APPENDIX 7: Symbols for Geologic Maps

1 

Contact, showing dip where trace is horizontal, and strike and dip where trace is inclined

2 Contact, located approximately (give limits)

3 Contact, located very approximately, or conjectural

4 Contact, concealed beneath mapped units

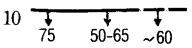
5 Contact, gradational (optional symbols)

6 Fault, nonspecific, well located (optional symbols)

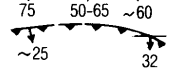
7 Fault, nonspecific, located approximately

8 Fault, nonspecific, assumed (existence uncertain)

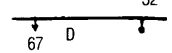
9 Fault, concealed beneath mapped units

10 

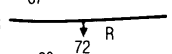
Fault, high-angle, showing dip (left) and approximate dips

11 

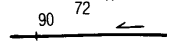
Fault, low-angle, showing approximate dip and strike and dip

12 

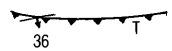
Fault, high-angle normal (D or ball and bar on downthrown side)

13 

Fault, reverse (R on upthrown side)

14 

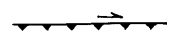
Fault, high-angle strike-slip (example is left lateral)

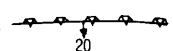
15 

Fault, thrust (T on overthrust side)

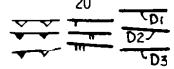
16 

Fault, low-angle normal or detachment (D on downthrown side)

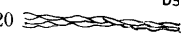
17 
Fault, low-angle strike-slip (example is right lateral)

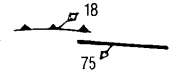
18 

Fault, low-angle, overturned (teeth in direction of dip)

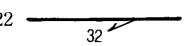
19 

Optional sets of symbols for different age-groups of faults

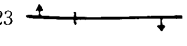
20 
Fault zone or shear zone, width to scale (dip and other accessory symbols may be added)

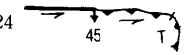
21 

Faults with arrows showing plunge of rolls, grooves or slickensides

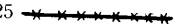
22 

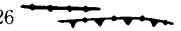
Fault showing bearing and plunge of net slip

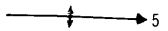
23 
Point of inflection (bar) on a high-angle fault

24 

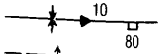
Points of inflection on a strike-slip fault passing into a thrust

25 
Fault intruded by a dike

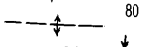
26 
Faults associated with veins

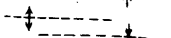
27 

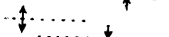
Anticline, showing trace and plunge of hinge or crest line (specify)

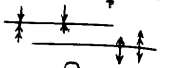
28 

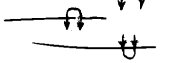
Syncline (as above), showing dip of axial surface or trough surface

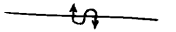
29 
Folds (as above), located approximately

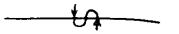
30 
Folds, conjectural

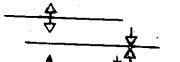
31 
Folds beneath mapped units

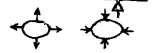
32 
Asymmetric folds with steeper limbs dipping north (optional symbols)

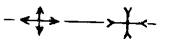
33 
Anticline (top) and syncline, overturned

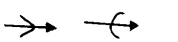
34 
Antiformal (inverted) syncline

35 
Synformal (inverted) anticline

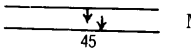
36 
Antiform (top) and synform (stratigraphic sequence unknown)

37 
Separate dome (left) and basin

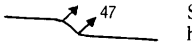
38 
Culmination (left) and depression

39 
Small anticline and syncline, showing shapes in horizontal section

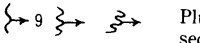
40 
Vertically plunging anticline and syncline

41 

Monocline, south-facing, showing traces of axial surfaces

42 

Steeply plunging monocline or flexure, showing trace in horizontal section and plunge of hinges

43 

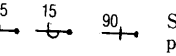
Plunge of hinge lines of small folds, showing shapes in horizontal section

44 

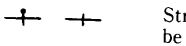
Strike and dip of beds or bedding

45 

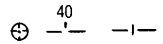
Strike and dip of overturned beds

46 

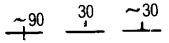
Strike and dip of beds where stratigraphic tops are known from primary features

47 
Strike and dip of vertical beds or bedding (dot is on side known to be stratigraphically the top)

48 
Horizontal beds or bedding (as above)

49 

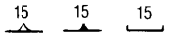
Approximate (typically estimated) strike and dip of beds

50 

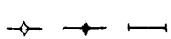
Strike of beds exact but dip approximate

