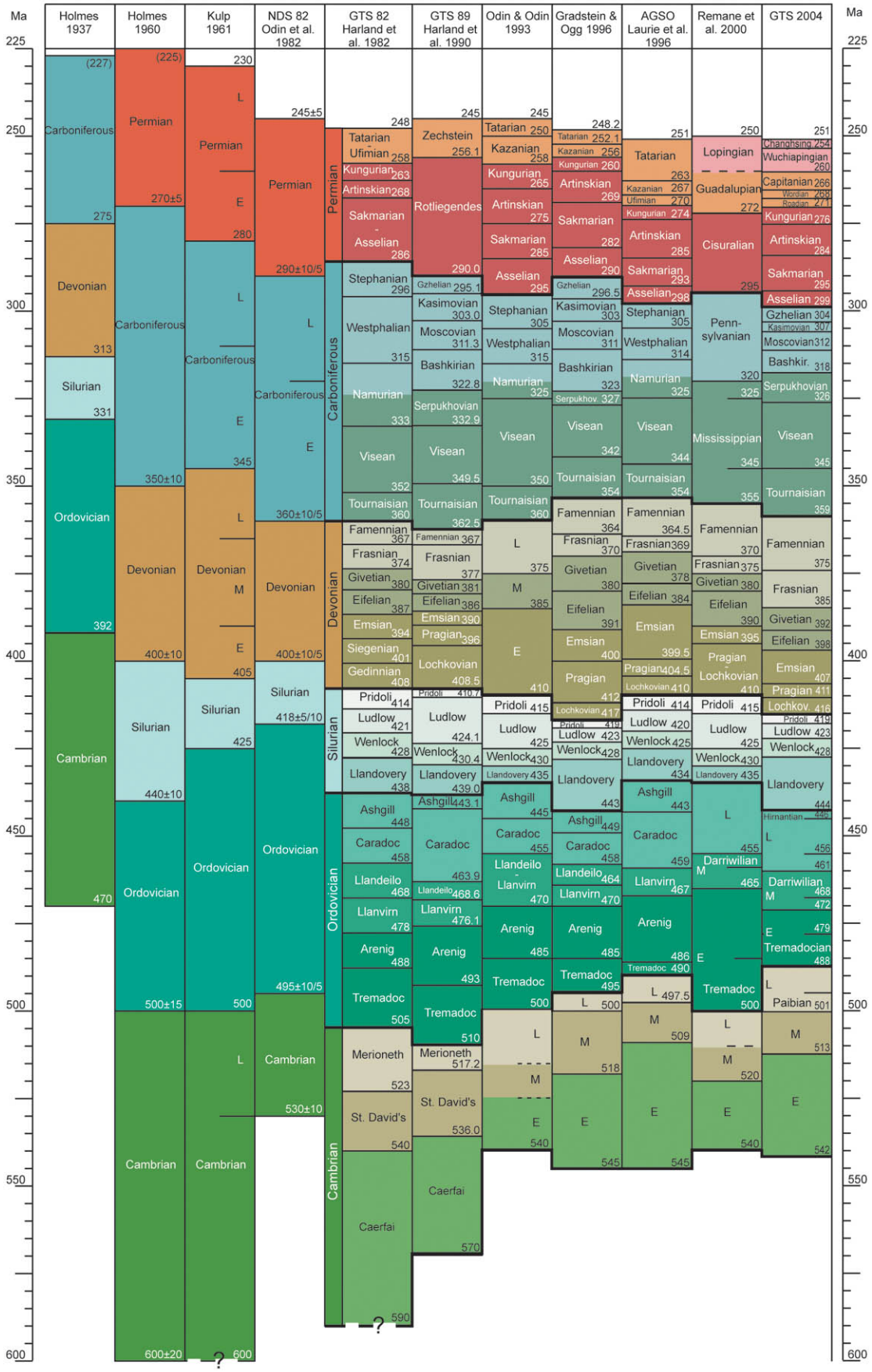
Cenozoic comparison chart
(color code according to the United States Geological Survey)



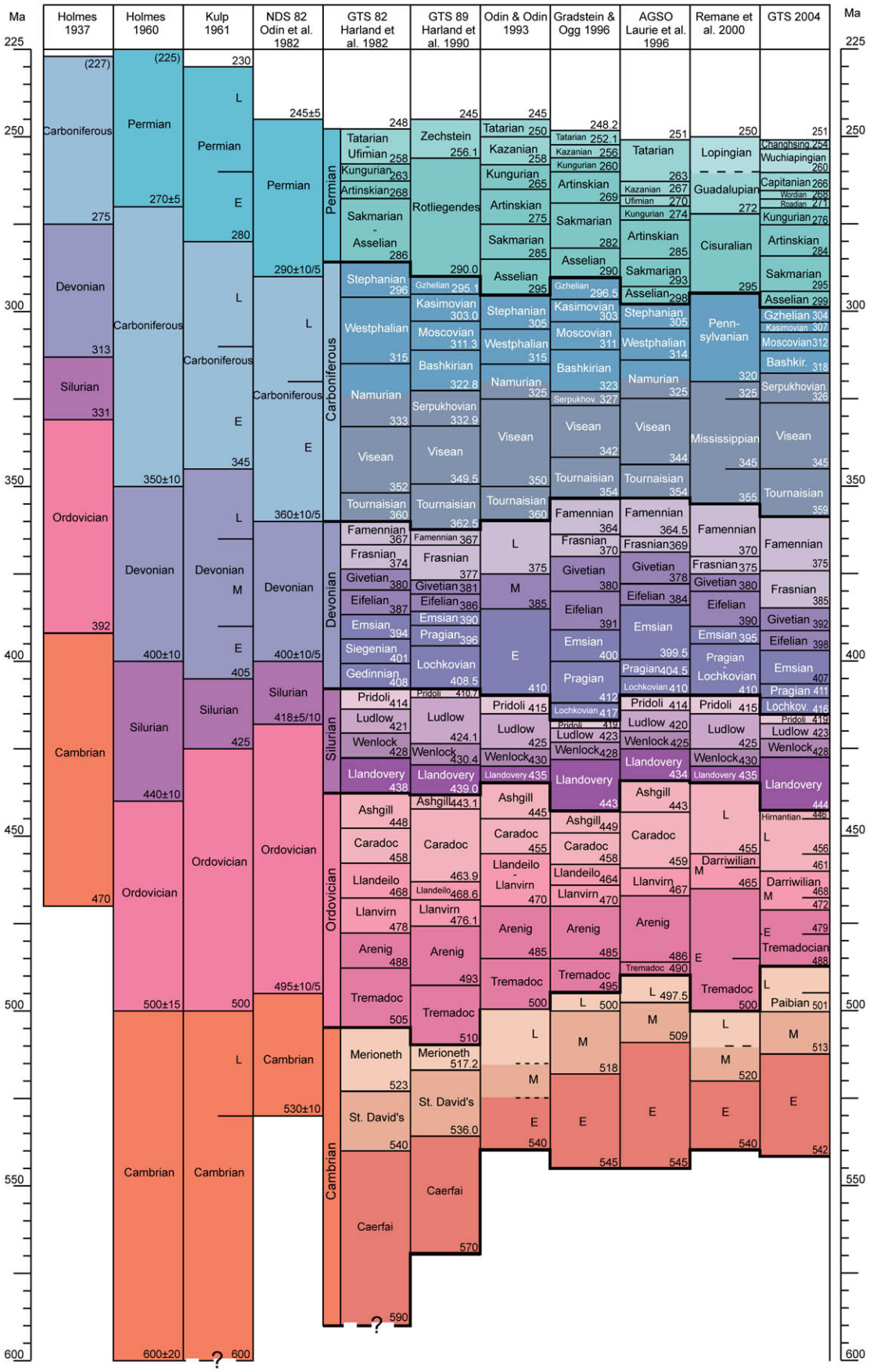
Cenozoic comparison chart
(color code according to the Commision de la Carte Geologique de Monde, Paris)



