

Changes in Stratigraphic Nomenclature by the U.S. Geological Survey, 1973

By GEORGE V. COHEE *and* WILNA R. WRIGHT

CONTRIBUTIONS TO STRATIGRAPHY

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**CHANGES IN STRATIGRAPHIC NOMENCLATURE
BY THE U.S. GEOLOGICAL SURVEY, 1973**

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LISTING OF NOMENCLATURAL CHANGES

In the following table, stratigraphic names adopted, revised, reinstated, or abandoned are listed alphabetically. The age of the unit, the revision, and the area involved, along with the author's name and date of publication of the report, are given. The publication in which the changes in nomenclature were made are listed in the references at the end of this publication. The capitalization of age terms in the age column follows official usage.

The following formal designations of Precambrian time are now in use by the U.S. Geological Survey:

Precambrian Z—base of Cambrian to 800 m.y.

Precambrian Y—800 m.y. to 1,600 m.y.

Precambrian X—1,600 m.y. to 2,500 m.y.

Precambrian W—older than 2,500 m.y.

The scheme of subdivisions has been devised simply to facilitate depiction and analysis of the Precambrian history of the United States. The time boundaries have been chosen so as to split as few of the known epochs of sedimentation, orogeny, and plutonism as possible. The boundaries do not correspond intentionally to geologic events. The scheme is intended as an interim measure, pending development of an internationally accepted standard.

For depiction on maps, only the letter designations (W, X, Y, Z) will be shown as map symbols, and lowercase letters will indicate the group or formation names as appropriate. If a unit extends across the boundary between letter-designated units, both letters, the younger first, will be used in the map symbol. When geochronologic data are not adequate for unit assignment, only the general term Precambrian and the symbol pC will be used. Rock units and events within a major time unit such as W, X,

Y or Z, keyed to geochronologic data as available, will be shown on map explanations by simple sequential arrangement.

The previously used age designations for the Precambrian are

Name	Age	Location
Admire Group -----	Early Permian -----	Kansas, Oklahoma, and Nebraska.
Adobe Town Member (of Washakie Formation).	middle and late Eocene.	Washakie Basin, southwestern Wyoming.
Agua Sandstone Member (of Temblor Formation).	late Oligocene -----	Southern California --
Albee Formation -----	Early and Middle Ordovician.	Northern New Hampshire and easternmost Vermont.
Amador Group -----	Middle(?) and Late Jurassic.	Central California ----
Ames Knob Formation -	Early Silurian to Early Devonian.	Coastal Maine -----
American Flat Latite --	Oligocene -----	Southwestern Colorado.
Amygdaloid Island Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Anarchist Group -----	Late(?) Permian -----	North-central Washington.
Anvil Rock Sandstone Member (of Lisman Formation).	Late Pennsylvanian --	Western Kentucky ----

given in the table because they were used by the authors in reports submitted to the Geologic Names Committee before the new scheme was adopted.

Revision and reference

- Admire Group geographically extended into Nebraska. (Burchett and others, 1972.)
- Adobe Town Member, upper member of Washakie Formation (reintroduced), adopted. Unconformably overlies Kinney Rim Member (new lower member) of Washakie in western part of basin and Laney Shale Member of Green River Formation in eastern part; unconformably underlies Browns Park Formation at south edge of basin. Its rocks formerly included in parts of Bridger and Uinta Formations (now restricted from use in basin). (Roehler, 1973a.)
- In Temblor Range, Agua Sandstone Member of Santas Shale of Clark and Clark (1935) adopted and reassigned as Agua Sandstone Member of Temblor Formation. (Dibblee, 1973.)
- Geographically extended into west-central Maine and divided into (ascending): Kennebago, Portage Brooks, and Deer Mountain Members (all three new). Age changed from Middle Ordovician to Early and Middle Ordovician.
- Amador Group abandoned. Its three formations, Cosumnes, Logtown Ridge, and Peñon Blanco, remain in good usage but are no longer assigned to any named group. (Sharp and Duffield, 1973.)
- Age changed from Silurian to Early Silurian to Early Devonian. Underlies Thorofare Andesite. (Brookins and others, 1973.)
- Age changed from Miocene to Oligocene. (Lipman and others, 1973.)
- Amygdaloid Island Flow adopted as trap flow, first of 12 named flows within Portage Lake Volcanics on Isle Royale. Eruption sequence: before Hill Point Flow (of Portage Lake, new name). (Huber, 1973.)
- Anarchist Series of Daly (1912) adopted, redefined, and reduced in rank to Anarchist Group (stratigraphically restricted to lower and middle parts of Anarchist Series as used by Waters and Krauskopf, 1946; Waters and Krauskopf's upper part of Anarchist now included in Kobau Formation, formerly Kobau Group of Bostock, 1940). Anarchist Group includes (ascending): Spectacle and Bullfrog Mountain Formations (both new names). Base not exposed; unconformably underlies Kobau Formation or Palmer Mountain Greenstone (new name). (Rinehart and Fox, 1972.)
- Former member of Lisman Formation (now abandoned), reassigned to lower part of Sturgis Formation (new). Overlies Providence Limestone Member of Sturgis; underlies Madisonville Limestone Member of Sturgis. (Kehn, 1973.)

Name	Age	Location
Ardmore Bentonite Bed (of Sharon Springs Member) (of Pierre Shale).	Late Cretaceous -----	Wyoming, South Dakota, and Montana.
Avenal Sandstone -----	early and middle Eocene.	Southern California --
Aziscohos Formation ---	Early Ordovician -----	West-central Maine, northern New Hampshire.
Bachelor Mountain Rhyolite.	Oligocene -----	South-central Colorado.
Badger Spring Grano- diorite.	Precambrian -----	Central Arizona -----
Barker Porphyry -----	Eocene -----	Montana -----
Barnwell Formation ---	late Eocene (Jackson) _	South Carolina and Georgia.
Basey Member (of Snowshoe Formation).	Middle Jurassic -----	Eastern Oregon -----
Bearpaw Shale (of Montana Group).	Late Cretaceous -----	Montana and Wyoming.
Beattyville Shale Member (of Lee Formation).	Early Pennsylvanian _	Eastern Kentucky ----
Beaverdam Run Member (of Catskill Forma- tion).	Late Devonian -----	Eastern Pennsylvania _
Bell Creek Gneiss -----	Precambrian W -----	Northern Peninsula, Michigan.
Bell Springs Member (of Nugget Sandstone).	Late Triassic(?) -----	Wyoming -----
Belridge Diatomite Member (of Monterey Shale).	late Miocene -----	Southern California --
Bergman Group -----	Early and Late Cretaceous.	Alaska -----

Revision and reference

- Geographically extended into south-central Montana and assigned to Claggett Shale as bed near its base. In Wyoming, assigned to Mesaverde Formation in southern Bighorn Basin and to Cody Shale in northern Bighorn and Powder River Basins; remains bed of Sharon Springs Member of Pierre Shale in Red Bird area of Wyoming and at its type locality in South Dakota. (Gill and Cobban, 1973.)
- Geographically extended to include rocks west of McLure Valley called Acebedo Sandstone by Dickinson (1963) and rocks in Devils Den area called Mabury Sandstone by Van Couvering and Allen (1943). (Dibblee, 1973.)
- Aziscohos Formation of Green (1964) adopted. Gradational into overlying Albee Formation. (Harwood, 1973.)
- Name changed from Bachelor Mountain Rhyolite to Bachelor Mountain Tuff. (Steven and Ratté, 1973.)
- Badger Spring Granodiorite adopted. Intrudes Bumblebee Granodiorite (new) and Spud Mountain Volcanics; underlies Hickey Formation or Quaternary deposits. (Anderson and Blacet, 1972a.)
- Age changed from Eocene(?) to Eocene. (Keefer, 1972.)
- Assigned to Orangeburg Group (now reinstated, raised in rank, and restricted to Orangeburg and surrounding counties in south-central South Carolina) as uppermost of its four formations; overlies McBean Formation. (Siple and Pooser, this report, p. A55.)
- Basey Member of Dickinson and Vigrass (1965) adopted as uppermost of three members of Snowshoe Formation in Suplee area; overlies Warm Springs Member of Snowshoe. (Imlay, 1973.)
- Assigned to Montana Group (newly restricted) only in central Montana; no longer assigned to any named group in Wyoming. (Gill and Cobban, 1973.)
- Beattyville Shale Member abandoned because (1) it was poorly defined, (2) it has been applied to different stratigraphic intervals, and (3) it is neither necessary nor useful in describing Pennsylvanian stratigraphy of eastern Kentucky. Replaced by informal units of shale and sandstone. (Weir, this report, p. A56.)
- Beaverdam Run Member of Catskill Formation reassigned as Beaverdam Run Tongue of Trimmers Rock Sandstone. Overlies Walcksville Tongue of Catskill; underlies Irish Valley Member of Catskill. (Wood, 1973.)
- Bell Creek Gneiss adopted. Intruded by Compeau Creek Gneiss. (Cannon and Simons, 1973.)
- Geographically extended into northwestern Colorado. (Pipiringos, 1972.)
- Belridge Diatomite of Siegfus (1939) adopted as Belridge Diatomite Member, uppermost of four members of Monterey Shale, and geographically restricted to area northeast of San Andreas fault. Gradational into underlying McLure Shale Member of Monterey; unconformably overlain by Tulare Formation and in places disconformably overlain by Etchegoin Formation. (Dibblee, 1973.)
- Bergman Group abandoned; its rocks now included in unnamed units. (Patton, 1973.)

Name	Location	Location
Beulah Limestone -----	Mississippian -----	Central Colorado -----
Bigelow Brook Formation.	Ordovician(?) to Silurian(?).	Northeastern Connecticut.
Bitterwater Creek Shale.	late Miocene and early Pliocene(?).	Southern California --
Blanco Formation -----	Pleistocene -----	Texas Panhandle -----
Birch Creek Schist -----	Precambrian or Paleozoic.	Alaska -----
Blue Mesa Tuff -----	late Oligocene -----	Southwestern Colorado.
Bobcat Member (of Harebell Formation).	Late Cretaceous -----	Yellowstone National Park area of north- western Wyoming.
Bowser Formation -----	Middle Jurassic -----	Cook Inlet area, southern Alaska.
Branch Canyon Sand- stone.	middle and late Miocene.	Southern California --
Bridger Formation -----	middle and late Eocene.	Wyoming, Colorado, and Utah.
Brynt Draw Member (of Popo Agie Formation) (of Chugwater Group).	Late Triassic -----	Wyoming -----
Bullfrog Mountain Formation (of Anarch- ist Group).	Late(?) Permian -----	North-central Washington.
Bumblebee Granodiorite.	Precambrian -----	Central Arizona -----
Burns Formation (of Silverton Volcanic Group).	Oligocene -----	Southwestern Colorado.

Revision and reference

- Beulah Limestone and underlying Hardscrabble Limestone abandoned; their rocks now included in Leadville Limestone (more widely used term), now geographically extended into central Colorado. (Scott, this report, p. A48.)
- Bigelow Brook Formation adopted. Structurally overlies Southbridge Formation (new name); unconformably underlies Pleistocene deposits. (Pease, 1972.)
- Bitterwater Creek Shale of Dibblee (1962) adopted. Disconformably(?) overlies Santa Margarita Formation; unconformably underlies Paso Robles Formation. (Dibblee, 1973.)
- Stratigraphically restricted and redefined following usage of Evans and Meade (1945). Age changed from middle Pliocene to Pleistocene. (Izett and others, 1972.)
- Birch Creek Schist abandoned because it contains too many rocks of varying age. Replaced by informally named units. (Foster and others, 1973.)
- Blue Mesa Tuff now considered same as one of four unnamed ash-flow sheets of Gilpin Peak Tuff (abandoned). (Lipman and others, 1973.)
- Bobcat Member adopted as upper unit of Harebell (now redefined and stratigraphically extended) and replaces former basal conglomeratic unit of overlying Pinyon Conglomerate (now redefined and stratigraphically restricted). Overlies unnamed lower member of Harebell. (Love, 1973).
- Age changed from Middle(?) and Late Jurassic to Middle Jurassic. (Imlay and Detterman, 1973.)
- Branch Canyon Formation of Hill, Carlson, and Dibblee (1958) adopted as Branch Canyon Sandstone. Intertongues with Saltos Shale Member of Monterey Shale and Caliente Formation; conformably underlies Santa Margarita Formation. (Dibblee, 1973.)
- Bridger and Uinta Formations restricted from use in Washakie Basin, southwestern Wyoming. Their rocks now included in Washakie Formation (reintroduced as defined by Hayden, 1869) and its two members, Kinney Rim and Adobe Town (both new). Their usage elsewhere remains unchanged. (Roehler, 1973a.)
- Geographically extended into northwestern Colorado. (Pipiringos, 1972.)
- Bullfrog Mountain Formation adopted as upper of two newly named formations of Anarchist Group (formerly lower part of Anarchist Series of Daly, 1912). Conformably overlies Spectacle Formation (new name) of Anarchist; unconformably(?) underlies Kobau Formation (formerly Kobau Group of Postock, 1940) or Palmer Mountain Greenstone (new name). (Rinehart and Fox, 1972.)
- Bumblebee Granodiorite adopted. Intrudes Spud Mountain Volcanics; intruded by Badger Spring Granodiorite (new); underlies Hickey Formation. (Anderson and Blacet, 1972a.)
- No longer included in Silverton Volcanic Group (abandoned). (Lipman and others, 1973.)