51 

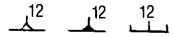
Trace of single bed, showing dip where trace is horizontal and where it is inclined

52 

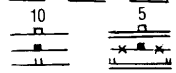
Strike and dip of foliation (optional symbols)

53 
Strike of vertical foliation

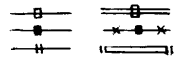
54 
Horizontal foliation

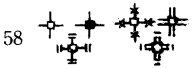
55 

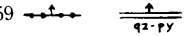
Strike and dip of bedding and parallel foliation

56 

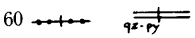
Strike and dip of joints (left) and dikes (optional symbols)

57 
Vertical joints (left) and dikes

58 
Horizontal joints (left) and dikes

59 

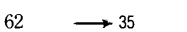
Strike and dip of veins (optional symbols)

60 

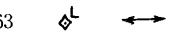
Vertical veins

61 

Horizontal veins

62 

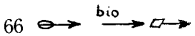
Bearing (trend) and plunge of lineation

63 
Vertical and horizontal lineations

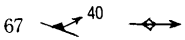
64 

Bearing and plunge of cleavage-bedding intersection

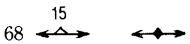
65 
Bearing and plunge of cleavage-cleavage intersections

66 

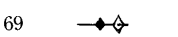
Bearings of pebble, mineral, etc. lineations

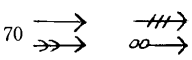
67 

Bearing of lineations in plane of foliation

68 

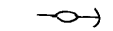
Horizontal lineation in plane of foliation

69 
Vertical lineation in plane of vertical foliation

70 
Bearing of current from primary features; from upper left: general; from cross-bedding; from flute casts; from imbrication

71 
Bearing of wind direction from dune forms (left) and cross-bedding

72 
Bearing of ice flow from striations (left) and orientation of striations

73 
Bearing of ice flow from drumlins

74 
Bearing of ice flow from crag and tail forms

75 
Spring

76 

Thermal spring

77 

Mineral spring

78
Asphaltic deposit

79 

Bituminous deposit

80 
Sand, gravel, clay, or placer pit

81 
Mine, quarry, or open pit

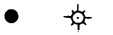
82 
Shafts: vertical, inclined, and abandoned

83 
Adit, open (left) and inaccessible

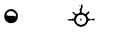
84 

Trench (left) and prospect

85 
Water wells: flowing, nonflowing, and dry

86 
Oil well (left) and gas well

87 
Well drilled for oil or gas, dry

88 
Wells with shows of oil (left) and gas

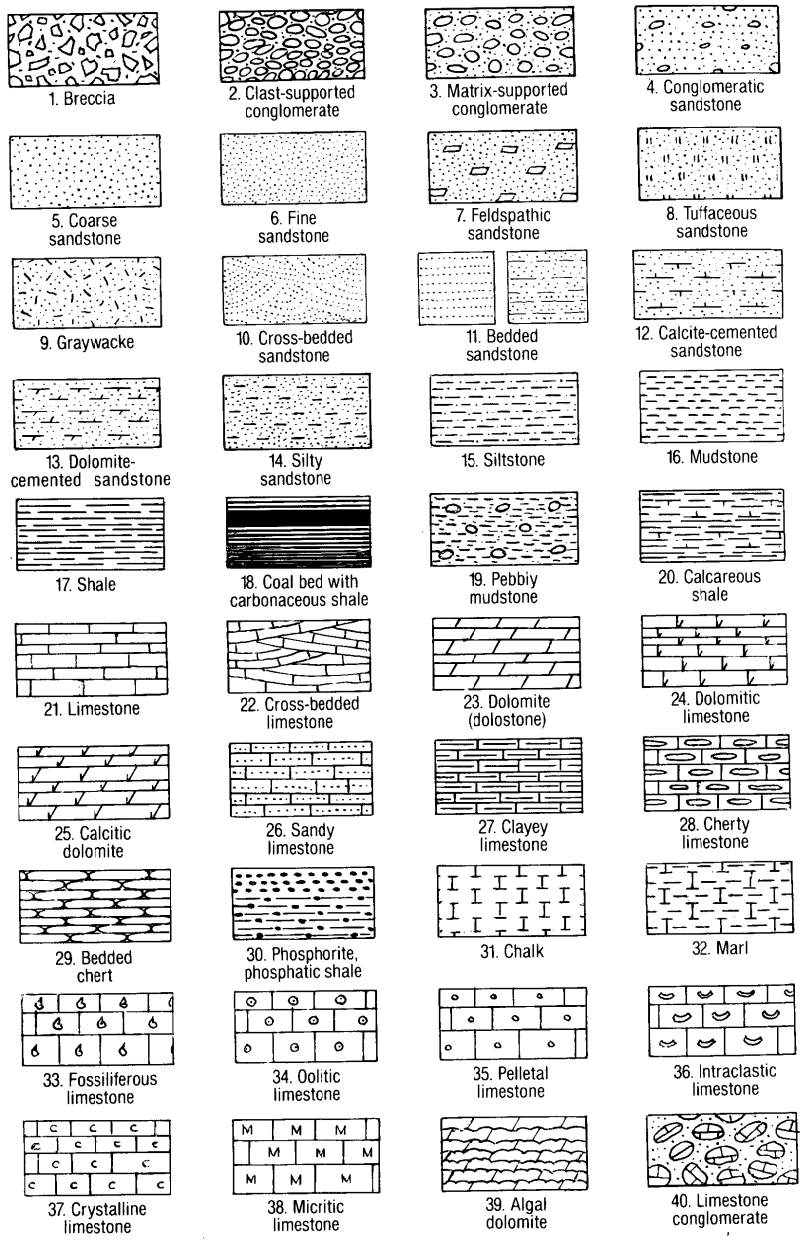
89
Oil or gas well, abandoned (left) and shut in