Paleozoic comparison chart
(color code according to the Commision de la Carte Geologique de Monde, Paris)



Paleozoic comparison chart
(color code according to the United States Geological Survey)



CUSTOM COLOR PALETTE

SUGGESTED STRATIGRAPHIC-AGE MAP-UNIT COLORS

ABOUT THIS CUSTOM COLOR PALETTE

As an easy way to assign color to geologic map units, custom color palettes have been designed to replicate the colors shown on the chart showing Suggested Stratigraphic-Age and Volcanic Map-Unit Colors (Section 33). The CMYK (cyan/magenta/yellow, with K = 0) color combinations shown on this chart have been used for many years on geologic maps published by the U.S. Geological Survey.

This particular palette contains custom colors that replicate the "Stratigraphic-Age Map-Unit Colors" set of colors on the chart showing Suggested Stratigraphic-Age and Volcanic Map-Unit Colors.

The custom colors replicate colors that consist of varying amounts of cyan, magenta, and yellow ink. The amount of each ink color is indicated by the three-character code in each custom color name (A=8%, 1=13%, 2=20%, 3=30%, 4=40%, 5=50%, 6=60%, 7=70%, X=100%). The name of the stratigraphic-age subdivision is also given in the color name. Thus, a custom color named "02Tertiary3_CMY.A4X" would be used for a Tertiary map unit, and this particular custom color would replicate the color that is made up of 8% cyan, 40% magenta, and 100% yellow (the numbers shown before and after the age name have been added for sorting purposes only).

The custom color palettes were created in Adobe Illustrator 8.0.1 on a Macintosh and saved in Illustrator EPS format. Note that some colors can only be distinguished from one another on monitors that can display 16.7 million colors.

ABOUT CUSTOM COLORS

Please be aware that it is necessary technically to design custom colors as non-CMYK, single-ink spot colors. In order for them to print as true process-color (CMYK) inks, the custom colors must be converted to CMYK before separation. To change a selected polygon's color to CMYK, click on the CMYK button in your document's Color window. Note that this process is irreversible; however, the original custom color will still be available for selection in your document's Swatches window.

TO USE THIS CUSTOM COLOR PALETTE

To access colors from this custom color palette, first close this file. Then, choose "Window > Swatch Libraries > Other Library..."; a selection dialog box will open. Choose the custom color palette that you are interested in; it will open as a separate swatch pallete window. To view the custom colors by name, choose the "Name" option in the swatch palette window's option menu.

INTERNATIONAL STRATIGRAPHIC CHART

International Commission on Stratigraphy

ICS

IUGS

Eonothem Eon	Erathem Era	System Period	Series Epoch	Stage Age	Age Ma	GSSP
Phanerozoic	Cenozoic	Neogene	Holocene		0.0115	
			Pleistocene	Upper	0.126	
				Middle	0.781	
				Lower	1.806	
			Pliocene	Gelasian	2.588	
				Piacenzian	3.600	
				Zanclean	5.332	
			Miocene	Messinian	7.246	
				Tortonian	11.608	
				Serravallian	13.65	
				Langhian	15.97	
				Burdigalian	20.43	
				Aquitanian	23.03	
		Paleogene	Oligocene	Chattian	28.4 ±0.1	
				Rupelian	33.9 ±0.1	
			Eocene	Priabonian	37.2 ±0.1	
				Bartonian	40.4 ±0.2	
				Lutetian	48.6 ±0.2	
				Ypresian	55.8 ±0.2	
			Paleocene	Thanetian	58.7 ±0.2	
				Selandian	61.7 ±0.2	
				Danian	65.5 ±0.3	
	Mesozoic	Cretaceous	Upper	Maastrichtian	70.6 ±0.6	
				Campanian	83.5 ±0.7	
				Santonian	85.8 ±0.7	
				Coniacian	89.3 ±1.0	
				Turonian	93.5 ±0.8	
				Cenomanian	99.6 ±0.9	
			Lower	Albian	112.0 ±1.0	
				Aptian	125.0 ±1.0	
				Barremian	130.0 ±1.5	
				Hauterivian	136.4 ±2.0	
				Valanginian	140.2 ±3.0	
				Berriasian	145.5 ±4.0	