Name	Age	Location
Bursum Formation (of Magdalena Group).	Early Permian (Wolfcampian).	Central New Mexico --
Buttonbed Sandstone Member (of Temblor Formation).	middle Miocene -----	Southern California --
Caliente Formation ----	Oligocene(?), Miocene, and Pliocene.	Southern California --
Campbell Mountain Member (of Bachelor Mountain Rhyolite).	Oligocene -----	South-central Colorado.
Canyon Lake Member of Superstition Tuff).	Miocene -----	South-central Arizona--
Cape Foulweather Basalt.	middle Miocene -----	Northwestern Oregon and southwestern Washington.
Carman Sandstone Member (of Etchegoin Formation).	Pliocene -----	West-central California.
Carneros Sandstone Member (of Temblor Formation).	early Miocene (Saucasian).	Southern California --
Carpenter Creek Porphyry.	Eocene -----	Montana -----
Carthage Limestone Member (of Lisman Formation).	Late Pennsylvanian --	Western Kentucky and southern Illinois.
Carthage Limestone Member (of Lisman Formation).	Late Pennsylvanian --	Western Kentucky ---
Castine Volcanics -----	Early Devonian -----	Coastal Maine -----
Casto Volcanics -----	Permian(?) -----	Idaho -----

Revision and reference

- In southern part of Manzano Mountains, reassigned to Madera Group as uppermost of its three formations; overlies Wild Cow Formation (new). In northern part of Manzano Mountains, equivalent rocks not separately mappable included in La Casa Member of Wild Cow Formation. Bursum remains uppermost formation of Magdalena Group elsewhere. (Myers, 1973.)
- In Temblor Range, Buttonbed Sandstone Member adopted as uppermost of seven members of Temblor Formation. Overlies or intertongues with Media Shale Member of Temblor; conformably underlies Gould Shale Member of Monterey Shale. (Dibblee, 1973.)
- Caliente Formation of Dibblee (in Stock, 1948) adopted as used by Hill, Carlson, and Dibblee (1958); includes rocks formerly assigned to Pato Red Member (now abandoned) of Vaqueros Formation. Overlies or intertongues with Vaqueros Formation and Branch Canyon Sandstone (new name); conformably underlies Quatal Formation. (Dibblee, 1973.)
- Formation affiliation name changed to Bachelor Mountain Tuff. (Steven and Ratté, 1937.)
- Canyon Lake Member of Stuckless and Sheridan (1971) adopted as uppermost of the three members in their Superstition Tuff. Overlies Geronimo Head Formation (newly adopted), which intertongues with Superstition. (Stuckless and O'Neil, 1973.)
- Cape Foulweather Basalt adopted. It is of the same origin as the late-Yakima-type basalt. Unconformably overlies Astoria Formation, an unnamed sandstone and siltstone unit, or Depoe Bay Basalt (new); underlies middle Miocene siltstone offshore; intrudes Astoria and Caquina Formations near Caquina Head. (Snively and others, 1973.)
- Carman Sandstone adopted as upper of two members of Etchegoin Formation (in subsurface of Elk Hills report area). Overlies Tupman Shale Member (new); underlies San Joaquin Formation. (Berryman, 1973.)
- In Temblor Range, Carneros Sandstone Member of Temblor Formation of Cunningham and Barbat (1932) adopted. Conformably overlies Santos Shale Member; conformably underlies Media Shale Member. (Dibblee, 1973.)
- Age changed from post-Cretaceous (?) to Eocene. (Keefer, 1972.)
- Carthage Limestone of Owen (1856) adopted as Carthage Limestone Member of Lisman Formation as used by Smith and Smith (1967). Overlies Madisonville Limestone Member. (Johnson, 1973.)
- Former member of Lisman Formation (now abandoned), reassigned to lower part of Sturgis Formation (new). Overlies Madisonville Limestone Member; underlies unnamed upper part of Sturgis. (Kehn, 1973.)
- Age changed from Cambrian (?) to Early Devonian. Correlates with Thoro-fare Andesite-Vinalhaven Rhyolite sequence. (Brookins and others, 1973.)
- Casto Volcanics abandoned; rocks now considered that part of Challis Volcanics (Eocene) altered by Tertiary granite (Casto pluton). (Cater and others, 1973.)

Name	Age	Location
Catskill Formation (of Susquehanna Group).	Late Devonian and Early Mississippian.	Eastern Pennsylvania.
Cerro Bravo Andesite --	Late Cretaceous(?) --	Northeastern Puerto Rico.
Challis Volcanics -----	Eocene only in this report area.	South-central Idaho --
Chisana Formation ----	Early Cretaceous ----	Southern Alaska ----
Chopawamsic Formation (of Glenarm Series).	Early Cambrian to Ordovician(?).	Northeastern Virginia.
Chuckanut Formation --	Late Cretaceous and Paleocene.	Washington -----
Claggett Shale (of Montana Group).	Late Cretaceous ----	South-central and east-central Montana.
Clarks Ferry Member (of Catskill Formation).	Late Devonian -----	Eastern Pennsylvania.
Clay Mesa Shale Tongue (of Mancos Shale).	Late Cretaceous -----	West-central New Mexico.
Cloverly Formation ----	Early Cretaceous ----	Wyoming, Montana, Colorado, and Utah.
Cody Shale (of Colorado Group) or (of Montana Group).	Late Cretaceous -----	Montana and Wyoming.
Colorado Shale/Formation/Group.	Early and Late Cretaceous.	Montana and Wyoming.

Revision and reference

- Clark's Ferry Member of Catskill Formation of Dyson (1967) adopted as Clarks Ferry Member of Catskill; age is Late Devonian. Walcksville Sandstone Member of Catskill reassigned as Walcksville Tongue of Catskill; overlies Trimmers Rock Sandstone. Beaverdam Run Member of Catskill reassigned as Beaverdam Run Tongue of Trimmers Rock. Subdivisions of Catskill are (ascending): Walcksville Tongue, [Beaverdam Run Tongue of Trimmers Rock], Irish Valley Member, Long Run Member of Sevon (1969), Berry Run Member of Sevon (1969), Clarks Ferry Member (not new), Duncannon Member of Dyson (1967) (all Upper Devonian), and Spechty Kopf Member (Upper Devonian and Lower Mississippian). (Wood, 1973.)
- Cerro Bravo Andesite adopted; intrudes Hato Puerco and Cambalache Formations. (Pease and Briggs, 1972.)
- Stratigraphically extended by including rocks formerly assigned to Casto Volcanics (now abandoned). (Cater and others, 1973.)
- Chisana Formation adopted. Conformably overlies Jurassic and Cretaceous marine mudstones; unconformably underlies Cretaceous(?) continental sedimentary rocks. (Richter and Jones, 1973.)
- Age changed from Late Cambrian to Late Ordovician to Early Cambrian to Ordovician(?). (Mixon and others, 1972.)
- Chuckanut Formation of McLellan (1927) adopted. Unconformably overlies greenschist and phyllite of Mount Shuksan; underlies or is intruded by Hannegan Volcanics or Chilliwack batholith. (Staatz and others, 1972.)
- Included in Montana Group in south-central and east-central Montana, Ardmore Bentonite Bed geographically extended into south-central Montana and assigned to Claggett Shale as bed near its base. (Gill and Cobban, 1973.)
- Clark's Ferry Member of Catskill Formation of Dyson (1967) adopted as Clarks Ferry Member. Overlies Berry Run Member of Sevon (1969); underlies Duncannon Member of Dyson (1967). (Wood, 1973.)
- Clay Mesa Shale Tongue adopted as lower of two members of Mancos. Intertongues with Dakota Sandstone, overlying its Cubero Sandstone Tongue (new) and underlying its Paguate Sandstone Tongue (new). (Landis and others, 1973.)
- Previous geographic extension of Cloverly Formation into northwestern Colorado rescinded; its rocks now included in Dakota Sandstone. Its usage elsewhere remains unchanged. (Segerstrom and Young, 1972.)
- Removed from Colorado and (or) Montana Groups and no longer assigned to any named group. Ardmore Bentonite Bed assigned to Cody Shale in northern Bighorn and Powder River Basins of Wyoming. (Gill and Cobban, 1973.)
- Cody Shale removed from Colorado Group and no longer assigned to any named group. Telegraph Creek Member removed from Colorado and Cody Shales and its member usage abandoned; Telegraph Creek remains in good usage only as lowermost formation of Montana Group in central Montana. Niobrara Formation or its equivalents now considered uppermost unit of Colorado. (Gill and Cobban, 1973.)

Name	Age	Location
Congaree Formation ---	middle Eocene (Claiborne).	South Carolina -----
Copper Harbor Con- glomerate.	Precambrian Y (mid- dle Keweenawan).	Northwestern Michi- gan and northern Wisconsin.
Consumnes Formation (of Amador Group).	Late Jurassic or older.	Central California ---
Council Grove Group --	Early Permian -----	Kansas, Oklahoma, Nebraska.
Coyote Sandstone Mem- ber (of Madera Lime- stone).	Pennsylvanian -----	New Mexico ----- Central Arizona -----
Crazy Basin Quartz Monzonite.	Precambrian -----	Southwestern Colo- rado.
Crystal Lake Tuff ----	late Oligocene -----	West-central New Mexico.
Cubero Sandstone Tongue.	Late Cretaceous ----	California -----
Cymric Shale Member (of Temblor Forma- tion).	late Oligocene -----	California -----
Dakota Sandstone ----	Early and Late Cretaceous.	Northwestern Colo- rado.
Dakota Sandstone ----	Early and Late Cretaceous.	West-central New Mexico.
Deer Mountain Mem- ber (of Albee Forma- tion).	Early and (or) Mid- dle Ordovician.	West-central Maine --
Depoe Bay Basalt ----	middle Miocene -----	Northwestern Oregon and southwestern Washington.
Devilwater Shale Mem- ber (of Monterey Shale).	middle Miocene -----	Southern California (restricted).

Revision and reference

- Assigned to Orangeburg Group (now reinstated, raised in rank, and restricted to Orangeburg and surrounding counties in south-central South Carolina) as lowermost of its four formations; underlies Warley Hill Formation. (Siple and Pooser, this report, p. A55.)
- Includes unnamed rocks previously separated into (ascending): Great, Middle, and Outer Conglomerates and intervening Lake Shore Trap (all now abandoned). (White, 1972; Wolff and Huber, 1973.)
- Removed from Amador Group (now abandoned) and no longer assigned to any named group. Stratigraphically restricted by reassignment of uppermost 610 m to overlying Logtown Ridge Formation. Age changed from Middle(?) and Late Jurassic to Late Jurassic or older. (Sharp and Duffield, 1973.)
- Council Grove Group geographically extended into Nebraska. This does not include any or all formations or members of Council Grove accepted elsewhere. (Burchett and others, 1972.)
- Coyote Sandstone Member abandoned; its rocks not included in *Sol se Mete* Member (new) of Wild Cow Formation (new). (Myers, 1973.)
- Crazy Basin Quartz Monzonite adopted. Intrudes Spud Mountain Volcanics. (Anderson and Blacet, 1972a.)
- Crystal Lake Tuff adopted. Overlies Fish Canyon Tuff; underlies Carpenter Ridge Tuff. (Lipman and others, 1973.)
- Cubero Sandstone Tongue adopted as one of four members of Dakota. Overlies Oak Canyon Member (new) of Dakota; underlies Clay Mesa Shale Tongue (new) of Mancos Shale. (Landis and others, 1973.)
- In Temblor Range, Cymric Shale Member adopted as lowermost of seven members of Temblor Formation; commonly known as Salt Creek Shale of Williams (1936), but this name is preoccupied. Disconformably overlies Point of Rocks Sandstone; conformably underlies Wygal Sandstone Member (new) of Temblor. (Dibblee, 1973.)
- Lower Cretaceous rocks formerly included in Cloverly Formation in northwestern Colorado now considered to be Dakota Sandstone. (Segerstrom and Young, 1972.)
- In west-central New Mexico, divided into (ascending): Oak Canyon Member (new), Cubero Sandstone Tongue (new), Paguate Sandstone Tongue (new), and Twowells Sandstone Tongue. Intertongues with Mancos Shale. (Landis and others, 1973.)
- Deer Mountain Member adopted as uppermost of three new members of Albee. Overlies Portage Brook Member of Albee; underlies Dixville Formation. (Harwood, 1973.)
- Depoe Bay Basalt adopted. Same origin as Yakima-type basalt. Unconformably overlies Astoria Formation; unconformably underlies sandstone of Whale Cove, unnamed sandstone, or Cape Foulweather Basalt (new). (Snavely and others, 1973.)
- In southern Coast Ranges, Devilwater Silt of Bailey (1939) adopted as one of four members of Monterey Shale and geographically restricted to area northeast of San Andreas fault. Overlies Gould Shale Member of Monterey; conformably underlies McLure Shale Member of Monterey. (Dibblee, 1973.)

Name	Age	Location
Dillon Mesa Tuff -----	late Oligocene -----	Southwestern Colorado.
Dogie Spring Member (of Superstition Tuff).	Miocene -----	South-central Arizona.
Douglas Group -----	Late Pennsylvanian (Virgil).	Kansas, Missouri, and Nebraska.
Dry Creek Shale -----	Late Cambrian -----	Montana and Wyoming.
Duffer Peak Granodiorite.	Late Cretaceous -----	Northwestern Nevada.
Eagle Sandstone (of Montana Group).	Late Cretaceous -----	Montana and Wyoming.
Eastford Gneiss -----	Early(?) Devonian --	Northeastern Connecticut.
Edwards Island Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweenaw).	Isle Royale, northern Michigan.
Elk Hills Shale Member (of Monterey Shale).	Miocene -----	Southern California --
Ellemeham Formation ..	Jurassic or Cretaceous.	North-central Washington.
Esmeralda Formation _	late Miocene to early Pliocene.	Southwestern Nevada.
Etchegoin Formation --	early and late Pliocene.	Southern California (restricted).
Etchegoin Formation --	early and late Pliocene.	Southern California --
Eureka Tuff (of Silverton Volcanic Group).	late Oligocene -----	Southwestern Colorado.
Farmers Creek Rhyolite.	Oligocene -----	South-central Colorado.
Ferron Sandstone Member (of Mancos Shale).	Late Cretaceous -----	East- and south- central Utah.

