LEGEND

STRATIFIED SEQUENCE (Mainly marine) — Most complete sequences | Combinations

CONTINENTAL DEPOSITS

EUGEOSYNCLINAL DEPOSITS

VOLCANIC ROCKS

PLUTONIC AND INTRUSIVE ROCKS

METAMORPHIC ROCKS

CENOZOIC

QUATERNARY

- Qh — Holocene
- Qp — Pleistocene. *Glacial deposits not included, see below* (Atlantic and Gulf Coastal Plains and part of Great Plains)
- Limits of Pleistocene glacial deposits. *Solid line, Wisconsin glaciations; broken line, older glaciations. North of these lines, extensive areas of bedrock are concealed* (Northern interior region, Pennsylvania to Montana)
- Q — Quaternary. *Only large areas and thick deposits shown* (Western United States)
- Qv, Qf — Quaternary volcanic rocks. Qf, *Felsic volcanic rocks*

TERTIARY

- Tp — Pliocene
- Tm — Miocene
- To — Oligocene
- Te3 — Jackson Group (EOCENE; Atlantic and Gulf Coastal Plains)
- Te2 — Claiborne Group (EOCENE; Atlantic and Gulf Coastal Plains)
- Te1 — Wilcox Group (EOCENE; Atlantic and Gulf Coastal Plains)
- Tx — Paleocene. *Includes Midway Group of Gulf Coastal Plain*
- Te — Eocene
- Tpc — Pliocene continental deposits
- Tmc — Miocene continental deposits
- Toc — Oligocene continental deposits
- Tec — Eocene continental deposits
- Tel — Eocene lacustrine deposits
- Txc — Paleocene continental deposits
- Tmoe — Miocene and Oligocene eugeosynclinal deposits (Olympic Peninsula, Washington in Olympic Peninsula)
- Toee — Oligocene and Eocene eugeosynclinal deposits (Olympic Peninsula, Washington in Olympic Peninsula)
- Tee — Eocene eugeosynclinal deposits (Olympic Peninsula, Washington in Olympic Peninsula)
- Tpv, Tpf — Pliocene volcanic rocks. Tpf, *felsic volcanic rocks*
- Tmv, Tmf — Miocene volcanic rocks. Tmf, *Felsic volcanic rocks*
- lTv, lTf — Lower Tertiary volcanic rocks. *Oligocene and Eocene; some Cretaceous included in Arizona and elsewhere*. lTf, *felsic volcanic rocks in southwestern Colorado*
- Teb — Eocene marine pillow basalt (Coast Ranges of Washington and Oregon)
- uTa — Upper Tertiary andesite (Cascade Range of Washington and Oregon)
- lTa — Lower Tertiary andesite (Cascade Range of Washington and Oregon)
- Tt — Tertiary intrusive rocks. *Plugs, stocks, and laccoliths of all Tertiary ages; some granite plutons of early to middle Tertiary age*

MESOZOIC

CRETACEOUS

UPPER

- uK4 — Navarro Group (=Laramie and other formations)
- uK3, uK3b, uK3a — Taylor Group (=Montana Group). *In Montana plains, separated into uK3a and b at base of Judith River Formation*
- uK2 — Austin and Eagle Ford Groups (=Colorado Group)
- uK1 — Woodbine and Tuscaloosa Groups (=Dakota Group). *Lower Cretaceous included in parts of Rocky Mountain region*
- (Atlantic and Gulf Coastal Plains and western interior region)
- uK — Upper Cretaceous
- Kc — Cretaceous continental deposits. *Includes Upper and Lower Cretaceous, depending on locality*
- Ke — Cretaceous eugeosynclinal deposits. *Mainly Upper Cretaceous, some Paleocene and Eocene* (Northwestern California)
- Kv — Cretaceous volcanic rocks (Montana, Arizona, and New Mexico)
- lKg3 — Latest Cretaceous granitic rocks. *Laramide granitic rocks of common usage. Mainly 70 to 80 my, but includes early Tertiary in places* (Arizona, Colorado, and Montana)
- Kg2 — Upper Cretaceous granitic rocks. *80–90 my* (Sierra Nevada, California)
- Kg1 — Lower Cretaceous granitic rocks. *105–120 my* (Sierra Nevada, California)
- Kg, Kgn — Cretaceous granitic rocks. Kgn, *border gneiss of Idaho batholith* (Western United States)
- Ki — Cretaceous intrusive rocks. *Small plugs and stocks of alkalic rocks* (Arkansas)