Eonothem Eon	Erathem Era	System Period	Series Epoch	Stage Age	Age Ma	GSSP
Phanerozoic	Mesozoic	Jurassic	Upper	Tithonian	145.5 ±4.0	
				Kimmeridgian	150.8 ±4.0	
				Oxfordian	155.7 ±4.0	
			Middle	Callovian	161.2 ±4.0	
				Bathonian	164.7 ±4.0	
				Bajocian	167.7 ±3.5	
				Aalenian	171.6 ±3.0	
			Lower	Toarcian	175.6 ±2.0	
				Pliensbachian	183.0 ±1.5	
				Sinemurian	189.6 ±1.5	
				Hettangian	196.5 ±1.0	
		Triassic	Upper	Rhaetian	199.6 ±0.6	
				Norian	203.6 ±1.5	
				Carnian	216.5 ±2.0	
			Middle	Ladinian	228.0 ±2.0	
				Anisian	237.0 ±2.0	
			Lower	Olenekian	245.0 ±1.5	
				Induan	249.7 ±0.7	
	Paleozoic	Permian	Lopingian	Changhsingian	251.0 ±0.4	
				Wuchiapingian	253.8 ±0.7	
			Guadalupian	Capitanian	260.4 ±0.7	
				Wordian	265.8 ±0.7	
				Roadian	268.0 ±0.7	
			Cisuralian	Kungurian	270.6 ±0.7	
				Artinskian	275.6 ±0.7	
				Sakmarian	284.4 ±0.7	
				Asselian	294.6 ±0.8	
		Carboniferous	Penn-sylvanian	Gzhelian	299.0 ±0.8	
				Kasimovian	303.9 ±0.9	
				Moscovian	306.5 ±1.0	
				Bashkirian	311.7 ±1.1	
			Missis-sippian	Serpukhovian	318.1 ±1.3	
				Visean	326.4 ±1.6	
				Tournaisian	345.3 ±2.1	
					359.2 ±2.5	

Eonothem Eon	Erathem Era	System Period	Series Epoch	Stage Age	Age Ma	GSSP
Phanerozoic	Paleozoic	Devonian	Upper	Famennian	359.2 ±2.5	
				Frasnian	374.5 ±2.6	
			Middle	Givetian	385.3 ±2.6	
				Eifelian	391.8 ±2.7	
			Lower	Emsian	397.5 ±2.7	
				Pragian	407.0 ±2.8	
				Lochkovian	411.2 ±2.8	
		Silurian	Pridoli		416.0 ±2.8	
			Ludlow	Ludfordian	418.7 ±2.7	
				Gorstian	421.3 ±2.6	
			Wenlock	Homerian	422.9 ±2.5	
				Sheinwoodian	426.2 ±2.4	
			Llandovery	Telychian	428.2 ±2.3	
				Aeronian	436.0 ±1.9	
				Rhuddanian	439.0 ±1.8	
		Ordovician	Upper	Hirnantian	443.7 ±1.5	
					445.6 ±1.5	
					455.8 ±1.6	
			Middle	Darriwilian	460.9 ±1.6	
					468.1 ±1.6	
			Lower		471.8 ±1.6	
				Tremadocian	478.6 ±1.7	
		Cambrian	Furongian		488.3 ±1.7	
				Paibian	501.0 ±2.0	
			Middle			
					513.0 ±2.0	
			Lower			
					542.0 ±1.0	

	Eonothem Eon	Erathem Era	System Period	Age Ma	GSSP GSSA
Precambrian	Proterozoic	Neo-proterozoic	Ediacaran	542	
			Cryogenian	~630	
			Tonian	850	
		Meso-proterozoic	Stenian	1000	
			Ectasian	1200	
			Calymmian	1400	
		Paleo-proterozoic	Statherian	1600	
			Orosirian	1800	
			Rhyacian	2050	
			Siderian	2300	
				2500	
	Archean	Neoarchean			
				2800	
		Mesoarchean			
				3200	
		Paleoarchean			
				3600	
		Eoarchean	Lower limit is not defined		

Subdivisions of the global geologic record are formally defined by their lower boundary. Each unit of the Phanerozoic interval (~542 Ma to Present) and the base of the Ediacaran is defined by a Global Standard Section and Point (GSSP) at its base, whereas the Precambrian Interval is formally subdivided by absolute age, Global Standard Stratigraphic Age (GSSA).

This chart gives an overview of the international chronostratigraphic units, their rank, their names and formal status. These units are approved by the International Commission on Stratigraphy (ICS) and ratified by the International Union of Geological Sciences (IUGS).

The Guidelines of ICS (Remane et al., 1996, Episodes, 19: 77-81) regulate the selection and definition of the international units of geologic time. Many GSSP's actually have a 'golden' spike ( ) and Stage and/or System name plaque mounted at the boundary level in the boundary stratotype section, whereas a GSSA is an abstract age without reference to a specific level in a rock section on Earth. Updated descriptions of each GSSP and GSSA are posted on the ICS website (*www.stratigraphy.org*).

Some stages within the Ordovician and Cambrian will be formally named upon international agreement on their GSSP limits. Most intra-stage boundaries (e.g., Middle and Upper Aptian) are not formally defined. Numerical ages of the unit boundaries in the Phanerozoic are subject to revision. Colors are according to the United States Geological Survey (USGS). The listed numerical ages are from 'A Geologic Time Scale 2004', by F.M. Gradstein, J.G. Ogg, A.G. Smith, et al. (2004) with Cambridge University Press.

This chart was drafted and printed with funding generously provided for the GTS Project 2004 by ExxonMobil, Statoil Norway, ChevronTexaco and BP. The chart was produced by Gabi Ogg.

INTERNATIONAL STRATIGRAPHIC CHART

International Union of Geological Sciences

UNESCO — Commission de la Carte Geologique du Monde / Commission on the Geological Map of the World

ICS — International Commission on Stratigraphy

Compiled by Jurgen Remane, Chairman of the International Commission of Stratigraphy (ICS) with the collaboration of all ICS Subcommissions, A. FAURE-MURET (Université Paris Sud) and G.S. ODIN (ICS-CNRS)
Edited by an intercommission working group with J:REMANE, M.B. CITA (IUGS-ICS); J. DERCOURT, P.BOUYSSE (CGMW);F. REPETTO (Unesco) and A. FAURET- MURET (UPS)
Composition : G. ROCHE and L. DAUMAS (CNRS, Université Paris Sud, Orsay)