Revision and reference

- Dillon Mesa Tuff now considered same as one of four unnamed ash-flow sheets of Gilpin Peak Tuff (abandoned). (Lipman and others, 1973.)
- Dogie Spring Member of Stuckless and Sheridan (1971) adopted as middle of three members in their Superstition Tuff. Intertongues with Geronimo Head Formation newly adopted. (Stuckless and O'Neil, 1973.)
- Douglas Group geographically extended into Nebraska. This does not include any or all formations or members of Douglas accepted elsewhere. (Burchett and others, 1972.)
- Dry Creek Shale extended into Yellowstone National Park area, Wyoming, and reduced in rank to bottom member of Snowy Range Formation. Conformably underlies Sage Limestone Member; conformably overlies Pilgrim Limestone. (Ruppel, 1972.)
- Duffer Peak Granodiorite adopted. Intrudes unnamed Triassic(?) quartzite, marble, and amphibolite and Permian or older Happy Creek Volcanic Series and intruded by unnamed Cretaceous alkali and aplite; unconformably underlies unnamed Tertiary volcanic units. (Smith, 1973.)
- Assigned to Montana Group (newly restricted) only in central Montana; no longer assigned to any named group in Wyoming. (Gill and Cobban, 1973.)
- Age changed from pre-Pennsylvanian to Early (?) Devonian. (Pease, 1972.)
- Edwards Island Flow adopted as trap flow, 1 of 12 named flows, within Portage Lake Volcanics on Isle Royale. Eruption sequence: after Middle Point Flow and before Scoville Point Flow (both of Portage Lake, both new names). (Huber, 1973.)
- Elk Hills Shale Member adopted as uppermost member of Monterey Shale in subsurface of report area. Overlies McDonald Shale Member of Monterey of local usage; underlies Reef Ridge Shale. (Adkison, 1973.)
- Elleham Formation adopted. Unconformably overlies Kobau Formation (formerly Kobau Group of Bostock, 1940); underlies unnamed Tertiary clastic sequence. (Rinehart and Fox, 1972.)
- Geographically restricted to sedimentary rocks exposed in Weepah Hills. Rocks elsewhere formerly included in Esmeralda are unnamed. (Albers and Stewart, 1972.)
- Geographically restricted to area east of San Andreas fault. Stratigraphically extended in Diablo Range area to include underlying Jacalitos Formation (now abandoned) and overlying San Joaquin Formation (now geographically restricted). Overlies Reef Ridge or Monterey Shale and underlies Tulare or San Joaquin (in Kettleman Hills area) Formation. Age changed from middle Pliocene to early and late Pliocene. (Dibblee, 1973.)
- Etchegoin Formation (in subsurface of Elk Hills) divided into (ascending): Tupman Shale and Carman Sandstone Members (both new); Etchegoin remains unchanged elsewhere. (Berryman, 1973.)
- Reduced in rank to Eureka Member of Sapinero Mesa Tuff. Silverton Volcanic Group abandoned. (Lipman and others, 1973.)
- Name changed from Farmers Creek Rhyolite to Farmers Creek Tuff. (Steven and Ratté, 1973.)
- Geographically extended into west-central Colorado. (Cashion, 1973.)

Name	Age	Location
Figuera Volcanics ----	Early Cretaceous ----	Northeastern Puerto Rico.
Flag Rock Group -----	middle Precambrian --	West-central South Daktoa.
Fluorspar Canyon Formation.	Middle Devonian ----	South-central Nevada.
Fox Hills Sandstone (of Montana Group).	Late Cretaceous ----	Montana, Wyoming, the Dakotas, Colorado, and Nebraska.
Franklin Canyon Formation	Devonian(?) -----	Northern California -
Frontier Formation ---	Late Cretaceous ----	Montana, Idaho, Wyoming, Colorado, Utah.
Gammon Shale (of Montana Group).	Late Cretaceous ----	Montana and Wyoming.
Gammon Ferruginous Member (of Pierre Shale).		
Gammon Ferruginous Member (of Cody Shale).		
Geronimo Head Formation.	Miocene -----	South-central Arizona.
Gilpin Peak Tuff (of Potosi Volcanic Group).	Oligocene -----	Southwestern Colorado.
Glenarm Series -----	Precambrian to Ordovician(?) .	Virginia only -----
Glenn Shale -----	Early and Middle Jurassic.	East-central Alaska -
Goble Volcanic Series ..	latest Eocene -----	Northwestern Oregon and southwestern Washington.
Goose Egg Formation --	Permian and Early Triassic.	Wyoming and northwestern Colorado.

Revision and reference

- Figuera Formation of Meyerhoff and Smith (1931) and Figuera Volcanics of Kaye (1959) (previously abandoned) redefined and reinstated as Figuera Lava. Conformably underlies Fajardo Formation. (Briggs, 1973.)
- Flag Rock Formation, originally defined by Dodge (1942) in Lead area, adopted, geographically extended into Rochford district, and redefined as group. Includes (ascending): Montana Mine Formation, Rapid Creek Greenstone with intertonguing Nahant Schist, and Rochford Formation (all four newly named). Unconformably overlies Irish Gulch Slate and conformably underlies Poverty Gulch Slate (both newly named). (Bayley, 1972.)
- Fluorspar Canyon Formation abandoned; its rocks now assigned to middle part of Nevada Formation. (Cornwall, 1972.)
- Assigned to Montana Group (newly restricted) only in central Montana; no longer assigned to any named group elsewhere. (Gill and Cobban, 1973.)
- Age changed from Paleozoic(?) to Devonian(?). (Hietanen, 1973.)
- Name changed to Frontier Sandstone in Yellowstone National Park area, Wyoming. (Ruppel, 1972.)
- Assigned as formation to Montana Group (newly restricted) only in central Montana; no longer assigned as member of formation to any named group elsewhere. Remains in good usage as Gammon Ferruginous Member of Pierre Shale or Cody Shale in southeastern Montana or northeastern Wyoming. (Gill and Cobban, 1973.)
- Geronimo Head Formation of Stuckless and Sheridan (1971) adopted. Overlies Siphon Draw Member, intertongues with Dogie Spring Member, and underlies Canyon Lake Member (all of Superstition Tuff, all newly adopted.) (Stuckless and O'Neil, 1973.)
- Gilpin Peak Tuff and Potosi Volcanic Group abandoned. Gilpin Peak rocks now considered same as four ash-flow sheets (ascending): Ute Ridge, Blue Mesa, Dillon Mesa, and Sapinero Mesa Tuffs. (Lipman and others, 1973.)
- Age changed from latest Precambrian to Late Ordovician to Precambrian to Ordovician(?) in Virginia only; former age remains correct usage elsewhere. (Mixon and others, 1972.)
- Age changed from Middle Triassic to Early Cretaceous to Early and Middle Jurassic. (Imlay and Detterman, 1973.)
- Name changed from Goble Volcanic Series to Goble Volcanics. (MacLeod and Snively, 1973.)
- Goose Egg Formation geographically extended into northwestern Colorado; age is Permian only. (Segerstrom and Young, 1972.)

Name	Age	Location
Gould Shale Member (of Monterey Shale).	early and middle Miocene.	Southern California (restricted).
Grace Island Flow (of Portage Lake Volcanics).	Precambrian Y (mid- dle Keweenawan).	Isle Royale, northern Michigan).
Graneros Shale -----	Late Cretaceous -----	Eastern Colorado ----
Gravelly Flat Forma- tion.	Late Jurassic and Early Cretaceous.	Southern California -
Great Conglomerate ---	Precambrian Y (Keweenawan).	Lake Superior area, Michigan.
Gredal Shale Member (of Kreyenhagen Shale).	middle Eocene -----	Southern California --
Greenstone Flow (of Central Mine Group).	Precambrian Y (mid- dle Keweenawan).	Northern Michigan --
Grove Creek Member (of Snowy Range Formation) (of Gal- latin Group).	Late Cambrian -----	Montana, Idaho, and Wyoming.
Hannegan Volcanics --	early Tertiary -----	Washington -----
Hardscrabble Limestone	Mississippian -----	Central Colorado ----
Harebell Formation ---	Late Cretaceous -----	Northwestern Wyoming.
Harmony Hills Tuff Member (of Quichapa Formation).	Miocene -----	Southwestern Utah and southeastern Nevada.
Hartt Cabin Bed (of Laney Member) (of Green River Formation).	middle Eocene -----	Southwestern Wyoming.
Hebron Formation -----	Ordovician(?) to Silurian(?).	Northeastern Connecticut.
Hell Creek Formation --	Late Cretaceous -----	Central Montana ----

Revision and reference

- In southern Coast Ranges, geographically restricted to area northeast of San Andreas fault as lowermost of four members of Monterey Shale. Conformably overlies Buttonbed Sandstone Member (new name) of Temblor Formation; underlies Devilwater Shale Member or McLure Shale Member of Monterey. Age changed from middle Miocene to early and middle Miocene. (Dibblee, 1973.)
- Grace Island Flow adopted as porphyrite flow, one of 12 named flows within Portage Lake Volcanics on Isle Royale Eruption sequence: after Minong Flow and before Greenstone Flow (both of Portage Lake). (Huber, 1973.)
- Graneros Shale redefined in type locality to include only noncalcareous beds below bentonite marker bed. Formation divided into lower barren unit, Thatcher Limestone Member (redefined), and upper fossiliferous unit. (Cobban and Scott, 1972.)
- Gravelly Flat Formation of Rose and Colburn (1963) adopted. Locally includes Knoxville Formation as used by Arnold and Johnson (1910), Badger Shale of Marsh (1960), and lower and middle parts of Panoche Group of Dickinson (1966a, b). Overlies unnamed serpentine; conformably underlies Panoche Formation. (Dibblee, 1973.)
- Great Conglomerate abandoned; its rocks assigned to Copper Harbor Conglomerate. (White, 1972; Wolff and Huber, 1973.)
- Gredal Formation of Van Couvering and Allen (1948) adopted as Gredal Shale Member, lower of two members of Kreyenhagen Shale. Overlies Avenal Sandstone; underlies Point of Rocks Sandstone. (Dibblee, 1973.)
- Reassigned to Portage Lake Volcanics; geographically extended to Isle Royale, Michigan (Huber, 1973.)
- Name changed to Grove Creek Limestone Member, uppermost member of Snowy Range Formation in Yellowstone National Park area, Wyoming. Conformably overlies Sage Limestone Member; unconformably underlies Bighorn Dolomite. (Ruppel, 1972.)
- Hannegan Volcanics of Misch (1952) adopted. Overlies or intrudes Chuckanut Formation, Custer Gneiss of McTaggart and Thompson (1967), and greenschist and phyllite of Mount Shuksan. (Staatz and others, 1972.)
- Beulah Limestone and underlying Hardscrabble Limestone abandoned; their rocks now included in Leadville Limestone (a more widely used term), now geographically extended into central Colorado. (Scott, this report, p. A48.)
- Basal conglomerate removed from overlying Pinyon Conglomerate and assigned to Bobcat Member (new) of Harebell Formation. Redefined Harebell now includes unnamed lower member and Bobcat Member. (Love, 1973.)
- Geographically extended into southeastern Nevada. Age changed from Oligocene or Miocene to Miocene. (Noble and McKee, 1972.)
- Hartt Cabin Bed adopted as uppermost of three newly named beds of Laney Member (newly revised). Overlies Sand Butte and LaCledé Beds; intertongues with Sand Butte Bed and Kinney Rim Member of Washakie Formation; underlies Kinney Rim Member. (Roehler, 1973b.)
- Age changed from Devonian or older to Ordovician(?) to Silurian(?). (Pease, 1972.)
- Assigned to Montana Group (newly restricted) as uppermost formation only in central Montana; overlies Fox Hills Sandstone. (Gill and Cobban, 1973.)

Name	Age	Location
Henshaw Formation ---	Late Pennsylvanian --	Western Kentucky ----
Henson Formation (of Silverton Volcanic Group).	Oligocene -----	Southwestern Colorado.
Hex Claytsonne -----	Early Cretaceous ----	Southern California --
Hiko Tuff -----	middle Miocene -----	Southeastern Nevada _
Hill Point Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweena- wan).	Isle Royale, northern Michigan.
Horseshoe Bend Formation.	Permian(?) -----	Northern California --
Huckleberry Formation.	Precambrian Y (post- Belt).	Northeastern Washing- ton and northwestern Idaho.
Huginnin Porphyrite (of Central Mine Group).	Precambrian Y (middle Keweena- wan).	Isle Royale, northern Michigan.
Irish Gulch Slate -----	middle Precambrian --	West-central South Dakota.
Isla Mona Limestone ---	early or middle Miocene.	Isla de Mona, Puerto Rico.
Island Mine Conglom- erate (of Eagle River Group).	Precambrian Y (middle Keweena- wan).	Isle Royale, northern Michigan.
Jacalitos Formation ----	early Pliocene -----	Southern California --
Jelm Formation (of Chugwater Group).	Late Triassic -----	Wyoming and north- western Colorado.
Juana Diaz Formation _	Oligocene and early Miocene.	Southern Puerto Rico -
Judith River Formation (of Montana Group).	Late Cretaceous -----	Montana, Wyoming, and North Dakota.
Kailua Volcanic Series -	Pliocene(?) -----	Oahu, Hawaii -----

Revision and reference

Henshaw Formation abandoned; its rocks now included in upper part of Sturgis Formation (new). (Kehn, 1973.)

No longer included in Silverton Volcanic Group (abandoned). (Lipman and others, 1973.)

Hex Formation of Marsh (1960) adopted as Hex Claystone. Its stratigraphic position is not definitely known, but it appears to be injected between underlying Gravelly Flat Formation and overlying Panoche Formation. (Dibblee, 1973.)

Hiko Tuff of Dolgoff (1963) adopted. Overlies unnamed tuff or Harmony Hills Tuff Member of Quichapa Formation; underlies Kane Wash Tuff. (Noble and McKee, 1972.)

Hill Point Flow adopted as ophitic flow, one of 12 named flows within Portage Lake Volcanics on Isle Royale. Eruption sequence: after Amygdaloid Island Flow (new name) and before Huginnin Flow (both of Portage Lake). (Huber, 1973.)