LOWER

- lK3 — Washita Group
- lK2 — Fredericksburg Group
- lK1 — Trinity Group
- (Texas)
- lK — Lower Cretaceous

JURASSIC

- J — Jurassic
- Jc — Jurassic continental deposits (Minnesota, Iowa, and Michigan)
- uMe — Upper Mesozoic eugeosynclinal deposits. *Lower Cretaceous to Upper Jurassic, but with uncertain limits; includes Franciscan assemblage of California* (Western California, Oregon, and Washington)
- lMv — Lower Mesozoic volcanic rocks (Central Nevada, southern Arizona, and New Hampshire)
- Jg — Jurassic granitic rocks
- Jmi — Jurassic mafic intrusives (Western Nevada)

TRIASSIC

- JTr — Lower Jurassic and Upper Triassic. *Glen Canyon Group* (Colorado Plateau)
- Tr — Triassic. *Mainly marine, but includes continental Dockum Group in Texas and New Mexico, and Newark Group in Appalachian region*
- lMe — Lower Mesozoic
- lMe — Lower Mesozoic eugeosynclinal deposits. *Middle and lower Jurassic and Triassic* (Western United States)
- Tv — Mafic lava interbedded in Triassic Newark Group (Central Appalachians and New England)
- Rg — Triassic granitic rocks
- Tri — Triassic mafic intrusives. *In Newark Group* (Appalachian region)
- TRPe — Triassic and Permian eugeosynclinal deposits. *Dominantly volcanic* (Oregon, California and Nevada)

PALEOZOIC

PERMIAN

- P4 — Ochoan Series
- P3b — Upper part of Guadalupian Series
- P3a — Lower part of Guadalupian Series
- P2b — Upper part of Leonardian Series
- P2a — Lower part of Leonardian Series
- P1 — Wolfcampian Series
- (Midcontinent region (central Texas to Kansas), New Mexico, and northern Arizona. Note: Subdivisions of Guadalupian and Leonardian Series are operational units, which are not necessarily correlative from one area to another; see diagram.)
- P4 — Ochoan Series
- P3 — Guadalupian Series
- P2 — Leonardian Series
- P1 — Wolfcampian Series
- (West Texas standard)
- P — Permian. *Smaller areas included in undifferentiated upper Paleozoic* (Colorado Plateau and Great Basin)
- P2ac — Continental deposits of early Leonardian age
- P1c — Continental deposits of Wolfcampian age (Northern Texas, southern Oklahoma, and New Mexico)
- Pe — Permian eugeosynclinal deposits. *Mostly not separated from undifferentiated upper Paleozoic eugeosynclinal deposits* (Klamath Mountains and Northern Sierra Nevada, California)
- Units not differentiated as to age:
- Dikes. *Mainly Triassic in Appalachian region, Precambrian in Minnesota, Tertiary in western United States*
- um — Ultramafic rocks. *Of Paleozoic age in Appalachian region; of upper Paleozoic and Mesozoic age in western United States; a few of Precambrian age*

CARBONIFEROUS SYSTEMS

PENNSYLVANIAN

UPPER

- lP4 — Virgilian Series (=Monongahela Group)
- lP3 — Missourian Series (=Conemaugh Group)

MIDDLE

- lP2 — Des Moinesian Series (=Allegheny Group)

LOWER

- lP1, lP1a — Atokan and Morrowan Series (=Pottsville Group). lP1a, *Jackfork Sandstone of Morrowan age in Ouachita Mountains*
- (Central interior region, from Appalachians to Kansas and central Texas)
- lP — Pennsylvanian
- uPe, P, uPzc — Upper Paleozoic. P, *Permian separated in part; uPzc, clastic wedge facies in Nevada and Idaho; Diamond Peak, Wood River, Milligen and associated formations* (Western United States)
- uPe — Upper Paleozoic eugeosynclinal deposits. *Permian separated in a few places: see above* (Western United States)
- Pg3 — Upper Paleozoic granitic rocks. *About 250–300 my. Mainly in southeast part of Piedmont province, where they are post-metamorphic; rare in New England*
- cat — Cataclastic rocks. *Produced by Paleozoic orogenies* (Piedmont province)