EONOTHEM EON	ERATHEM ERA	SYSTEM PERIOD	SERIES EPOCH	STAGE AGE	AGE Ma	AGE +/- (SEPM Spec. Vol. #54 (1995))		STAGE NOTATION	SERIES NOTATION	SYSTEM NOTATION
PHANEROZOIC	CENOZOIC CZ	Quaternary	HOLOCENE		0.01				Q_2	Q
			PLEISTOCENE	Calabrian	1.81		GSSP		Q_1	
		NEOGENE	PLIOCENE	Gelasian	2.58		GSSP	n9	N_2	N
				Piacenzian	3.60		GSSP	n8		
				Zanclean	5.32		GSSP	n7		
			MIOCENE	Messinian	7.12		GSSP	n6	N_1	
				Tortonian	11.2			n5		
				Serravallian	14.8			n4		
				Langhian	16.4			n3		
				Burdigalian	20.5			n2		
				Aquitanian	23.8		GSSP	n1		
		PALEOGENE	OLIGOCENE	Chattian	28.5			e9	E_3	E
				Rupelian	33.7		GSSP	e8		
			EOCENE	Priabonian	37.0			e7	E_2	
				Bartonian	41.3			e6		
				Lutetian	49.0			e5		
				Ypresian	55.0			e4		
			PALEOCENE	Thanetian	57.9			e3	E_1	
				Selandian	61.0			e2		
				Danian	65.5	0.1	GSSP	e1		
	MESOZOIC MZ	CRETACEOUS	UPPER/LATE	**Maastrichtian**	71.3	0.5	GSSP	k6	K_2	K
				Campanian	83.5	0.5		k5		
				Santonian	85.8	0.5		k4		
				Coniacian	89.0	0.5		k3		
				Turonian	93.5	0.2		k2		
				Cenomanian	98.9	0.6	GSSP	k1		
			LOWER/EARLY	Albian	112.2	1.1		b6	K_1	
				Aptian	121.0	1.4		b5		
				Barremian	127.0	1.6		b4		
				Hauterivian	132.0	1.9		b3		
				Valanginian	136.5	2.2		b2		
				Berriasian	142.0	2.6		b1		
		JURASSIC	UPPER/LATE	Tithonian	150.7	3.0		j7	J_3	J
				Kimmeridgian	154.1	3.3		j6		
				Oxfordian	159.4	3.6		j5		
			MIDDLE	Callovian	164.4	3.8		j4	J_2	
				Bathonian	169.2	4.0		j3		
				Bajocian	176.5	4.0	GSSP	j2		
				Aalenian	180.1	4.0	GSSP	j1		
			LOWER/EARLY	Toarcian	189.6	4.0		l4	J_1	
				Pliensbachian	195.3	3.9		l3		
				Sinemurian	201.9	3.9	GSSP	l2		
				Hettangian	205.1	4.0		l1		
		TRIASSIC	UPPER/LATE	Rhaetian	209.6	4.1		t7	T_3	T
				Norian	220.7	4.4		t6		
				Carnian	227.4	4.5		t5		
			MIDDLE	Ladinian	234.3	4.6		t4	T_2	
				Anisian	241.7	4.7		t3		
			LOWER/EARLY	Olenekian	244.8	4.8		t2	T_1	
				Induan	250	4.8	GSSP	t1		

EONOTHEM EON	ERATHEM ERA	SYSTEM PERIOD	SERIES EPOCH	STAGE AGE	AGE Ma	AGE +/- (Subcommissions or other sources)		STAGE NOTATION	SERIES NOTATION	SYSTEM NOTATION
PHANEROZOIC	PALEOZOIC PZ	PERMIAN	LOPINGIAN	Changhsingian	251.4	3.6		p9	P_3	P
				Wuchiapingian	253.4			p8		
			GUADALUPIAN	**Capitanian**	265		GSSP	p7	P_2	
				Wordian			GSSP	p6		
				Roadian			GSSP	p5		
			CISURALIAN	Kungurian				p4	P_1	
				Artinskian	283			p3		
				Sakmarian				p2		
				Asselian	292		GSSP	p1		
		CARBONIFEROUS	PENNSYLVANIAN	*Gzhelian*				c7	C_2	C
				Kazimovian				c6		
				Moscovian				c5		
				Bashkirian	320		GSSP	c4		
			MISSISSIPPIAN	*Serpukhovian*	327			c3	C_1	
				Visean	342	3.6		c2		
				Tournaisian	354	4	GSSP	c1		
		DEVONIAN	UPPER/LATE	**Famennian**	364		GSSP	d7	D_3	D
				Frasnian	370		GSSP	d6		
			MIDDLE	**Givetian**	380		GSSP	d5	D_2	
				Eifelian	391		GSSP	d4		
			LOWER/EARLY	**Emsian**	400		GSSP	d3	D_1	
				Pragian	412		GSSP	d2		
				Lochkovian	417		GSSP	d1		
		SILURIAN	PRIDOLI		419		GSSP	s8	S_4	S
			LUDLOW	**Ludfordian**			GSSP	s7	S_3	
				Gorstian	423		GSSP	s6		
			WENLOCK	**Homerian**			GSSP	s4	S_2	
				Sheinwoodian	428		GSSP	s5		
			LLANDOVERY	**Telychian**			GSSP	s3	S_1	
				Aeronian			GSSP	s2		
				Rhuddanian	440		GSSP	s1		
		ORDOVICIAN	UPPER/LATE	*"sixth stage"*					O_3	O
				"fifth stage"			*GSSP*			
			MIDDLE	**Darriwilian**	467.5	3	GSSP		O_2	
				"third stage"						
			LOWER/EARLY	*"second stage"*			*GSSP*		O_1	
				Tremadocian	495		GSSP			
		CAMBRIAN	UPPER/LATE		500				C_3	C
			MIDDLE		520				C_2	
			LOWER/EARLY		545		GSSP		C_1	

EONOTHEM EON	ERATHEM ERA	SYSTEM PERIOD	AGE (Defined these Eras and Periods)		NOTATION SYSTEM	NOTATION ERA
PRECAMBRIAN PC -	PROTEROZOIC PR	NEOPROTEROZOIC III	540		NP_3	NP
	NEOPROTEROZOIC	CRYOGENIAN	650	GSSA	NP_2	
		TONIAN	850	GSSA	NP_1	
	MESOPROTEROZOIC	STENIAN	1000	GSSA	MP_3	MP
		ECTASIAN	1200	GSSA	MP_2	
		CALYMMIAN	1400	GSSA	MP_1	
	PALEOPROTEROZOIC	STATHERIAN	1600	GSSA	PP_4	PP
		OROSIRIAN	1800	GSSA	PP_3	
		RHYACIAN	2050	GSSA	PP_2	
		SIDERIAN	2300	GSSA	PP_1	
	ARCHEAN AR	NEOARCHEAN	2500	GSSA	NA	NA
		MESOARCHEAN	2800		MA	MA
		PALEOARCHEAN	3200		PA	PA
		EOARCHEAN	3600		EA	EA

No subdivision into periods

This 2000 edition of the International Stratigraphic Chart is intended to give a clear picture of the present state of the art in chronostratigraphic subdivisions of geological time, mentionning only units recommended for international use. A typographical distinction is made between **formal**, semiformal and *informal* units.