Age changed from Paleozoic(?) to Permian(?). (Hietanen, 1973.)

Assigned to Windermere Group as its lower unit in southwestern part of belt. Divided into two informal members: lower conglomerate and upper volcanic, correlative with Shedroof Conglomerate and Leola Volcanics of Windermere, respectively, in northeastern part of belt. Overlies Belt Supergroup and correlative rocks; underlies Monk Formation, upper unit of Windermere. Age changed from Precambrian to Precambrian Y. (Miller and others, 1973.)

Name and rank changed from Huginnin Porphyrite to Huginnin Flow; reassigned to Portage Lake Volcanics. (Huber, 1973.)

Irish Gulch Slate adopted in Rochford district. Unconformably(?) overlies Moonshine Gulch Quartzite (new); unconformably underlies Montana Mine Formation (new basal formation of redefined Flag Rock Group). (Bayley, 1972.)

Name changed and corrected from Isla Mona Limestone to Isla de Mona Dolomite. (Briggs and Seiders, 1972.)

Reassigned as Island Mine Conglomerate Bed (at reduced rank) to Portage Lake Volcanics. (Huber, 1973.)

Jacalitos Formation abandoned; its rocks now included in lower part of Etchegoin Formation. (Dibblee, 1973.)

Red Draw and Sips Creek Members of Jelm geographically extended into northwestern Colorado. (Pipiringos, 1972.)

Stratigraphically extended to include former lower member of overlying Ponce Limestone; Ponce now stratigraphically restricted to include its upper member only. Age changed from early and middle Oligocene to Oligocene and early Miocene. (Monroe, 1973b.)

Assigned to Montana Group (newly restricted) only in central Montana; no longer assigned to any named group elsewhere. (Gill and Cobban, 1973.)

Age changed from Early Cretaceous to Early and Late Cretaceous. Removed from Shaktolik Group (now abandoned) and no longer assigned to any named group. (Patton, 1973.)

Name	Age	Location
Kaltag Formation -----	Early and Late Cretaceous.	Alaska -----
Kennebago Member (of Albee Formation).	Early and (or) Middle Ordovician.	West-central Maine ---
Kinney Rim Member (of Washakie Formation).	middle Eocene -----	Washakie Basin, southwestern Wyoming.
Kobau Formation -----	Permian or Triassic --	North-central Washington.
Koolau Volcanic Series -	Pliocene(?) and Pleistocene.	Oahu, Hawaii -----
Kootenai Formation ----	Early Cretaceous ----	Montana and Wyoming.
Kreyenhagen Shale/ Formation.	middle Eocene to early Oligocene.	Southern California --
La Casa Member (of Wild Cow Formation) (of Madera Group).	Late Pennsylvanian (Virgilian).	Central New Mexico --
LaCledde Bed (of Laney Member) (of Green River Formation).	middle Eocene -----	Southwestern Wyoming.
La Garita Quartz Latite	Oligocene -----	South-central Colorado.
Lake Shore Trap -----	Precambrian Y (Keweenawan).	Lake Superior area, Michigan.
Laney Shale Member (of Green River Formation).	middle Eocene -----	Southwestern Wyoming.
Leadville Limestone/ Dolomite.	Early and Late Mississippian.	Western Colorado, northeastern Arizona, and north- western New Mexico.
Lee Formation -----	Late Mississippian and Early Pennsyl- vanian.	Virginia, Kentucky, and Tennessee.
Leola Volcanics -----	Precambrian Y (post- Belt).	Northeastern Wash- ington and north- western Idaho.

Revision and reference

- Age changed from Early Cretaceous to Early and Late Cretaceous. Removed from Shaktolik Group (now abandoned) and no longer assigned to any named group. (Patton, 1973.)
- Kennebago Member adopted as lowermost of three new members of the Albee. Overlies Azischoos Formation; underlies Portage Brook Member of Albee. (Harwood, 1973.)
- Kinney Rim Member, basal member of Washakie Formation (reintroduced), adopted. Unconformably underlies Adobe Town Member (new) of Washakie. (Roehler, 1973a.)
- Kobau Group of Bostock (1940) adopted and redefined as Kobau Formation. Unconformably (?) overlies Bullfrog Formation (new name) of Anarchist Group (formerly lower part of Anarchist Series of Daly (1912)) and, in part, conformably overlies Palmer Mountain Greenstone (new name); unconformably underlies Ellemeham Formation (new name). (Rinehart and Fox, 1972.)
- Age changed from Pliocene (?) to Pliocene (?) and Pleistocene. Its rocks now include rocks formerly in Kailua Volcanic Series (abandoned). (Doell and Dalrymple, 1973.)
- Kootenai Formation extended into Yellowstone National Park area, Wyoming. (Ruppel, 1972.)
- Divided into (ascending): in Devils Den area and northwestern Temblor Range, Gredal Shale Member; and, in Devils Den area only, Welcome Shale Member. Overlies Avenal Sandstone; underlies Wagonwheel Formation or Temblor Formation. (Dibblee, 1973.)
- La Casa Member adopted as uppermost of three members of Wild Cow Formation (new). Overlies Pine Shadow Member (new); underlies Bursum Formation. (Myers, 1973.)
- LaCledde Bed adopted as lowermost of three newly named beds of Laney Member (newly revised). Overlies and intertongues with Cathedral Bluffs Tongue of Wasatch Formation; unconformably underlies or intertongues with Sand Butte and Hartt Cabin Beds of Laney. (Roehler, 1973b.)
- Name changed from La Garita Quartz Latite to La Garita Tuff. (Steven and Ratté, 1973.)
- Lake Shore Trap abandoned; its rocks assigned to Copper Harbor Conglomerate. (White, 1972; and Wolff and Huber, 1973.)
- Name changed from Laney Shale Member to Lane Member and newly revised member divided into (ascending): LaCledde, Sand Butte, and Hartt Cabin Beds (all new). (Roehler, 1973b.)
- Beulah Limestone and underlying Hardscrabble Limestone abandoned; their rocks now included in Leadville Limestone (more widely used term), now geographically extended into central Colorado. (Scott, this report, p. A48.)
- In Kentucky only, Beattyville Shale Member of Lee abandoned and replaced by informal units of shale and sandstone. Usage of Beattyville was never extended into Virginia and Tennessee. (Weir, this report, p. A56.)
- Assigned to Windermere Group as middle of its three formations in northeastern part of belt. Overlies Shedroof Conglomerate and underlies Monk Formation, both of Windermere; correlates with informal upper volcanic member of Huckleberry Formation of Windermere in southwestern part of belt and with Irene Volcanics of Windermere System (Canadian terms) northward in British Columbia, Canada. Age changed from Precambrian to Precambrian Y. (Miller and others, 1973.)

Name	Age	Location
Lexington Limestone --	Middle and Late Ordovician.	Kentucky -----
Lirio Limestone -----	Miocene -----	Isla de Mona, Puerto Rico.
Lisman Formation -----	Late Pennsylvanian --	Western Kentucky and southern Illinois.
Lisman Formation ----	Late Pennsylvanian --	Western Kentucky and southern Illinois.
Logtown Ridge Formation (of Amador Group).	Late Jurassic -----	Central California ---
Long Island Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Los Moyos Limestone (of Madera Group).	Middle and Late Pennsylvanian (Des Moinesian and Missourian).	Central New Mexico--
Lyons Valley Member (of Popo Agie Formation) (of Chugwater Group).	Late Triassic -----	Wyoming -----
Madera Limestone/Formation.	Middle Pennsylvanian to Early Permian (Des Moinesian to Wolfcampian).	Manzano Mountains, central New Mexico.
Madisonville Limestone Member (of Lisman Formation).	Late Pennsylvanian --	Western Kentucky ---
Magdalena Group -----	Pennsylvanian and Early Permian.	Manzano Mountains, central New Mexico.
Mammoth Mountain Rhyolite.	Oligocene -----	South-central Colorado.
McBean Formation ----	middle Eocene (Claiborne).	South Carolina and Georgia.
McCann Hill Chert ----	Early to Late Devonian.	East-central Alaska --

Revision and reference

Strodes Creek Member (new) included in Lexington Limestone, interlensing or intertonguing with its Millersburg Member. (Black and Cuppels, 1973.) Age changed from Pliocene or Pleistocene to Miocene. (Briggs and Seiders, 1972.)

Carthage Limestone of Owen (1856 adopted as Carthage Limestone Member of Lisman Formation as used by Smith and Smith (1967). Overlies Madisonville Limestone Member. (Johnson, 1973).

Lisman Formation abandoned; its rocks and former members (in ascending order, Providence Limestone, Anvil Rock Sandstone, Madisonville Limestone, and Carthage Limestone) now included in lower part of Sturgis Formation (new). (Kehn, 1973.)

Removed from Amador Group (now abandoned) and no longer assigned to any named group. Stratigraphically extended 610 m downward at expense of underlying Cosumnes Formation. (Sharp and Duffield, 1973.)

Long Island Flow adopted as trap flow, one of 12 named flows within Portage Lake Volcanics on Isle Royale. Eruption sequence: after Tobin Harbor Flow and before Middle Point Flow (both of Portage Lake, both new names). (Huber, 1973.)

Los Moyos Limestone adopted as lowermost of three formations of Madera Group. Conformably overlies Sandia Formation and underlies Wild Cow Formation (new). (Myers, 1973.)

Geographically extended into northwestern Colorado. (Pipiringos, 1972.)

In Manzano Mountains area of central New Mexico, redefined, raised to group rank, and divided into (ascending); Los Moyos Limestone (new), Wild Cow Formation (new), and Bursum Formation. Bursum remains uppermost formation of Magdalena Group elsewhere. (Myers, 1973.)

Former member of Lisman Formation (now abandoned), reassigned to lower part of Sturgis Formation (new). Overlies Anvil Rock Sandstone Member of Sturgis; underlies Carthage Limestone Member of Sturgis. (Kehn, 1973.)

Geographically restricted from Manzano Mountains area of central New Mexico. Its formations revised as follows: Sandia Formation mapped but not included in any named group; Madera Limestone raised to group rank and Bursum Formation reassigned thereto as its uppermost formation. (Myers, 1973.)

Name changed from Mammoth Mountain Rhyolite to Mammoth Mountain Tuff. (Steven and Ratté, 1973.)

Assigned to Orangeburg Group (now reinstated, raised in rank, and restricted to Orangeburg and surrounding counties in south-central South Carolina) as one of its four formations; overlies Warley Hill Formation and underlies Barnwell Formation, both of Orangeburg Group. (Siple and Pooser, this report, p. A55.)

Age changed from Early(?) to Late Devonian to Early to Late Devonian. (Berdan and Copeland, 1973.)

Name	Age	Location
McCarthy Formation --	Early Jurassic -----	Late Triassic and Early Jurassic.
McHugh Complex -----	Late Jurassic and (or) Cretaceous.	Southern Alaska -----
McLure Shale Member (of Monterey Shale).	middle and late Miocene.	Southern California (restricted).
Mancos Shale -----	Late Cretaceous -----	West-central area of New Mexico.
Media Shale Member (of Temblor Forma- tion).	early and middle Miocene.	Southern California --
Meiklejohn Formation -	Early Cretaceous ---- Late Mississippian --	South-central Nevada--
Melozi Formation (of Shaktolik Group).		Alaska -----
Mesaverde Formation --	Late Cretaceous -----	Wyoming -----
Middle Point Flow (of Portage Lake Vol- canics).	Precambrian Y (mid- dle Keweenawan).	Isle Royale, northern Michigan.
Milk Creek Formation --	late Miocene and Pliocene.	Arizona -----
Miller Mountain Forma- tion.	Early Cambrian -----	Southwestern Nevada--
Milltown Andesite -----	Miocene -----	South-central Nevada--
Minong Breccia -----	Precambrian Y (Keweenawan).	Isle Royale, northern Michigan.
Minong Porphyrite ----	Precambrian Y (Keweenawan).	Isle Royale, northern Michigan.
Minong Trap (of Cen- tral Mine Group).	Precambrian Y (mid- dle Keweenawan).	Isle Royale, northern Michigan.
Monk Formation -----	Precambrian Y (post- Belt).	Northeastern Wash- ington and north- western Idaho.

Revision and reference

- Age changed from Late Triassic and Early Jurassic to Early Jurassic (Imlay and Detterman, 1973.)
- McHugh Complex adopted; overlies Valdez(?) Group in thrust contact. (Clark, 1973.)
- In southern Coast Ranges, geographically restricted to area northeast of San Andreas fault. Conformably overlies Devilwater Shale Member of Monterey or unconformably overlies Gould Shale Member of Monterey or Point of Rocks Sandstone or Panoche Formation; gradational into overlying Belridge Diatomite Member of Monterey. Age changed from late Miocene to middle and late Miocene. (Dibblee, 1973.)
- In west-central New Mexico, divided into (ascending): Clay Mesa Shale Tongue (new), Whitewater Arroyo Shale Tongue, and its main body. Intertongues with Dakota Sandstone. (Landis and others, 1973.)
- In Temblor Range, Media Shale Member of Temblor Formation of Cunningham and Barbat (1932) adopted. Conformably overlies Carneros Sandstone Member; underlies or intertongues with Buttonbed Sandstone Member (new). (Dibblee, 1973.)
- Meiklejohn Formation abandoned; its rocks now assigned to Eleana Formation. (Cornwall, 1972.)
- Removed from Shaktolik Group (now abandoned) and no longer assigned to any named group. (Patton, 1973.)
- Ardmore Bentonite Bed assigned to Mesaverde Formation in southern Big-horn Basin of Wyoming. (Gill and Cobban, 1973.)
- Middle Point Flow adopted as porphyrite flow, one of 12 named flows within Portage Lake Volcanics on Isle Royale. Eruption sequence: after Long Island Flow and before Edwards Island Flow (both of Portage Lake, both new names). (Huber, 1973.)
- Mill Creek Beds of Reed (1950) adopted as Milk Creek Formation. (Anderson and Blacet, 1972b.)
- Miller Mountain Formation abandoned; its rocks in its type area now assigned to (ascending): Campito, Poleta(?), Hurbless(?), and two unnamed formations. (Albers and Stewart, 1972.)
- Age changed from Oligocene or Miocene to Miocene. (Cornwall, 1972.)
- Minong Breccia abandoned; its rocks now considered part of unnamed tuff breccia above Minong Flow. (Huber, 1973.)
- Minong Porphyrite abandoned; its rocks now considered part of unnamed tuff breccia above Minong Flow. (Huber, 1973.)
- Name and rank changed from Minong Trap to Minong Flow; reassigned to Portage Lake Volcanics. (Huber, 1973.)
- Assigned to Windermere Group as uppermost of its three formations in northeastern part of belt and as upper of its two formations in southwestern part of belt. Overlies Huckleberry Formation of Windermere in southwestern part, Leola Volcanics of Windermere in northeastern part, and Irene Volcanics of Windermere System (Canadian terms) northward in British Columbia, Canada; underlies Paleozoic rocks; correlates with (ascending): Toby Conglomerate and Horsethief Creek Group (Canadian terms) farther north in British Columbia, Canada. Age changed from Precambrian to Precambrian Y. (Miller and others, 1973.)