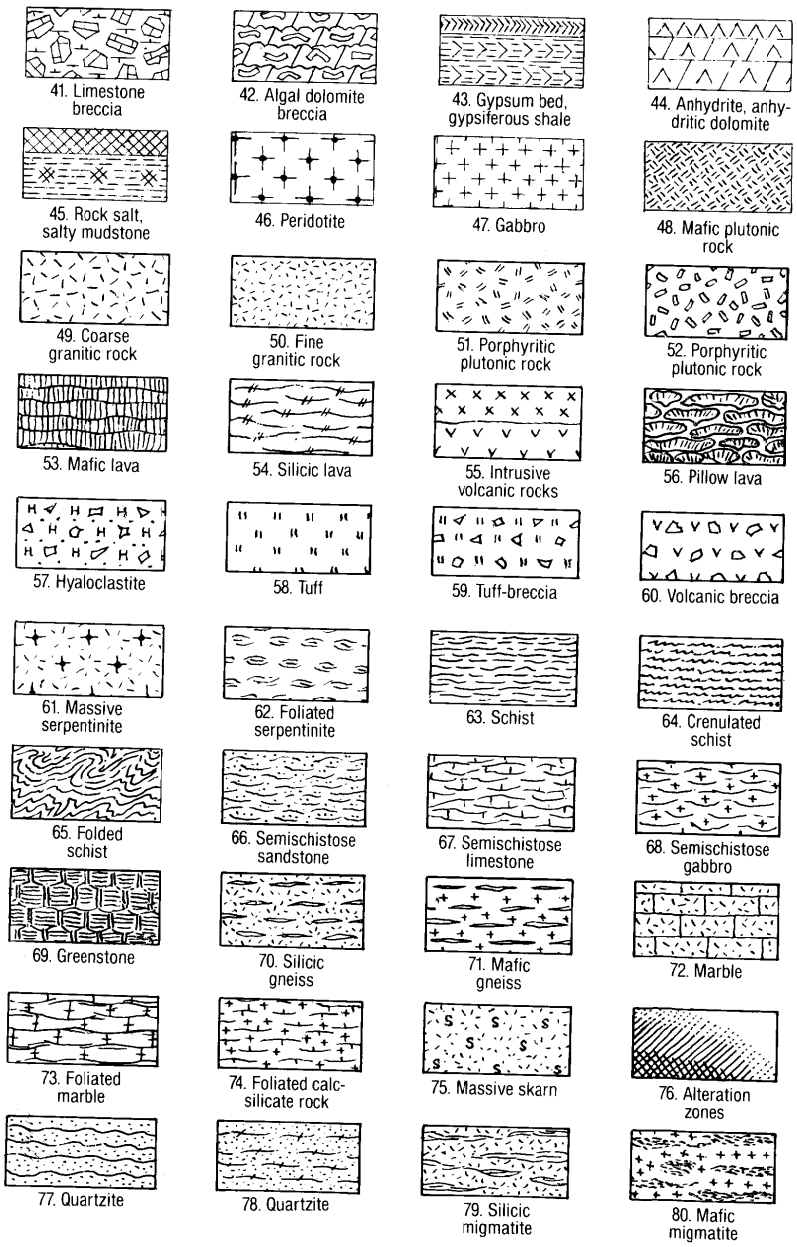
90
Drilling well or well location

91
Glory hole, open pit, or quarry, to scale

92
Dump or fill, to scale

APPENDIX 8:
Lithologic Patterns for Stratigraphic Columns and Cross Sections





APPENDIX 9:
Fossil and Structure Symbols for Columnar Sections and Field Notes*

	Algae		Tree trunk fallen
	Algal mats		Trilobites
	Ammonites		Vertebrates
	Belemnites		Wood
	Brachiopods		Beds distinct
	Bryozoans		Beds obscure
	Corals, solitary		Unbedded
	Corals, colonial		Graded beds
	Crinoids		Planar cross-bedding
	Echinoderms		Trough cross-bedding
	Echinoids		Ripple structures
	Fish bones		Cut and fill
	Fish scales		Load casts
	Foraminifers, general		Scour casts
	Foraminifers, large		Convolution
	Fossils		Slumped beds
	Fossils abundant		Paleosol
	Fossils sparse		Mud cracks
	Gastropods		Salt molds
	Graptolites		Burrows
	Leaves		Pellets
	Ostracodes		Oolites
	Pelecypods		Pisolites
	Root molds		Intraclasts
	Spicules		Stylolite
	Stromatolites		Concretion
	Tree trunk in place		Calcitic concretion

*Chiefly after the *Standard Legend* of the Royal Dutch/Shell Group of Companies (Shell International Petroleum Maatschappij B. V., The Hague, July 1977)

APPENDIX 10: Major Geochronologic and Chronostratigraphic Units in Use by the U.S. Geological Survey[1]

Eon or Eonothem	Era or Erathem	Period or System	Epoch or Series	Age estimates of boundaries in millions of years[2]
Phanerozoic	Cenozoic (Cz)	Quaternary (Q)	Holocene	0.010
			Pleistocene	
		Tertiary (T) — Neogene Subperiod or Subsystem (N)	Pliocene	2 (1.7–2.2)
			Miocene	5 (4.9–5.3)
		Tertiary (T) — Paleogene Subperiod or Subsystem (Pε)	Oligocene	24 (23–26)
			Eocene	38 (34–38)
			Paleocene	55 (54–56)