The 1986 Guidelines of ICS (COWIE et al, 1986)and their recent revision (REMANE et al, 1996) regulate the definition of the international chronostratigraphic/geochronologic units. The Revised Guidelines were voted by the full commission of ICS as a mandatory document. Both versions of the guidelines stipulate that global chronostratigraphic units are not defined by unit-stratotypes, but their lower boundary only, following the principle introduced with the definition of the base of the Devonian in 1972 (MARTINSSON, 1977). This is indeed the only way to arrive at a global chronostratigraphic scale made of strictly contiguous units.

Phanerozoic global chronostratigraphic boundaries are formally defined by a **G**lobal **S**tandard **S**tratotype **S**ection and **P**oint (**GSSP** - COWIE et al, 1986), whereas Precambrian chronostratigraphic boundaries are formally defined in terms of absolute ages : **G**lobal **S**tandard **S**tratigraphic **A**ge (**GSSA**- REMANE et al, 1996). In order to become mandatory, a boundary definition as to be accepted by 60% majority in successive votes, first by the working group responsible for the choice of the GSSP, then by the concerned Subcommission of ICS and finally by the Full Commission of ICS. With its ratification through IUGS, the GSSP or GSSA becomes mandatory.

FORMAL UNITS (in bold characters) are all the those which have their lower boundary defined by a GSSP or GSSA voted by ICS in accordance with the Guidelines and ratified by IUGS. Proposed GSSPs (in bold italic) are pending ratification. SEMIFORMAL UNITS (normal characters): Several Subcommissions of ICS (Neogene, Paleogene, Jurassic, Triassic, Permian) have conducted a formal vote by postal ballot about the stage names which should be used and codified by a GSSP. But as long as no GSSP has been formally adopted, these units, recommendable as they are, have no formal status. *INFORMAL UNITS* (in italics) are not formally adopted by the Subcommissions.

The subdivisions used in the present Global Chart, are based on the proposals made by the concerned Subcommissions. Simplified subdivisions have, however been adopted for the Carboniferous and the Ordovician, in order to maintain the necessary homogeneity of presentation. The complete versions were included in the detailed explanatory note. Also some traditional names which are becoming obsolete have been omitted : Lias, Dogger, Malm in the Jurassic and Tertiary in the Cenozoic (the latter already abandoned in the first edition of this chart). "Tertiary" can be used as an informal name like Permotrias.

Numerical ages of the Phanerozoic chronostratigraphic boundaries were provided by Subcommission summaries, compilation in Episodes (1997) by Gradstein & Ogg, or other sources, and are subject to revision.

The letter/number symbols used for divisions down to stage/age rank and the colours of the individual units are established by the CGMW, taking as a basis its Geological Atlas of the World. This chart is updated periodically during its general assemblies occuring within the International Geological Congress and upon ratification of GSSPs by IUGS.

Status of GSSPs in January 2002 (updated by James Ogg)

INTERNATIONAL STRATIGRAPHIC CHART

International Commission on Stratigraphy

ICS

IUGS

Eonothem Eon	Erathem Era	System Period	Series Epoch	Stage Age	Age Ma	GSSP
Phanerozoic	Cenozoic	Neogene	Holocene		0.0115	
			Pleistocene	Upper	0.126	
				Middle	0.781	
				Lower	1.806	
			Pliocene	Gelasian	2.588	
				Piacenzian	3.600	
				Zanclean	5.332	
			Miocene	Messinian	7.246	
				Tortonian	11.608	
				Serravallian	13.65	
				Langhian	15.97	
				Burdigalian	20.43	
				Aquitanian	23.03	
		Paleogene	Oligocene	Chattian	28.4 ±0.1	
				Rupelian	33.9 ±0.1	
			Eocene	Priabonian	37.2 ±0.1	
				Bartonian	40.4 ±0.2	
				Lutetian	48.6 ±0.2	
				Ypresian	55.8 ±0.2	
			Paleocene	Thanetian	58.7 ±0.2	
				Selandian	61.7 ±0.2	
				Danian	65.5 ±0.3	
	Mesozoic	Cretaceous	Upper	Maastrichtian	70.6 ±0.6	
				Campanian	83.5 ±0.7	
				Santonian	85.8 ±0.7	
				Coniacian	89.3 ±1.0	
				Turonian	93.5 ±0.8	
				Cenomanian	99.6 ±0.9	
			Lower	Albian	112.0 ±1.0	
				Aptian	125.0 ±1.0	
				Barremian	130.0 ±1.5	
				Hauterivian	136.4 ±2.0	
				Valanginian	140.2 ±3.0	
				Berriasian	145.5 ±4.0	

Eonothem Eon	Erathem Era	System Period	Series Epoch	Stage Age	Age Ma	GSSP
Phanerozoic	Mesozoic	Jurassic	Upper	Tithonian	145.5 ±4.0	
				Kimmeridgian	150.8 ±4.0	
				Oxfordian	155.0 ±4.0	
			Middle	Callovian	161.2 ±4.0	
				Bathonian	164.7 ±4.0	
				Bajocian	167.7 ±3.5	
				Aalenian	171.6 ±3.0	
			Lower	Toarcian	175.6 ±2.0	
				Pliensbachian	183.0 ±1.5	
				Sinemurian	189.6 ±1.5	
				Hettangian	196.5 ±1.0	
		Triassic	Upper	Rhaetian	199.6 ±0.6	
				Norian	203.6 ±1.5	
				Carnian	216.5 ±2.0	
			Middle	Ladinian	228.0 ±2.0	
				Anisian	237.0 ±2.0	
			Lower	Olenekian	245.0 ±1.5	
				Induan	249.7 ±0.7	
	Paleozoic	Permian	Lopingian	Changhsingian	251.0 ±0.4	
				Wuchiapingian	253.8 ±0.7	
			Guadalupian	Capitanian	260.4 ±0.7	
				Wordian	265.8 ±0.7	
				Roadian	268.0 ±0.7	
			Cisuralian	Kungurian	270.6 ±0.7	
				Artinskian	275.6 ±0.7	
				Sakmarian	284.4 ±0.7	
				Asselian	294.6 ±0.8	
		Carboniferous	Penn-sylvanian	Upper	Gzhelian	299.0 ±0.8
					Kasimovian	303.9 ±0.9
				Middle	Moscovian	306.5 ±1.0
				Lower	Bashkirian	311.7 ±1.1
			Missis-sippian	Upper	Serpukhovian	318.1 ±1.3
				Middle	Visean	326.4 ±1.6
				Lower	Tournaisian	345.3 ±2.1
						359.2 ±2.5