Name	Age	Location
Montana Group -----	Late Cretaceous -----	Central and eastern Montana.
Montana Mine Forma- tion (of Flag Rock Group).	middle Precambrian --	West-central South Dakota.
Monterey Shale -----	Miocene -----	Central and southern California.
Monterey Shale/ Formation.	Miocene -----	Southern California (locally only).
Moonshine Gulch Quartzite.	middle Precambrian --	West-central South Dakota.
Morena Rhyolite -----	Oligocene or Miocene -	Southwestern Nevada -
Mount Owen Quartz Monzonite.	Precambrian W or X --	Northwestern Wyoming.
Mucarabones Sand -----	Oligocene and Miocene_	Puerto Rico -----
Nahant Schist (of Flag Rock Group).	middle Precambrian --	West-central South Dakota.
Nelson Mountain Quartz Latite.	Oligocene -----	South-central Colorado.
New York Peak Quartz Monzonite.	Late Cretaceous -----	Northwestern Nevada_
Nizina Mountain Formation.	Middle Jurassic -----	Wrangell Mountains, southern Alaska.
Nugget Sandstone -----	Triassic(?) only in report area.	Utah, Wyoming, and Idaho.
Nuka Formation -----	Late Mississippian and Permian.	Northern Alaska -----
Nulato Formation (of Shaktolik Group).	Early and Late Cretaceous.	Alaska -----

Revision and reference

- Geographically restricted to central and eastern Montana. Cody Shale and Trinidad Sandstone removed from Montana Group and no longer assigned to any named group. Hell Creek Formation newly assigned to Montana Group. Various subdivisions throughout central and eastern Montana given. (Gill and Cobban, 1973.)
- Montana Mine Formation adopted in Rochford district as basal formation of Flag Rock Group (redefined). Unconformably overlies Irish Gulch Slate (new); conformably underlies Nahant Schist or intervening Rapid Creek Greenstone (both new formations of redefined Flag Rock Group). (Bayley, 1972.)
- In southern Coast Ranges, includes (ascending): geographically restricted to area southwest of San Andreas fault—Saltos Shale Member and Whiterock Bluff Shale Member (now reassigned; formerly considered member of Margarita Formation); geographically restricted to area northeast of San Andreas fault—Gould Shale Member, Devilwater Shale Member, McClure Shale Member, and Belridge Diatomite Member. (Dibblee, 1973.)
- In subsurface of Elk Hills area, Monterey Shale includes (ascending): Gould, Devilwater(?), McDonald (of local usage), and Elk Hills (new) Shale Members. Usage remains unchanged elsewhere. (Adkison, 1973.)
- Moonshine Gulch Quartzite adopted as oldest rocks exposed in Rochford district; unconformably(?) underlies Irish Gulch Slate or Rapid Creek Greenstone (both new). (Bayley, 1972.)
- Morena Rhyolite abandoned; its rocks now included in Sandstone Formation. (Albers and Stewart, 1972.)
- Mount Owen Quartz Monzonite adopted. Emplaced in Precambrian W gneiss and migmatite. (Reed and Zartman, 1973.)
- Age changed from middle Oligocene to middle Oligocene to Miocene. (Monroe, 1973a.)
- Nahant Schist adopted in Rochford district and assigned to Flag Rock Group (redefined). Conformably overlies Rapid Creek Greenstone or Montana Mine Formation and conformably underlies Rochford Formation (all three new formations of Flag Rock); at some places intertongues with Rapid Creek. (Bayley, 1972.)
- Name changed from Nelson Mountain Quartz Latite to Nelson Mountain Tuff. (Steven and Ratté, 1973.)
- New York Peak Quartz Monzonite adopted. Intrudes Permian or older Happy Creek Volcanic Series and unnamed syenodiorite pluton; intruded by unnamed fine-grained quartz monzonite. (Smith, 1973.)
- Age changed from Middle and Late Jurassic to Middle Jurassic. (Imlay and Detterman, 1973.)
- Nugget Sandstone and its Bell Springs Member geographically extended into northwestern Colorado. (Pipiringos, 1972.)
- Redefined and stratigraphically restricted to middle, largely arkosic unit of original type section (now designated reference section). Age changed from Late Mississippian to Late Permian to: Late Mississippian and Permian. (Tailleur and others, 1973.)
- Age changed from Early Cretaceous to Early and Late Cretaceous. Removed from Shaktolik Group (now abandoned) and no longer assigned to any named group. (Patton, 1973.)

Name	Age	Location
Oak Canyon Member (of Dakota Sandston).	Early and Late Cretaceous.	West-central New Mexico.
Ogotoruk Formation ---	Late Jurassic -----	Lisburne Peninsula, northwestern Alaska.
Orangeburg Formation -	middle and late Eocene (Claiborne and Jackson).	South-central South Carolina.
Outer Conglomerate ---	Precambrian Y (Keweenawan).	Lake Superior area, Michigan.
Outlet Tunnel Member (of La Garita Quartz Latite).	Oligocene -----	South-central Colorado.
Paguate Sandstone Tongue (of Dakota Sandstone).	Late Cretaceous ----	West-central New Mexico.
Painted Rock Sandstone Member (of Vaqueros Formation).	early and middle Miocene.	Southern California --
Palmer Mountain Greenstone.	Permian or Triassic --	North-central Washington.
Parkman Sandstone (of Montana Group).	Late Cretaceous ----	Montana and Wyoming.
Paso Robles Formation -	Pliocene and Pleistocene.	Southern California --
Pato Red Member (of Vaqueros Formation).	early Miocene -----	Southern California --
Pattiway Formation ---	Paleocene -----	Southern California --
Peñon Blanco Volcanics (of Amador Group).	Late Jurassic -----	Central California ----
Phoenix Park Member (of La Garita Quartz Latite).	Oligocene -----	South-central Colorado.
Picayune Formation (of Silverton Volcanic Group).	Oligocene -----	Southwestern Colorado.
Pierre Shale (of Montana Group).	Late Cretaceous ----	Southeastern Montana_

Revision and reference

- Oak Canyon Member adopted as lowermost of four members of Dakota. (Landis and others, 1973.)
- Age changed from Jurassic or Cretaceous to Late Jurassic. (Imlay and Detterman, 1973.)
- Name Orangeburg reinstated, raised in rank to group status, and restricted to Orangeburg and surrounding counties in South Carolina. Consists of ascending): Congaree Formation, Warley Hill Formation, and restricted McBean Formation of Claiborne (middle Eocene) age and Barnwell Formation of Jackson (late Eocene) age. (Siple and Pooser, this report, p. A55.)
- Outer Conglomerate abandoned; its rocks assigned to Copper Harbor Conglomerate. (White, 1972; Wolff and Huber, 1973.)
- Formation affiliation name changed to La Garita Tuff. (Steven and Ratté, 1973.)
- Paguete Sandstone Tongue adopted as one of four members of Dakota. Intertongues with Mancos Shale, overlying its Clay Mesa Shale Tongue (new) and underlying its Whitewater Arroyo Shale Tongue. (Landis and others, 1973.)
- Painted Rock Formation of Dibblee (1952) adopted as Painted Rock Sandstone Member, uppermost of three members of Vaqueros Formation as redefined by Hill, Carlson, and Dibblee (1958). Overlies Soda Lake Shale Member; underlies Saltos Shale Member of Monterey Shale. (Dibblee, 1973.)
- Palmer Mountain Greenstone adopted. Unconformably(?) overlies Bullfrog Mountain Formation (new name) of Anarchist Group (formerly lower part of Anarchist Series of Daly, 1912); conformably underlies Kobau Formation (formerly Kobau Group of Bostock, 1940). (Rinehart and Fox, 1972.)
- Assigned to Montana Group (newly restricted) only in central Montana; no longer assigned to any named group in Wyoming. (Gill and Cobban, 1973.)
- Age changed from Pliocene and Pleistocene(?) to Pliocene and Pleistocene. (Dibblee, 1973.)
- Pato Red Member abandoned; its rocks now included in Caliente Formation. (Dibblee, 1973.)
- Pattitway Formation of Hill, Carlson, and Dibblee (1958) adopted. Unconformably underlies Simmler Formation; base is not exposed. (Dibblee, 1973.)
- Removed from Amador Group (now abandoned) and no longer assigned to any named group. (Sharp and Duffield, 1937.)
- Formation affiliation name changed to La Garita Tuff. (Steven and Ratté, 1973.)
- No longer included in Silverton Volcanic Group (abandoned). (Lipman and others, 1973.)
- Assigned to Montana Group (newly restricted) only in southeastern Montana; no longer assigned to any named group elsewhere. (Gill and Cobban, 1973.)

Name	Age	Location
Pine Shadow Member (of Wild Cow Formation) (of Madera Group).	Late Pennsylvanian (Virgilian).	Central New Mexico --
Pinyon Conglomerate --	Late Cretaceous and Paleocene.	Northwestern Wyoming.
Pleito Formation -----	middle and late Oligocene.	Southern California --
Point of Rocks Sandstone.	middle and late Eocene.	Southern California --
Ponce Limestone -----	middle or late Miocene.	Southern Puerto Rico.
Popo Agie Formation (of Chugwater Group).	Late Triassic -----	Wyoming -----
Portage Brook Member (of Albee Formation).	Early and (or) Middle Ordovician.	West-central Maine --
Portage Lake Lava Series.	Precambrian Y (middle Keweenawan).	Northern Michigan ---
Portage Lake Volcanics.	Precambrian Y (middle Keweenawan).	Northern Michigan ---
Potomac Group -----	Early Cretaceous (locally only).	Virginia only -----
Potosi Volcanic Group --	Oligocene and Miocene.	Southwestern Colorado.
Poverty Gulch Slate ---	middle Precambrian --	West-central South Dakota.
Pozo Formation -----	Pliocene -----	Southwestern Nevada_
Providence Limestone Member.	Late Pennsylvanian --	Western Kentucky ---

Revision and reference

- Pine Shadow Member adopted as middle of three members of Wild Cow Formation (new). Overlies Sol se Mete Member (new); underlies La Casa Member (new). (Myers, 1973.)
- Pinyon Conglomerate redefined and stratigraphically restricted by removal of its basal conglomerate, now included in underlying Harebell Formation as Bobcat Member (new). (Love, 1973.)
- Pleito Formation of Wagner and Schilling (1923) adopted. Conformably overlies and underlies tongues of Tecuya Formation or, where missing, San Emigdio and Temblor Formations, respectively. (Nilsen and others, 1973.)
- Point of Rocks Sandstone of Reed and Hollister (1936) as revised by Van Couvering and Allen (1943), adopted. Overlies Gredal Shale Member of Kreyenhagen Formation; underlies Welcom Shale Member of Kreyenhagen. (Dibblee, 1973.)
- Stratigraphically restricted to its upper member only; its lower member now included in underlying Juana Diaz Formation, not stratigraphically extended. Age changed from late Oligocene and early Miocene to middle or late Miocene. (Monroe, 1973b.)
- Popo Agie Formation and its Brynt Draw and Lyons Valley Members geographically extended into northwestern Colorado. (Pipiringos, 1972.)
- Portage Brook Member adopted as middle of three new members of Albee. In places overlies Kennebago Member (new) of Albee; elsewhere overlies Azischos Formation. Underlies Deer Mountain Member (new) of Albee. (Harwood, 1973.)
- Name changed from Portage Lava Series to Portage Lake Volcanics. (Wolff and Huber, 1973.)
- On Isle Royale includes (ascending): Amgydaloid Island, Hill Point, Huginnin, Minong, Grace Island, Greenstone, Washington Island, Tobin Harbor, Long Island, Middle Point, Edwards Island, and Scoville Point Flows and Island Mine Conglomerate Bed (all new names except Huginnin, Minong, Greenstone, and Island Mine). Includes other named units elsewhere. (Huber, 1973.)
- Age changed from Early and Late Certaceous to Early Certaceous in Virginia only; former age remains correct usage elsewhere. (Mixon and others, 1972.)
- Potosi Volcanic Group and its Gilpin Peak Tuff abandoned. Its Sunshine Peak Tuff remains in good usage; its Gilpin Peak Tuff considered same as and replaced by (ascending): Ute Ridge (new), Blue Mesa, Dillon Mesa, and Sapinero Mesa Tuffs (Lipman and others, 1973.)
- Poverty Gulch Slate adopted in the Rochford district. Conformably overlies Rochford Formation (new uppermost formation of redefined Flag Rock Group); in apparent conformity, underlies Swede Gulch Formation (new). (Bayley, 1972.)
- Age changed from Pliocene(?) to Pliocene. (Albers and Stewart, 1972.)
- Former member of Lisman Formation (now abandoned), reassigned to lower part of Sturgis Formation (new). Basal member of Sturgis, overlying Carbondale Formation; underlies Anvil Rock Sandstone Member of Sturgis. (Kehn, 1973.)