MISSISSIPPIAN

UPPER

- M3 — Chesterian Series

MIDDLE

- M2 — Meramecian Series

LOWER

- M1 — Osagean and Kinderhookian Series
- M — Mississippian
- Pzmi — Paleozoic mafic intrusives. *Of various ages, not differentiated* (Appalachian region)
- ms, m1, m2, m3, m4 — Metamorphic complexes. *Metamorphosed during Phanerozoic orogenies. Ages of original rocks uncertain; in Piedmont province may be largely Precambrian Z, but with some lower Paleozoic; in northern Washington may be largely lower to upper Paleozoic*
  - ms, *schist and phyllite*
  - m1, *felsic paragneiss and schist*
  - m2, *mafic paragneiss (=hornblende and amphibolite)*
  - m3, *migmatite*
  - m4, *felsic orthogneiss (=granite gneiss)*
  - (Piedmont province and northern Washington)

DEVONIAN

- D3 — Upper Devonian
- D2 — Middle Devonian
- D1 — Lower Devonian
- D — Devonian
- DS — Devonian and Silurian
- D3c — Upper Devonian continental deposits
- D2c — Middle Devonian continental deposits (New York, Pennsylvania, and Maine)
- De — Devonian eugeosynclinal deposits (Appalachian region)
- DSe — Devonian and Silurian eugeosynclinal deposits (New England)
- Dv — Devonian volcanic rocks (Appalachian region)
- DSv — Devonian and Silurian volcanic rocks (Appalachian region)
- Pzg2 — Middle Paleozoic granitic rocks. *About 350–400 my. In New England, New Hampshire Plutonic Series and others, related to Acadian orogeny; in Piedmont province, symmetamorphic* (Appalachian region (New England and Piedmont province), rarely in western United States)

SILURIAN

- S3 — Upper Silurian (Cayugan)
- S2 — Middle Silurian (Niagaran)
- S1 — Lower Silurian (Alexandrian)
- S — Silurian (Eastern United States)
- Se — Silurian eugeosynclinal deposits (Appalachian region)
- SOe — Silurian and Ordovician eugeosynclinal deposits (New England)
- lPe — Lower Paleozoic eugeosynclinal deposits (Western United States)
- Sv — Silurian volcanic rocks (Appalachian region)

ORDOVICIAN

- O3 — Upper Ordovician (Cincinnatian)
- O2 — Middle Ordovician (Mohawkian). *Upper Ordovician included in places*
- O1, O1b, O1a — Lower Ordovician (Canadian). *In Ozark Plateau of Missouri, divided into O1a and b at base of Jefferson City Dolomite*
- O — Ordovician
- lPz, C — Lower Paleozoic. C, *Cambrian separated in part* (Western United States and Piedmont province)
- OC — Lower Ordovician and Cambrian carbonate rocks (New York and western New England)
- Oe — Ordovician eugeosynclinal deposits (Appalachian region)
- Ov — Ordovician volcanic rocks (Appalachian region)
- Pzg1 — Lower Paleozoic granitic rocks. *About 400–500 my. In New England, Highlandcroft and Oliverian Plutonic Series, related to Taconian orogeny; in Piedmont province premetamorphic* (Appalachian region (New England and Piedmont province), rarely in western United States)

CAMBRIAN

- Є, Єq — Cambrian. Єq, *basal Lower Cambrian clastic rocks, Chilhowee Group and equivalents, shown separately in parts of Appalachian region*
- Єe — Cambrian eugeosynclinal deposits (Appalachian region)
- Єv — Cambrian volcanic rocks (Appalachian region)
- Єg — Cambrian granitic rocks. *About 500 my* (Oklahoma and Colorado)

PRECAMBRIAN

Z — 800 my to beginning of Cambrian

- Z — Z sedimentary rocks. *Includes (among other units): In Appalachian region, Ocoee Supergroup and Lynchburg Formation, including rocks older than 800 my; in Lake Superior region, Bayfield Group, Jacobsville and Hinckley Sandstones; in northwestern United States, Windermere Group; in Great Basin, Noonday, Johnnie, and other formations; in Grand Canyon, Chuar Group of Grand Canyon Supergroup*
- Zv — Z volcanic rocks. *In Appalachian region, Catoctin Greenstone, and related units, including rocks older than 800 my*
- Zg — Z granitic rocks. *About 650–800 my*