Eonothem Eon	Erathem Era	System Period	Series Epoch	Stage Age	Age Ma	GSSP
Phanerozoic	Paleozoic	Devonian	Upper	Famennian	359.2 ±2.5	
				Frasnian	374.5 ±2.6	
			Middle	Givetian	385.3 ±2.6	
				Eifelian	391.8 ±2.7	
			Lower	Emsian	397.5 ±2.7	
				Pragian	407.0 ±2.8	
				Lochkovian	411.2 ±2.8	
		Silurian	Pridoli		416.0 ±2.8	
			Ludlow	Ludfordian	418.7 ±2.7	
				Gorstian	421.3 ±2.6	
			Wenlock	Homerian	422.9 ±2.5	
				Sheinwoodian	426.2 ±2.4	
			Llandovery	Telychian	428.2 ±2.3	
				Aeronian	436.0 ±1.9	
				Rhuddanian	439.0 ±1.8	
		Ordovician	Upper	Hirnantian	443.7 ±1.5	
					445.6 ±1.5	
					455.8 ±1.6	
			Middle	Darriwilian	460.9 ±1.6	
					468.1 ±1.6	
			Lower		471.8 ±1.6	
				Tremadocian	478.6 ±1.7	
		Cambrian	Furongian		488.3 ±1.7	
				Paibian	501.0 ±2.0	
			Middle		513.0 ±2.0	
			Lower		542.0 ±1.0	

Eonothem Eon	Erathem Era	System Period	Age Ma	GSSP GSSA
Precambrian	Proterozoic	Neo-proterozoic	542	
		Ediacaran	~630	
		Cryogenian	850	
		Tonian	1000	
		Meso-proterozoic	1200	
		Stenian	1400	
		Ectasian	1600	
		Calymmian	1800	
		Paleo-proterozoic	2050	
		Statherian	2300	
		Orosirian	2500	
		Rhyacian	2800	
		Siderian	3200	
	Archean	Neoarchean	3600	
		Mesoarchean		
		Paleoarchean		
		Eoarchean	Lower limit is not defined	

Subdivisions of the global geologic record are formally defined by their lower boundary. Each unit of the Phanerozoic interval (~542 Ma to Present) and the base of the Ediacaran is defined by a Global Standard Section and Point (GSSP) at its base, whereas the Precambrian Interval is formally subdivided by absolute age, Global Standard Stratigraphic Age (GSSA).

This chart gives an overview of the international chronostratigraphic units,their rank, their names and formal status. These units are approved by the International Commission on Stratigraphy (ICS) and ratified by the International Union of Geological Sciences (IUGS).

The Guidelines of the ICS (Remane et al., 1996, Episodes, 19: 77-81) regulate the selection and definition of the international units of geologic time. Many GSSP's actually have a 'golden' spike ( ) and Stage and/or System name plaque mounted at the boundary level in the boundary stratotype section, whereas a GSSA is an abstract age without reference to a specific level in a rock section on Earth. Updated descriptions of each GSSP and GSSA are posted on the ICS website (*www.stratigraphy.org*).

Some stages within the Ordovician and Cambrian will be formally named upon international agreement on their GSSP limits. Most intra-stage boundaries (e.g., Middle and Upper Aptian) are not formally defined. Numerical ages of the unit boundaries in the Phanerozoic are subject to revision. Colors are according to the Commission for the Geological Map of the World (*www.cgmw.org*). The listed numerical ages are from 'A Geologic Time Scale 2004', by F.M. Gradstein, J.G. Ogg, A.G. Smith, et al. (2004; Cambridge University Press).

This chart was drafted and printed with funding generously provided for the GTS Project 2004 by ExxonMobil, Statoil Norway, ChevronTexaco and BP. The chart was produced by Gabi Ogg.

Color code according to the United States Geological Survey

Phanerozoic 179/226/209	Cenozoic 255/255/0	Quaternary RGB255/255/77	Holocene RGB255/255/179	Pleistocene RGB255/235/98		
		Neogene RGB253/204/138	Pliocene RGB254/235/172	Miocene RGB255/22/0		
		Paleogene RGB255/179/0	Oligocene RGB234/198/114	Eocene RGB234/173/67	Paleocene RGB235/147/1	
	Mesozoic RGB127/173/81	Cretaceous RGB127/195/28	Upper Cretaceous RGB22/241/151	Lower Cretaceous RGB179/223/127		
		Jurassic RGB77/180/126	Upper Jurassic RGB204/235/197	Middle Jurassic RGB127/202/147	Lower Jurassic RGB102/192/146	
		Triassic RGB103/195/183	Upper Triassic RGB204/236/225	Middle Triassic RGB153/215/190	Lower Triassic RGB103/179/159	
	Paleozoic RGB128/181/213	Permian RGB103/198/221	Lopingian RGB179/227/238	Guadalupian RGB153/216/216	Cisuralian RGB128/206/201	
		Carboniferous RGB153/189/218	Pennsylvanian RGB104/159/202	Mississippian RGB128/145/173		
		Devonian RGB153/153/201	Upper Devonian RGB203/189/220	Middle Devonian RGB153/131/190	Lower Devonian RGB128/125/186	
		Silurian RGB177/114/182	Pridoli RGB233/199/226	Ludlow RGB202/167/209	Wenlock RGB177/137/179	Llandovery RGB152/88/168
		Ordovician RGB249/129/166	Upper Ordovician RGB251/180/189	Middle Ordovician RGB250/154/177	Lower Ordovician RGB230/125/164	
		Cambrian RGB251/128/95	Upper Cambrian RGB253/205/184	Middle Cambrian RGB232/174/151	Lower Cambrian RGB231/124/114	
Precambrian RGB178/134/83	Proterozoic RGB204/216/145	NeoproterozoicIII RGB234/216/188				
		Cryogenian RGB220/171/170				
		Tonian RGB203/164/108				
	Neoproterozoic RGB202/165/149	Mesoproterozoic RGB221/194/136				
		Paleoproterozoic RGB179/178/94				
	Archaen RGB153/173/172	Neoarchaen RGB203/205/200				
		Mesoarchaen RGB221/194/136				
		Paleoarchaen RGB153/151/145				
		Eoarchaen RGB128/144/144				

Explanation:
The color code is in RGB code.
For example Devonian RGB153/189/218 represents Devonian with the color mix of 153 Red, 189 Green, and 218 Blue.

Color code according to the COMMISSION DE LA CARTE GEOLOGIQUE DU MONDE (CCGM), {Commission for the Geological Map of the World (CGMW)}, Paris, France.