Name	Age	Location
Putah Tuff Member (of Tehama Formation).	late Pliocene -----	Central California ----
Quail Canyon Sandstone Member (of Vaqueros Formation).	late Oligocene -----	Southern California --
Quantico Slate (of Glenarm Series).	Ordovician (?) -----	Northeastern Virginia.
Quatal Formation -----	Pliocene -----	Southern California --
Ramey Ridge Complex _	Precambrian -----	Idaho -----
Rangeley Formation ---	Early Silurian -----	Maine -----
Rapid Creek Greenstone (of Flag Rock Group).	middle Precambrian --	West-central South Dakota.
Rat Creek Quartz Latite.	Oligocene -----	South-central Colorado.
Rattlesnake Spring Granodiorite.	Late Cretaceous -----	Northwestern Nevada_
Red Draw Member (of Jelm Formation) (of Chugwater Group).	Late Triassic -----	Wyoming -----
Red Peak Formation ---	Early Triassic -----	Wyoming and north- western Colorado.
Redwater Shale Member (of Sundance Formation).	Late Jurassic -----	South Dakota and Wyoming.
Rendezvous Metagabbro_	Precambrian W -----	Northwestern Wyoming.
Renegade Tongue (of Wasatch Formation).	Eocene -----	East-central Utah ----
Rhyolite Canyon Formation.	early Miocene -----	Southeastern Arizona _

Revision and reference

Putah Tuff Member adopted and assigned as member of Tehama Formation in its geographic extension southward into central California. Putah has similar stratigraphic position with Nomlaki Tuff Member of Tehama in northern California but is neither coextensive nor correlative. (Sims and Sarna-Wojcicki, this report, p. A50.)

Quail Canyon Sandstone Member (formerly named Soda Lake Sandstone Member by Hill, Carlson, and Dibblee, 1958) adopted as lowermost of three members of Vaqueros Formation. Conformably overlies Simmler Formation; conformably underlies Soda Lake Shale Member of Vaqueros. (Dibblee, 1973.)

Age changed from Middle and Late Ordovician to Ordovician(?). (Mixon and others, 1972.)

Quatal Red Clay Member of Santa Margarita Formation of Ver Planck (1952) adopted as Quatal Formation as redefined by Hill, Carlson, and Dibblee (1958). Conformably overlies Caliente Formation; conformably underlies Morales Formation. (Dibblee, 1973.)

Age changed from Paleozoic(?) to Precambrian. (Cater and others, 1973.)

Age changed from Early Silurian(?) to Early Silurian. (Harwood, 1973.)

Rapid Creek Greenstone adopted in Rochford district and assigned to Flag Rock Group (redefined). Unconformably(?) overlies Moonshine Gulch Quartzite (new) or conformably, Montana Mine Formation (new) of Flag Rock; conformably underlies or intertongues with Nahant Schist (new) of Flag Rock. (Bayley, 1972.)

Name changed from Rat Creek Quartz Latite to Rat Creek Tuff. (Steven and Ratté, 1973.)

Rattlesnake Spring Granodiorite adopted. Intrudes unnamed Triassic(?) quartzite and amphibolite; unconformably underlies unnamed Tertiary volcanic units. (Smith, 1973.)

Geographically extended into northwestern Colorado. (Pipiringos, 1972.)

Red Peak Formation geographically extended into northwestern Colorado. (Segerstrom and Young, 1972.)

Geographically extended into northwestern Colorado as uppermost member of Sundance. Overlies Pine Butte Member. (Pipiringos, 1972.)

Rendezvous Metagabbro adopted. Northern contact marked by a fault; southern contact with migmatitic biotite gneiss is sharp and concordant. Passes westward beneath Paleozoic sedimentary rocks; passes eastward beneath surficial deposits. (Reed and Zartman, 1973.)

Geographically extended into west-central Colorado. (Cashion, 1973.)

Rhyolite Canyon Formation of Enlows (1951, 1955) adopted. Overlies unnamed lower rhyolite volcanic rocks of Oligocene and Miocene(?) age; underlies unnamed upper rhyolite volcanic rocks of Miocene age; intruded by unnamed monzonite and latite complex of Miocene age. (Drewes and others, 1973.)

Name	Age	Location
Rochford Formation (of Flag Rock Group).	middle Precambrian --	West-central South Dakota.
Sage Limestone Member (of Snowy Range Formation) (of Gallatin Group).	Late Cambrian -----	Montana and Wyoming.
Saline Formation (of Wilcox Group).	middle Eocene -----	Arkansas -----
Saltos Shale Member (of Monterey Shale).	early and middle Miocene.	Southern California (restricted).
Sand Butte Bed (of Laney Member) (of Green River Formation).	middle Eocene -----	Southwestern Wyoming.
Sandstorm Rhyolite ---	Oligocene or Miocene -	Southwestern Nevada -
San Emigdio Formation.	late Eocene and Oligocene.	Southern California --
San Joaquin Formation.	late Pliocene -----	Southern California --
Santa Margarita Formation.	late Miocene -----	Southern California --
Santos Shale Member (of Temblor Formation).	late Oligocene and early Miocene.	Southern California --
Sapinero Mesa Tuff ----	late Oligocene -----	Southwestern Colorado.
Scoville Point Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Shaktolik Group -----	Early Cretaceous ----	Alaska -----

Revision and reference

- Rochford Formation adopted in Rochford district as uppermost formation of Flag Rock Group (redefined). Conformably overlies Nahant Schist or intervening Rapid Creek Greenstone (both new formations of redefined Flag Rock Group); conformably underlies Poverty Gulch Slate (new). (Bayley, 1972.)
- Sage Limestone Member of Lochman-Balk (1950) adopted as middle member of Snowy Range Formation. Conformably overlies Dry Creek Shale Member; conformably underlies Grove Creek Limestone Member when present or unconformably underlies Bighorn Dolomite. (Ruppel, 1972.)
- Age changed from Eocene to middle Eocene. (Tschudy, 1973.)
- Saltos Shale Member of Monterey Shale of Hill, Carlson, and Dibble (1958) adopted as basal of two members of Monterey Shale in southern Coast Ranges and geographically restricted to area southwest of San Andreas fault. Conformably overlies Painted Rock Sandstone Member of Vaqueros Formation; conformably underlies Whiterock Bluff Shale Member of Monterey. (Dibblee, 1973.)
- Sand Butte Bed adopted as middle of three newly named beds of Laney Member (newly revised). Overlies or intertongues with LaCleda Bed (new); underlies or intertongues with Hartt Cabin Bed and is transitional into overlying Kinney Rim Member of Washakie Formation. (Roehler, 1973b.)
- Name changed to Sandstorm Formation; formation revised to include rocks of Morena Rhyolite (now abandoned). (Albers and Stewart, 1972.)
- San Emigdio Formation of Gester (1917) adopted as defined by Wagner and Schilling (1923). Conformably overlies and underlies Tejon and Pleito Formations, respectively. (Nilsen and others, 1973.)
- Geographically restricted to Kettleman Hills and subsurface of San Joaquin Valley. In Coalinga area, rocks formerly included in San Joaquin reassigned to upper part of Etchegoin Formation (now stratigraphically extended). (Dibblee, 1973.)
- Whiterock Bluff Shale Member removed from Santa Margarita Formation, reassigned to underlying Monterey Shale in southern Coast Ranges, and geographically restricted to area southwest of San Andreas fault. (Dibblee, 1973.)
- In Temblor Range, Santos Shale of Gester and Galloway (1933) adopted as Santos Shale Member of Temblor Formation. Conformably overlies Wygal Sandstone Member (new) and conformably underlies Carneros Sandstone Member, both of Temblor. Agua Sandstone Member of Temblor occurs as discontinuous lenses within Santos. (Dibblee, 1973.)
- Includes Eureka Tuff, now reduced in rank to its Eureka Member. Sapinero Mesa Tuff now considered same as uppermost of four unnamed ash-flow sheets of Gilpin Peak Tuff (abandoned). (Lipman and others, 1973.)
- Seoville Point Flow adopted as porphyrite flow, last of 12 named flows within Portage Lake Volcanics on Isle Royale. (Huber, 1973.)
- Shaktolik Group abandoned; its formations, Kaltag, Melozi, and Nulato, remain in good usage and are not assigned to another named group. (Patton, 1973.)

Name	Age	Location
Shawnee Group -----	Late Pennsylvanian (Virgil).	Kansas, Missouri, and Nebraska.
Shedroof Conglomerate-	Precambrian Y (post-Belt).	Northeastern Washington and northwestern Idaho.
Sheep Mountain Andesite (of Potosi Volcanic Group).	Oligocene -----	Southwestern Colorado.
Silverton Volcanic Group.	Oligocene -----	Southwestern Colorado.
Silvies Member (of Snowshoe Formation).	Middle Jurassic -----	Eastern Oregon -----
Simmler Formation ---	early and late Oligocene(?).	Southern California --
Siphon Draw Member (of Superstition Tuff.)	Miocene -----	South-central Arizona-
Sips Creek Member (of Jelm Formation) (of Chugwater Group).	Late Triassic -----	Wyoming -----
Skagit Volcanics -----	early(?) Tertiary ---	Washington -----
Snow Creek Porphyry -	Eocene -----	Montana -----
Snowshoe Formation --	Middle Jurassic -----	Eastern Oregon -----
Snowshoe Mountain Quartz Latite.	Oligocene -----	South-central Colo- rado.
Snowy Range Forma- tion (of Gallatin Group).	Late Cambrian -----	Montana and Wyoming.

Revision and reference

Shawnee Group geographically extended into Nebraska. This does not include any or all formations or members of Shawnee accepted elsewhere. (Burchett and others, 1972.)

Assigned to Windermere Group as lowermost of its three formations in northeastern part of belt. Overlies Belt Supergroup and correlative rocks; underlies Leola Volcanics of Windermere. Correlates with informal lower conglomerate member of Huckleberry Formation of Windermere in southwestern part of belt and with Toby Conglomerate of Windermere System (Canadian terms) northward in British Columbia, Canada. Age changed from Precambrian to Precambrian Y. (Miller and others, 1973.)

No longer included in Potosi Volcanic Group (abandoned). (Lipman and others, 1973.)

Silverton Volcanic Group abandoned; formerly included (ascending): Picyune Formation, Eureka Tuff, Burns Formation, and Henson Formation (none of which is now included in any named group). (Lipman and others, 1973.)

Silvies Member of Dickinson and Vigrass (1965) adopted as one of four members of Snowshoe Formation in Izee area. Intertongues with unnamed middle member; overlies and underlies unnamed lower and upper members, respectively. (Imlay, 1973.)

Simmler Formation of Dibblee (1952), as used by Hill, Carlson, and Dibblee (1958), adopted. Unconformably overlies Pattiway Formation or Upper Cretaceous and lower Tertiary marine sedimentary sequence; conformably underlies Vaqueros Formation. (Dibblee, 1973.)

Siphon Draw Member of Stuckless and Sheridan (1971) adopted as lowest of three members in their Superstition Tuff. Underlies Geronimo Head Formation (newly adopted), which intertongues with Superstition Tuff. (Stuckless and O'Neil, 1973.)

Geographically extended into northwestern Colorado. (Pipiringos, 1972.)

Skagit Volcanic Formation of Daly (1912) adopted as Skagit Volcanics. Overlies Hozomeen Group of Cairnes (1944) and Custer Gneiss of McTaggart and Thompson (1967) along Canadian border. (Staatz and others, 1972.)

Age changed from early Tertiary to Eocene. (Keefer, 1972.)

Snowshoe Formation of Lupher (1941) adopted as revised by Dickinson and Vigrass (1965). Overlies Hyde Formation of Lupher (1941); underlies Trowbridge Shale of Lupher (1941). Includes (ascending): in Suplee area, Weberg, Warm Springs, and Basey Members; in Izee area, unnamed lower member, unnamed middle member or Silvies Member (correlatives), and unnamed upper member; in Seneca area, undivided. (Imlay, 1973.)

Name changed from Snowshoe Mountain Quartz Latite to Snowshoe Mountain Tuff. (Steven and Lipman, 1973.)

Snowy Range Formation divided into (ascending): Dry Creek Shale, Sage Limestone, and Grove Creek Limestone Members in Yellowstone National Park area, Wyoming. (Ruppel, 1972.)