	Mesozoic (Mz)	Cretaceous (K)	Late / Early (Upper / Lower)	63 (63–66) – 96 (95–97)
		Jurassic (J)	Late / Middle / Early (Upper / Middle / Lower)	138 (135–141)
		Triassic (Ŧ)	Late / Middle / Early (Upper / Middle / Lower)	205 (200–215)
	Paleozoic (Pz)	Permian (P)	Late / Early (Upper / Lower)	~240
		Carboniferous Periods or Systems (C) — Pennsylvanian (IP)	Late / Middle / Early (Upper / Middle / Lower)	290 (290–305)
		Carboniferous Periods or Systems (C) — Mississippian (M)	Late / Early (Upper / Lower)	~330
		Devonian (D)	Late / Middle / Early (Upper / Middle / Lower)	360 (360–365)
		Silurian (S)	Late / Middle / Early (Upper / Middle / Lower)	410 (405–415)
		Ordovician (O)	Late / Middle / Early (Upper / Middle / Lower)	435 (435–440)
		Cambrian (€)	Late / Middle / Early (Upper / Middle / Lower)	500 (495–510)
Precambrian (pC)[3]	Proterozoic (P)	Late Proterozoic[4] (Z)		~570[2]
		Middle Proterozoic[4] (Y)		900
		Early Proterozoic[4] (X)		1600
	Archean (A)	Late Archean[4] (W)		2500
		Middle Archean[4] (V)		3000
		Early Archean[4] (U)		3400
	pre-Archean (pA)—an informal time term without specific rank.			3800? – 4550

1. Format modified slightly from Sohl, N.L., and Wright, W.B. (1980, *Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1979:* U.S. Geological Survey Bulletin 1502-A, p. A1-A3.), with Precambrian units from Harrison, J.E., and Peterman, Z.E. (1980, A preliminary proposal for the Precambrian of the United States and Mexico: *Geological Society of America Bulletin,* v. 91, p. 1128-1133). See these articles for sources of the original data.
2. Ranges reflect uncertainties of isotopic and biostratigraphic age assignments. Ages of boundaries not closely bracketed by data shown by ~.
3. A time term without specific rank.
4. Time terms only.