Y — 1600 to 800 my

BELT SUPERGROUP

- Y3 — Missoula Group
- Y2 — Wallace, Siyeh, and Helena Formations
- Y1 — Ravalli Group and Prichard Formation
- (Northwestern Montana and northern Idaho)
- Y — Y sedimentary rocks. *Includes (among other units): In Lake Superior region, Oronto Group of Keweenawan Supergroup, and Sioux Quartzite; in northwestern United States, undivided Belt Supergroup; in Utah, Big Cottonwood Group; in southwestern United States, Pahrump Group, Unkar Group of Grand Canyon Supergroup, Apache Group and Troy Quartzite; in northern Adirondack Mountains, Grenville Group*
- Yv — Y volcanic rocks. *Mafic lavas in Keweenawan Supergroup*
- Yg2 — Younger Y granitic rocks. *About 1000 my*
- Yg1 — Older Y granitic rocks. *About 1300–1400 my*
- Ys — Syenite (Adirondack Mountains and elsewhere)
- Ya — Anorthosite (Adirondack Mountains and elsewhere)
- Ymi — Mafic intrusives. *Includes Duluth Gabbro Complex* (Lake Superior region)
- Ym — Paragneiss and schist
- Ygn — Orthogneiss

X — 2500 to 1600 my

- X — X metasedimentary rocks. *Includes (among other units): In Lake Superior region, Animikie Group and Marquette Range Supergroup; in South Dakota and Wyoming units in Black Hills and Medicine Bow Mountains; in Arizona, Mazatzal Quartzite, Yavapai Series, Pinal Schist, and metavolcanic formations. Iron formations of Lake Superior region separately shown in red*
- Xv — X volcanic rocks. *Associated with X sedimentary rocks in northern Wisconsin*
- Xg — X granitic rocks. *About 1700–1800 my*
- Xm — Orthogneiss and paragneiss. *Extensive in western and southwestern United States; of varied compositions and origins*

W — 2500 my and older

- W — W metasedimentary rocks. *Includes (among other units): In Lake Superior region, Knife Lake Group; in Montana, Cherry Creek Group; various units in Wyoming*
- Wv — W volcanic rocks. *Ely Greenstone and other units in Lake Superior region*
- Wg — W granitic rocks. *2500 my and older*
- Wmi — W mafic intrusives. *Stillwater Complex of Montana*
- Wgn — Orthogneiss and paragneiss

DIAGRAM OF PERMIAN STRATA, NORTHERN ARIZONA TO MIDCONTINENT

[SHOWING UNITS USED ON U.S. MAP]

GREAT BASIN	NORTHERN ARIZONA	NEW MEXICO	CENTRAL TEXAS	OKLAHOMA	KANSAS & NEBRASKA	WEST TEXAS STANDARD
P Permian undivided		P4 Rustler Fm, Salado Fm, Castile Fm	P4 Quartermaster Fm, *Claytonville Dol*	P4 Quartermaster Fm		P4 Ochoan Series
		P3b Artesia Gp	P3b Cloud Chief Fm, Whitehorse Gp	P3b Cloud Chief Fm, Whitehorse Gp	P3b Whitehorse Gp	P3 Guadalupian Series
	P2b Kaibab Ls, Toroweap Fm	P2b San Andres Ls	P3a Blaine Fm, San Angelo Ss	P3a El Reno Gp	P3a various units	
			P2b Clear Fork Gp, *Leuders Ls*	P2b Hennessy Sh	P2b Nippewalla Gp, *Stone Corral Fm*	P2 Leonardian Series
	P2a Coconino Ss, Hermit Sh, Supai Fm	P2a Glorieta Ss, Yeso Fm	P2a Wichita Gp, *Coleman Jct Mbr*	P2a Garber Ss	P2a various units	
		P1c Abo Ss	P1 Cisco Gp (part), *Saddle Cr Mbr*	P1 Wellington Fm etc.	P1 various units	P1 Wolfcampian Series

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