Name	Age	Location
Soda Lake Shale Member (of Vaqueros Formation).	late Oligocene and early miocene.	Southern California -
Sol se Mete Member (of Wild Cow Formation) (of Madera Group).	Late Pennsylvanian (Missourian).	Central New Mexico -
Southbridge Formation.	Ordovician (?) to Silurian (?).	Northeastern Connecticut.
Spectacle Formation (of Anarchist Group).	Late (?) Permian ----	North-central Washington.
Staniukovich Shale ----	Late Jurassic -----	Southwestern Alaska -
Steele Shale (of Montana Group).	Late Cretaceous -----	Wyoming -----
Strodes Creek Member (of Lexington Limestone).	Late Ordovician -----	North-central Kentucky.
Sturgis Formation -----	Late Pennsylvanian --	Western Kentucky ---
Sundance Formation ---	Late Jurassic -----	South Dakota, Nebraska, Montana, Wyoming, and Colorado.
Sunshine Peak Tuff (of Potosi Volcanic Group.)	early Miocene -----	Southwestern Colorado.
Superstition Tuff -----	Miocene -----	South-central Alaska.
Swede Gulch Formation.	middle Precambrian --	West-central South Dakota.
Tecuya Formation ----	late Eocene (?) to early Miocene.	Southern California --

Revision and reference

- Soda Lake Shale Member of Hill, Carlson, and Dibblee (1959) adopted as middle of three members of Vaqueros. Overlies Quail Canyon Sandstone Member (new name) or, where Quail Canyon is missing, Simmler Formation; underlies Painted Rock Sandstone Member. (Dibblee, 1973.)
- Sol se Mete Member adopted as lowermost of three members of Wild Cow Formation (new). Overlies Los Moyos Limestone (new); underlies Pine Shadow Member (new). Replaces Coyote Sandstone Member (now abandoned) of Madera Limestone. (Myers, 1973.)
- Southbridge Formation adopted. Structurally overlies Hebron Formation or Eastford Gneiss; structurally underlies Bigelow Brook Formation (new name). (Pease, 1972.)
- Spectacle Formation adopted as lower of two newly named formations of Anarchist Group (formerly lower part of Anarchist Series of Daly, 1912). Base not exposed; conformably underlies Bullfrog Mountain Formation (new name) of Anarchist. Divided into two informally named members (ascending): conglomerate-free member and conglomerate-bearing member. (Rinehart and Fox, 1972.)
- Name changed from Staniukovich Shale to Staniukovich Formation. (Imlay and Detterman, 1973.)
- Removed from Montana Group (now geographically restricted to central and eastern Montana) and no longer assigned to any named group. (Gill and Cobban, 1973.)
- Strodes Creek Member adopted as lens, or possibly tongue, within Lexington Limestone. (Black and Cuppels, 1973.)
- Sturgis Formation adopted; overlies Carbondale Formation. Includes former rocks of Lisman Formation (now abandoned) and its members (now reassigned to Sturgis (ascending): Providence Limestone, Anvil Rock Sandstone, Madisonville Limestone, and Carthage Limestone Members) in lower part; includes former rocks of Henshaw Formation (now abandoned) in upper part. (Kehn, 1973.)
- Redwater Shale Member of Sundance geographically extended into northwestern Colorado, and Sundance Formation divided into (ascending): Canyon Springs Sandstone, Pine Butte, and Redwater Shale Members in northwestern Colorado. (Piperinos, 1972.)
- No longer included in Potosi Volcanic Group (abandoned). (Lipman and others, 1973.)
- Superstition Tuff of Stuckless and Sheridan (1971) adopted. Intertongues with Geronimo Head Formation (newly adopted). Includes (ascending): Siphon Draw, Dogie Spring, and Canyon Lake Members (all newly adopted). (Stuckless and O'Neill, 1973.)
- Swede Gulch Formation adopted as youngest Precambrian formation in Rochford district; in apparent conformity, overlies Poverty Gulch Slate (new). (Bayley, 1972.)
- Tecuya Beds of Stock (1920) adopted as Tecuya Formation. Conformably overlies Tejon Formation or intertongues with San Emigdio or Pleito Formations; conformably underlies and intertongues with Temblor Formation. (Nilsen and others, 1973.)

Name	Age	Location
Tehama Formation ----	late Pliocene -----	Northern California --
Telavirak Formation --	Late Jurassic -----	Lisburne Peninsula, northwestern Alaska.
Telegraph Creek For- mation (of Montana Group).	Late Cretaceous -----	Central Montana ----
Telegraph Creek Mem- ber (of Cody Shale).		
Telegraph Creek Mem- ber (of Colorado Shale).		
Telegraph Creek For- mation.	Late Cretaceous -----	Montana and Wyoming.
Temblor Formation --	late Oligocene to mid- dle Miocene.	Southern California (restricted).
Thatcher Limestone Member (of Graneros Shale).	Late Cretaceous -----	Southeastern Colo- rado.
Theodore Quartz Diorite.	Jurassic -----	Northwestern Nevada.
Thorofare Andesite ----	Late Silurian(?) to Early Devonian.	Coastal Maine -----
Tiglukpuk Formation --	Late Jurassic -----	North-central Alaska -
Tillamook Volcanic Series.	Eocene -----	Northwestern Oregon -
Titus Canyon Formation.	Oligocene -----	South-central Nevada and southeastern California.
Tobin Harbor Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Trimmers Rock Sandstone (of Susquehanna Group).	Late Devonian -----	Eastern Pennsylvania.

Revision and reference

Geographically extended southward into central California to include rocks assigned to Wolfskill Formation (now abandoned). Includes: Nomlaki Tuff Member in northern California and Putah Tuff Member (new name) in southern California, both having similar stratigraphic positions but neither coextensive nor correlative. (Sims and Sarna-Wojcicki, this report, p. A50.)

Age changed from Jurassic or Cretaceous to Late Jurassic. (Imlay and Detterman, 1973.)

Removed from member rank in Colorado Shale and Cody Shale; remains in good usage as lowermost formation of Montana Group in central Montana. (Gill and Cobban, 1973.)

Telegraph Creek Formation extended into Yellowstone National Park area, Wyoming. (Ruppel, 1972.)

Temblor geographically restricted to area northeast of San Andreas fault; Vaqueros Formation used southwest of fault. Revised to include following members (ascending): *in Temblor Range*, Cymric Shale Member (new), Wygal Sandstone Member (new name), Santos Shale Member, Carneros Sandstone Member, Media Shale Member, and Buttonbed Sandstone Member (new name); *in Devils Den area*, Cymric Shale Member, Wygal Sandstone Member, and Santos Shale Member, within which Agua Sandstone Member occurs as discontinuous lenses. Age changed from early and middle Miocene to late Oligocene to middle Miocene. (Dibblee, 1973.)

Thatcher Limestone Member redefined to include only its upper limestone bed which is regionally persistent and to reassign its lower siltstone bed to underlying barren unit of Graneros Shale. (Cobban and Scott, 1972.)

Theodore Quartz Diorite adopted. Intrudes unnamed Triassic(?) foliated quartzite and amphibolite; unconformably underlies unnamed Tertiary volcanic units. (Smith, 1973.)

Age changed from Silurian to Late Silurian(?) (late Ludovian? or Pridoli?) to Early Devonian (Gedinnian). Conformably underlies Vinalhaven Rhyolite; overlies Ames Knob Formation. Thorofare-Vinalhaven sequence correlates with Castine Volcanics. (Brookins and others, 1973.)

Tiglukpuk Formation abandoned; its complex assemblage of rocks not now included in any named formation(s). (Imlay and Detterman, 1973.)

Name changed from Tillamook Volcanic Series to Tillamook Volcanics. (MacLeod and Snavelly, 1973.)

Titus Canyon Formation of Stock and Bode (1935) adopted. Unconformably overlies Carrara, Zabriskie, and Wood Canyon Formations; partly unconformably underlies Tertiary volcanic and sedimentary rocks. (Cornwall, 1972.)

Tobin Harbor Flow adopted as porphyrite flow, one of 12 named flows within Portage Lake Volcanics on Isle Royale. (Huber, 1973.)

Beaverdam Run Member of Catskill Formation reassigned as Beaverdam Run Tongue of Trimmers Rock. Overlies Walcksville Tongue of Catskill; underlies Irish Valley Member of Catskill. (Wood, 1973.)

Name	Age	Location
Trinidad Sandstone (of Montana Group).	Late Cretaceous -----	Colorado and New Mexico.
Tupman Shale Member (of Etchegoin Formation).	Pliocene -----	West-central California.
Uinta Formation -----	late Eocene -----	Utah, Colorado and Wyoming.
Ungalik Conglomerate -	Early and Late Cretaceous.	Alaska -----
Ute Ridge Tuff -----	late Oligocene -----	Southwestern Colorado.
Vaqueros Formation ---	late Oligocene to middle Miocene.	Southern California (restricted).
Vinalhaven Rhyolite ---	Early Devonian -----	Late Silurian (post-Niagara).
Wagonwheel Formation--	early Oligocene -----	Southern California --
Wahoo Limestone -----	Late Mississippian to Permian.	(eastern Brooks Range, Arctic) Alaska.
Waianae Volcanic Series.	Pliocene and Pleistocene (?)	Oahu, Hawaii -----
Walcksville Sandstone Member (of Catskill Formation).	Late Devonian -----	Eastern Pennsylvania--
Warley Hill Marl -----	middle Eocene (Claiborne).	South Carolina -----
Warm Springs Member (of Snowshoe Formation).	Middle Jurassic -----	Eastern Oregon -----

Revision and reference

- Removed from Montana Group (now geographically restricted to central and eastern Montana) and no longer assigned to any named group. (Gill and Cobban, 1973.)
- Tupman Shale adopted as lower of two members of Etchegoin Formation (in subsurface of Elk Hills area). Overlies Reef Ridge Shale; underlies Carman Sandstone Member (new). (Berryman, 1973.)
- Uinta and Bridger Formations restricted from use in Washakie Basin, Wyoming. Their rocks now included in Washakie Formation (reintroduced as defined by Hayden, 1869) and its two members, Kinney Rim and Adobe Town (both new). (Roehler, 1973a.)
- Age changed from Early Cretaceous to Early and Late Cretaceous. (Patton, 1973.)
- Ute Ridge Tuff adopted and considered same as lowermost of four unnamed ash-flow sheets of Gilpin Peak Tuff (now abandoned). Overlies early intermediate-composition lavas and breccias (Oligocene); underlies Blue Mesa Tuff. (Lipman and others, 1973.)
- In Caliente Range, revised to include (ascending): Quail Canyon Sandstone Member (new name), Soda Lake Shale Member, and Painted Rock Sandstone Member; elsewhere Vaqueros is undivided. Rocks of its Pato Red Member (now abandoned) now included in overlying Caliente Formation. Vaqueros geographically restricted to area southwest of San Andreas fault; Temblor Formation used northeast of fault. (Dibblee, 1973.)
- Age changed from Late Silurian to Early Devonian. Conformably overlies Thorofare Andesite. Thorofare-Vinalhaven sequence correlates with Castine Volcanics. (Brookins and others, 1973.)
- Wagonwheel Formation of Johnson (1909) adopted. Conformably overlies Welcome Shale Member of Kreyenhagen Shale; disconformably underlies Temblor Formation. (Dibblee, 1973.)
- East of type area, on north flank of eastern Brooks Range, age changed from Early Pennsylvanian to Permian to latest Mississippian (Chesterian) to Middle Pennsylvanian (Atokan); elsewhere, age remains Pennsylvanian and Permian. Thus, its overall age is Late Mississippian to Permian. (Armstrong, 1972.)
- Age changed from Pliocene(?) to Pliocene and Pleistocene(?). (Doell and Dalrymple, 1973.)
- Walcksville Sandstone Member of Catskill reassigned as Walcksville Tongue. Overlies Trimmers Rock Sandstone; underlies Beaverdam Run Tongue of Trimmers Rock. (Wood, 1973.)
- Warley Hill Formation used in area of this report. Assigned to Orangeburg Group (now reinstated, raised in rank, and restricted to Orangeburg and surrounding counties in south-central South Carolina) as one of its four formations; overlies Congaree Formation and underlies McBean Formation, both of Orangeburg Group. (Siple and Pooser, this report, p. A56.)
- Warm Springs Member of Luper (1941) adopted as middle of three members of Snowshoe Formation in Suplee area. Overlies and intertongues with Weberg Member of Snowshoe; underlies Basey Member of Snowshoe. (Imley, 1973.)

Name	Age	Location
Washakie Formation ---	middle and late Eocene.	Washakie Basin, southwestern Wyoming.
Washington Island Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Wason Park Rhyolite --	Oligocene -----	South-central Colorado.
Webb Canyon Gneiss --	Precambrian W -----	Northwestern Wyoming.
Weberg Member (of Snowshoe Formation).	Middle Jurassic -----	Eastern Oregon -----
Welcome Shale Member (of Kreyenhagen Shale).	late Eocene and early Oligocene(?).	Southern California --
Whiterock Bluff Shale Member (of Santa Margarita Formation).	middle Miocene -----	southern California (restricted).
Wilcox Group/Formation	early and middle Eocene.	Arkansas -----
Wild Cow Formation (of Madera Group).	Late Pennsylvanian (Missourian and Virgilian).	Central New Mexico --
Willow Creek Member (of Bachelor Mountain Rhyolite).	Oligocene -----	South-central Colorado
Windermere Group ----	Precambrian Y (post- Belt).	Northeastern Wash- ing and northwestern Idaho.
Windy Gulch Member (of Bachelor Mountain Rhyolite).	Oligocene -----	South-central Colorado

Revision and reference

- Reintroduced into Washakie Basin, Wyoming, as defined by Hayden (1869). Its rocks formerly included in Bridger and Uinta Formations, now restricted from use in this basin. Washakie divided into (ascending): Kinney Rim and Adobe Town Members (both new). (Roehler, 1973a.)
- Washington Island Flow adopted as ophitic flow, one of 12 named flows within Portage Lake Volcanics on Isle Royale. (Huber, 1973.)
- Name changed from Wason Park Rhyolite to Wason Park Tuff. (Steven and Ratté, 1973.)
- Webb Canyon Gneiss adopted. Concordant volcanic(?) bodies within Precambrian W layered gneisses, amphibolites, and migmatites. (Reed and Zartman, 1973.)
- Weberg Member of Lusher (1941) adopted as lowermost of three members of Snowshoe Formation in Suplee area; underlies and intertongues with Warm Springs Member of Snowshoe. (Imlay, 1973.)
- Welcome Formation of Van Couvering and Allen (1943) adopted as Welcome Shale Member, upper of two members of Kreyenhagen Shale. Overlies Point of Rocks Sandstone; underlies Wagonwheel Formation. (Dibblee, 1973.)
- Based on usage of Hill, Carlson, and Dibblee (1958), removed from Santa Margarita Formation, reassigned as upper of two members of Monterey Shale in southern Coast Ranges, and geographically restricted to area southwest of San Andreas fault. Conformably overlies Saltos Shale Member of Monterey; conformably underlies Santa Margarita Formation. Age changed from late Miocene to middle Miocene. (Dibblee, 1973.)
- In Arkansas, where Saline Formation is assigned to Wilcox Group, Wilcox age changed from early Eocene to early and middle Eocene. Elsewhere, Wilcox age remains unchanged. (Tschudy, 1973.)
- Wild Cow Formation adopted as middle of three formations of Madera Group. Conformably overlies Los Moyos Limestone (new); underlies Bursum or Abo Formation. Divided into (ascending): Sol se Mete Member (Missourian), Pine Shadow Member (Virgilian), and La Casa Member (Virgilian) (all new). (Myers, 1973.)
- Formation affiliation name changed to Bachelor Mountain Tuff. (Steven and Ratté, 1973.)
- Windermere Series or System (Canadian terms) of Walker (1926) adopted and geographically extended southward into northeastern Washington as Windermere Group. Includes in southwestern part of belt (ascending): Huckleberry Formation and Monk Formation; in northeastern part of belt (ascending): Shedroof Conglomerate, Leola Volcanics (correlating with informal lower conglomerate and upper volcanic members of Huckleberry), and Monk Formation. Overlies Belt Supergroup and correlative rocks; underlies Paleozoic rocks. (Miller and others, 1973.)
- Formation affiliation name changed to Bachelor Mountain Tuff. (Steven and Ratté, 1973.)