Phanerozoic PH-154/217/229	Cenozoic CZ-250/253/1	Quaternary Q-254/230/146	Holocene Q2-255/251/240	Pleistocene Q1-255/247/176		
		Neogene N-255/232/0	Pliocene N2-255/255/153	Miocene N1-255/255/0		
		Paleogene E-253/154/82	Oligocene E3-254/224/144	Eocene E2-254/209/59	Paleocene E1-235/192/109	
	Mesozoic MZ-103/197/202	Cretaceous K-197/229/71	Upper Cretaceous K2-226/243/152	Lower Cretaceous K1-65/170/84		
		Jurassic J-226/244/224	Upper Jurassic J3-179/226/230	Middle Jurassic J2-179/215/232	Lower Jurassic J1-0/160/198	
		Triassic T-107/1/125	Upper Triassic T3-228/197/225	Middle Triassic T2-177/137/193	Lower Triassic T1-152/57/153	
	Paleozoic PZ-153/192/141	Permian P-240/64/40	Lopingian P3-250/154/163	Guadalupian P2-240/150/82	Cisuralian P1-202/60/64	
		Carboniferous C-103/171/160	Pennsylvanian C2-153/196/181	Mississippian C1-103/148/109		
		Devonian D-203/140/55	Upper Devonian D3-204/206/169	Middle Devonian D2-153/165/109	Lower Devonian D1-153/148/73	
		Silurian S-179/226/208	Pridoli S4-245/251/240	Ludlow S3-226/244/224	Wenlock S2-197/232/195	Llandovery S1-153/215/179
		Ordovician O-0/146/112	Upper Ordovician O3-102/192/146	Middle Ordovician O2-65/156/104	Lower Ordovician O1-1/128/85	
		Cambrian Ca-64/133/33	Upper Cambrian Ca3-215/211/170	Middle Cambrian Ca2-182/174/109	Lower Cambrian Ca1-102/169/75	
Precambrian PC-247/67/112	Proterozoic PR-251/154/148	Neoproterozoic NP-254/179/67				
		Mesoproterozoic MP-253/180/105				
		Paleoproterozoic PP-247/67/115				
	Archaen AR-240/2/127	Neoarchaen NA-249/155/197				
		Mesoarchaen MA-234/102177				
		Paleoarchaen PA-244/68/159				
		Eoarchaen EA-218/2/127				

Explanation:
The color code is in RGB code.
For example D-203/140/55 represents Devonian with the color mix of 203 Red, 140 Green, and 55 Blue.

INTERNATIONAL STRATIGRAPHIC CHART

International Union of Geological Sciences

EONOTHEM EON	ERATHEM ERA	SYSTEM PERIOD	SERIES EPOCH	STAGE AGE	AGES G.S. ODIN Ma	+/−	AGES S/C Ma	+/−		STAGE NOTATION	SERIES NOTATION	SYSTEM NOTATION
PHANEROZOIC PH	CENOZOIC CZ	QUATERNARY	HOLOCENE								Q₂	Q
			PLEISTOCENE								Q₁	
		NEOGENE	PLIOCENE	Gelasian ✓	1.75	0.05	1.81		GSSP	n₉	N₂	N
				Piacenzian	3.4		2.58		GSSP	n₈		
				Zanclean			3.60		GSSP	n₇		
			MIOCENE	Messinian	5.30	0.15	5.33		GSSP	n₆	N₁	
				Tortonian	7.30	0.15	7.1		GSSP	n₅		
				Serravallian	11.0	0.3	11			n₄		
				Langhian	14.3	0.5	13.6			n₃		
				Burdigalian	15.8	0.2	16.4			n₂		
				Aquitanian ✓	20.3	0.4	19.1			n₁		
		PALEOGENE	OLIGOCENE	Chattian	23.5	1.0	23.8		GSSP	e₉	E₃	E
				Rupelian	28	1				e₈		
			EOCENE	Priabonian	33.7	0.5			GSSP	e₇	E₂	
				Bartonian	37.0	1/0.5				e₆		
				Lutetian	40	1				e₅		
				Ypresian	46.0	1/0.5				e₄		
			PALEOCENE	Thanetian	53	1				e₃	E₁	
				Selandian ✓						e₂		
				Danian	65.0	0.5	65.0	0.1	GSSP	e₁		
	MESOZOIC MZ	CRETACEOUS	UPPER/LATE	Maastrichtian	72.0	0.5	71.3	0.5		k₆	K₂	K
				Campanian	83	1	83.5	0.5		k₅		
				Santonian	87	1	85.8	0.5		k₄		
				Coniacian	88	1	89.0	0.5		k₃		
				Turonian	92	2	93.5	0.2		k₂		
				Cenomanian	96	2	98.9	0.6		k₁		
			LOWER/EARLY	Albian	108	3/1	112.2	1.1		b₆	K₁	
				Aptian	113	3	121.0	1.4		b₅		
				Barremian	117	5/2	127.0	1.6		b₄		
				Hauterivian	123	6/2	132.0	1.9		b₃		
				Valanginian	131	4	136.5	2.2		b₂		
				Berriasian	135	5/5	144.2	2.6		b₁		
		JURASSIC	UPPER/LATE	Tithonian	141	?/5				j₇	J₃	J
				Kimmeridgian	146					j₆		
				Oxfordian	154	5				j₅		
			MIDDLE	Callovian	160	2				j₄	J₂	
				Bathonian	164	2				j₃		
				Bajocian	170	4/3			GSSP	j₂		
				Aalenian	175	3			GSSP	j₁		
			LOWER/EARLY	Toarcian	184	3				l₄	J₁	
				Pliensbachian	191					l₃		
				Sinemurian	200	4/7				l₂		
				Hettangian	203	3				l₁		
		TRIASSIC	UPPER/LATE	Rhetian	220					t₇	T₃	T
				Norian						t₆		
				Carnian	230	6				t₅		
			MIDDLE	Ladinian	233	5				t₄	T₂	
				Anisian	240	5				t₃		
			LOWER/EARLY	Olenekian						t₂	T₁	
				Induan	250	3	251.1	3.6		t₁		

EONOTHEM EON	ERATHEM ERA	SYSTEM PERIOD	SUBSYSTEM SUBPERIOD	SERIES EPOCH	STAGE AGE	AGES G.S. ODIN Ma	+/−	AGES S/C Ma	+/−		STAGE NOTATION	SERIES NOTATION	SYSTEM NOTATION
PHANEROZOIC PH	PALEOZOIC PZ	PERMIAN		LOPINGIAN	Changhsingian ✓	250	3	251.1	3.6		p₉	P₃	P
					Wuchiapigian ✓						p₈		
				GUADALUPIAN	Capitanian						p₇	P₂	
					Wordian						p₆		
					Roadian						p₅		
				CISURALIAN	Kungurian			272.2	3.2		p₄	P₁	
					Artinskian			280.3	2.6		p₃		
					Sakmarian						p₂		
					Asselian	295	5	298		GSSP	p₁		
		CARBONIFEROUS		PENNSYLVANIAN	Gzhelian ✓						c₇	C₂	C
					Kazimovian ✓						c₆		
					Moscovian ✓						c₅		
					Bashkirian ✓			320			c₄		
				MISSISSIPPIAN	Serpukhovian ✓					GSSP	c₃	C₁	
					Visean ✓	325	5	327			c₂		
					Tournaisian	345		342	3.6		c₁		
		DEVONIAN		UPPER/LATE	Famennian	355	5	354	4	GSSP	d₇	D₃	D
					Frasnian	370	5			GSSP	d₆		
				MIDDLE	Givetian	375	5			GSSP	d₅	D₂	
					Eifelian	380				GSSP	d₄		
				LOWER/EARLY	Emsian	390	5			GSSP	d₃	D₁	
					Pragian	400	5			GSSP	d₂		
					Lochkovian					GSSP	d₁		
		SILURIAN		PRIDOLI		410	8/5			GSSP	s₈	S₄	S
				LUDLOW	Ludfordian	415				GSSP	s₇	S₃	
					Gorstian					GSSP	s₆		
				WENLOCK	Homerian	425	5			GSSP	s₅	S₂	
					Sheinwoodian					GSSP	s₄		
				LLANDOVERY	Telychian	430	6			GSSP	s₃	S₁	
					Aeronian					GSSP	s₂		
					Rhuddanian					GSSP	s₁		
		ORDOVICIAN		UPPER/LATE		435	6/4	440		GSSP		O₃	O
				MIDDLE	Darriwilian	455	5			←4 ←3		O₂	
								467.5	3	GSSP			
				LOWER/EARLY	Tremadocian	465	5			←2 ←1		O₁	
						500		495		GSSP			
		CAMBRIAN		UPPER/LATE				500				Ɛ₃	Ɛ
				MIDDLE		520		520				Ɛ₂	
				LOWER/EARLY		540	5	545		GSSP		Ɛ₁	

EONOTHEM EON	ERATHEM ERA	SYSTEM PERIOD	AGES (Ma) S/C		NOTATION SYSTEM	NOTATION ERA
PRECAMBRIAN PC	PROTEROZOIC PR	NEOPROTEROZOIC	Neoproterozoic III	540	NP₃	NP
			Cryogenian	650 GSSA	NP₂	
			Tonian	850 GSSA	NP₁	
		MESOPROTEROZOIC	Stenian	1000 GSSA	MP₃	MP
			Ectasian	1200 GSSA	MP₂	
			Calymmian	1400 GSSA	MP₁	
		PALEOPROTEROZOIC	Statherian	1600 GSSA	PP₄	PP
			Orosirian	1800 GSSA	PP₃	
			Rhyacian	2050 GSSA	PP₂	
			Siderian	2300 GSSA	PP₁	
	ARCHEAN AR	NEOARCHEAN		2500 GSSA		NA
		MESOARCHEAN	No subdivision into periods	2800		MA
		PALEOARCHEAN		3200		PA
		EOARCHEAN		3600		EA

This new edition of the Global Stratigraphic Chart gives a clear picture of the present state of the art in the chronostratigraphic division of geological time, mentioning only units recommended for international use. The 1986 Guidelines of ICS (Cowie et al. 1986) and their revision (Remane et al. 1996) regulate the procedure to be followed in defining international chronostratigraphic/geochronologic units. The Revised Guidelines were ratified in a formal vote by the Full Commission of ICS. They stipulate that global chronostratigraphic units are NOT defined by unit-stratotypes, but by their lower boundary only, following the principle introduced with the definition of the base of the Devonian in 1972 (Martinsson, 1977). This is indeed the only way to arrive at a global chronostratigraphic scale made up of strictly contiguous units.

Phanerozoic global chronostratigraphic boundaries are thus formally defined by a Global Stratotype Section and Point (**GSSP** - Cowie et al. 1986), whereas Precambrian chronostratigraphic boundaries are formally defined in terms of absolute age by a Global Standard Stratigraphic Age (**GSSA** - Remane et al. 1996). In order to become formal, boundary definitions have to be accepted by a 60% majority in successive votes, first by the working group responsible for the choice of the GSSP, then by the concerned Subcommission of ICS, and finally by ICS. With its ratification through IUGS, a GSSP or GSSA becomes formal. International agreements of this kind should be respected in scientific publications.

In the present chart, a typographical distinction is made among **formal,** semiformal, and *informal* units. **FORMAL UNITS** (in bold characters): all those that have their lower boundary defined by a GSSP or a GSSA voted on by ICS and ratified by IUGS. SEMIFORMAL UNITS (normal characters): several Subcommissions of ICS (Neogene, Paleogene, Jurassic, Triassic, Permian) have conducted a formal vote by postal ballot on the stage names which should be used and codified by a GSSP. As long as no GSSP has been adopted, these units, recommendable as they are, have no formal status. *INFORMAL UNITS* (in italics): Cretaceous stages have never been voted upon, but they follow a long-standing tradition and tacit international agreement.

The divisions used in the present Global Chart are based on the proposals made by the concerned Subcommissions. Simplified subdivisions have, however, been adopted for the Carboniferous and the Ordovician, in order to maintain the necessary homogeneity of presentation. More detailed versions are included in the attached extended explanatory note. Also, some traditional names which are becoming obsolete have been omitted: Lias, Dogger, Malm in the Jurassic and Tertiary in the Cenozoic (the latter already abandoned in the first edition of this chart). 'Tertiary' can be used as an informal name like *Permotrias*.

Numerical ages of the Phanerozoic chronostratigraphic boundaries were provided by G. Odin (Chairman of the Subcommission on Geochronology of ICS). Differing ages indicated by some of the Subcommissions of ICS are mentioned in a parallel column.

The letter/number symbols and the colours used for divisions down to stage/age rank are the same as those employed in the Geological Atlas of the World. They were established in concert with the Commission on the Geological Map of the World (CGMW/CCGM).

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