Name	Age	Location
Wissahickon Formation (of Glenarm Series).	Precambrian and (or) Early Cambrian (locally only).	Northeastern Virginia only.
Wolfskill Formation ---	Pliocene -----	Central California ---
Wygat Sandstone Mem- ber (of Temblor Formation).	late Oligocene -----	California -----
Yakima Basalt -----	middle and late Miocene to late Pliocene.	Oregon and Washington.

BEULAH LIMESTONE AND HARDCRABBLE LIMESTONE (MISSISSIPPIAN) OF COLORADO ABANDONED

By GLENN R. SCOTT

The formation names Beulah Limestone and Hardscrabble Limestone, both of Mississippian (Meramecian?) age along the eastern side of the southern Front Range, Colo., are here abandoned.

The term Beulah Limestone was originally applied by Brainerd, Baldwin, and Keyte (1930, p. 94) (table 1) to outcrops on the north side of a creek 1½ miles west of Beulah in sec. 5, T. 23 S., R. 68 W., Pueblo County, Colo. Later, these same authors (1933, p. 387-391) applied the name Williams Canyon Limestone to the beds formerly named Beulah Limestone, but never formally abandoned the name Beulah Limestone. No reason was given for this change in names. Brainerd, Baldwin, and Keyte (1933, p. 381) assigned the Williams Canyon to the Devonian and assigned about 100 feet (30 m) of limestone that overlies the Williams Canyon to the Madison Limestone. Brainerd and Johnson (1934, p. 541-542) and Johnson (1945, p. 45, 50) later recommended changing the assignment of the limestone above the Williams Canyon in the southern Front Range from Madison to Leadville Limestone. Still later, Maher (1950) divided the Leadville or Madison

Revision and reference

Age changed from Precambrian to Early Ordovician to Precambrian and (or) Early Cambrian in Virginia only; former age remains correct usage elsewhere. (Mixon and others, 1972.)

Formal proposal for abandonment of Wolfskill Formation; its rocks reassigned to Tehama Formation (now geographically extended into central California). (Sims and Sarna-Wojcicki, this report, p. A50.)

In Temblor Range, Wygal Sandstone Member adopted as one of seven members of Temblor Formation. Conformably overlies Cymric Shale Member (new) of Temblor, at places lapping over onto Point of Rocks Sandstone; conformably underlies Santos Shale Member of Temblor. Dibblee, 1973.)

Age changed from late Miocene and early Pliocene to middle and late Miocene to early Pliocene. (Snively and others, 1973.)

of previous usage into two units, the Hardscrabble Limestone and an overlying unit, for which he resurrected the term Beulah Limestone. On the basis of subsurface lithic correlation across eastern Colorado and Kansas, he assigned both these units and the Williams Canyon to the Mississippian (Meramecian?). The use of the names Beulah Limestone and Hardscrabble Limestone has been entirely confined to an area within about 5 miles (7.9 km) of the town of Beulah. Although it has been suggested that rocks of these formations occur at Canon City, Manitou Park, and Colorado Springs (Brainerd and others, 1930; Maher, 1950), the rocks have not been mapped in these areas as Beulah and Hardscrabble; rather they have been mapped as the Leadville Limestone (Scott and Taylor, 1974). Though the age of the Williams Canyon is not provided by fossils and is still considered Mississippian by the U.S. Geological Survey, this unit is now generally assigned to the Late Devonian (Baars, 1972, p. 92).

The Beulah and Hardscrabble are difficult to distinguish one from the other and are impractical map units. Together, they are essentially identical in stratigraphic position and in lithology with the Leadville Limestone of Kinderhookian(?), Osagean, and Meramecian age. Fossils collected in 1972 from the SW $\frac{1}{4}$ sec. 33, T. 22 S., R. 68 W., by R. J. Ross, Jr., R. B. Taylor, and the

writer from the lower part of the Hardscrabble Limestone were identified by J. T. Dutro, Jr., who stated (written commun., 1972), "These two collections are Mississippian in age, but precise assignment is difficult because of relatively poor preservation of specimens. I suggest an Osagean possibility, although a younger age is not unreasonable."

For these reasons, the Beulah and Hardscrabble are here abandoned in favor of the older and more widely used term Leadville Limestone.

TABLE 1.—Names applied to Devonian and Mississippian rocks in southern part of Front Range, Colorado

Brainerd, Baldwin, and Keyte (1930, p. 94)		Brainerd, Baldwin, and Keyte (1933)		Johnson (1945)		Maher (1950)		Baars (1972)		Scott and Taylor (1974)	
Mississippian	Madison Limestone	Mississippian	Madison Limestone	Mississippian	Leadville Limestone	(Meramecian?)	Beulah Limestone	Upper Devonian	Williams Canyon Limestone	Upper Devonian	Williams Canyon Limestone
							Hardscrabble Limestone				
Mississippian or Devonian	Beulah Limestone	Devonian	Williams Canyon Limestone	Devonian	Williams Canyon Limestone	Mississippian	Williams Canyon Limestone	Upper Devonian	Williams Canyon Limestone	Upper Devonian	Williams Canyon Limestone

NEW AND REVISED STRATIGRAPHIC NAMES IN THE WESTERN SACRAMENTO VALLEY, CALIFORNIA

By JOHN D. SIMS and ANDRE M. SARNA-WOJCICKI

Compilation of a new geologic map at scale of 1:62,500 in 1970 and 1971 (Sims and others, 1973) of parts of Solano, Napa, and Contra Costa Counties, Calif., involved field study of upper Tertiary rocks of the western Sacramento Valley. This study provides the basis for extending the Tehama Formation (Russell and Vanderhoof, 1931; Anderson and Russell, 1939) approximately 30 miles (48 km) beyond that mapped by Thomasson, Olmsted, and LeRoux (1960) and Miller (1966). Strata mapped as the Tehama Formation by Thomasson, Olmsted, and LeRoux (1960),

Miller (1966), and Sims and others (1973) are coextensive with strata mapped and named the Wolfskill Formation by Weaver (1949). Because the name Tehama has precedence over Wolfskill, the latter name is here abandoned, and the name Tehama Formation is retained.

Two volcanic tuffs, the Nomlaki and the Putah, are recognized as members of the Tehama Formation. The stratigraphic positions of the two tuffs within the Tehama Formation are similar, but their compositions differ and their spatial distributions do not overlap; thus, the two tuffs are neither coextensive nor correlative.

The Nomlaki Tuff Member (Russell and Vanderhoof, 1931) is a light-gray to pink, massive ash-flow pumice lapilli tuff near the base of the Tehama Formation in the northern Sacramento Valley. It was mapped by Anderson and Russell (1939) as far south as Elk Creek in Glenn County (fig. 1). It has a maximum thickness of about 100 feet (30 m) and is about 14 feet (4 m) thick at the type locality, about 6 miles (10 km) northeast of Paskenta in Tehama County near the former headquarters of the "old Nomlaki [sic] Indian reservation" (sec. 12, T. 24 N., R. 6 W.; Anderson and Russell, 1939, p. 244). The Nomlaki is characterized by a mafic phenocryst assemblage dominated by hypersthene and dark-green hornblende with subordinate amounts of clinopyroxene and dark-brown hornblende (table 2). The indices of refraction of volcanic glass shards from the Nomlaki range from 1.498 to 1.504, with a mode of 1.501. X-ray fluorescence spectroscopic analyses of volcanic glass from the Nomlaki are given in table 2. The age of the Nomlaki Tuff Member is 3.4 ± 0.4 m.y. (late Pliocene) on the basis of a K/Ar date on plagioclase crystals from a sample collected at Bear Creek Falls in Shasta County (Evernden and others, 1964).

The Putah Tuff Member is here named for its type locality, in the roadcut on the north side of Putah Creek along California Highway No. 128, sec. 36, T. 8 N., R. 2 W., Yolo County. It occupies a stratigraphic position within the Tehama Formation similar to that of the Nomlaki Tuff Member, but its northern limit is about 46 miles (74 km) south of the southernmost Nomlaki (Kirby, 1943; Miller, 1966). It is recognized from the Rumsey Hills south to the Los Medanos Hills, and the unit reaches a maximum thickness of about 50 feet (15 m) about 1 mile (1.6 km) south of bridge crossing Putah Creek in sec. 36, T. 8 N., R. 2 W. It dips gently to the east and probably extends for some distance beneath the younger strata of the Sacramento Valley. The Putah is well

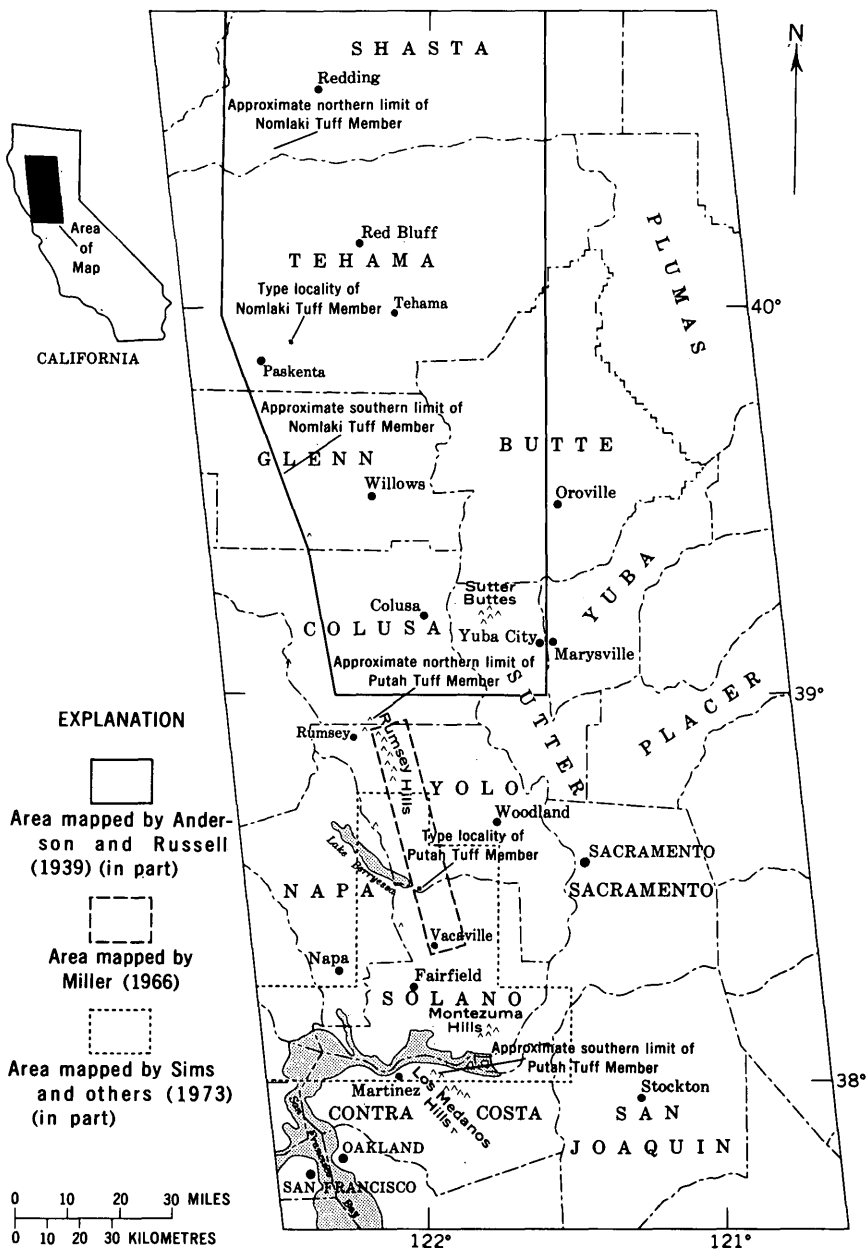


FIGURE 1.—Map of Sacramento Valley, Calif., showing distribution of the Nomlaki and Putah Tuff Members of the Tehama Formation and boundaries of areas in which the Tehama Formation has been mapped previously.

TABLE 2.—Summary of analytic data on Nomlaki and Putah Tuff Members of the Tehama Formation
(from Sarna-Wojcicki, 1970)

X-ray fluorescence spectroscopic analysis of volcanic glass									Mafic phenocryst frequency analysis (Percentage of count base)					Index of refraction of volcanic glass	
	Fe, per- cent	Ti, ppm	Ba, ppm	Mn, ppm	Zr, ppm	Rb, ppm	Sr, ppm	Zn, ppm	Dark- green horn- blende	Dark- brown horn- blende	Hyper- sthene	Clino- pyroxene	(Count base)	Main index of refraction	Range
Putah Tuff Member at type locality:															
(top) 287E	----1.36	1,251	814	278	276	153	27	45	0	3	91	6	(417)	1.503	1.500-1.504
287D	----1.34	1,088	794	262	256	174	35	43	0	3	93	4	(131)	1.502	1.500-1.504
(base) 287A	----1.39	1,018	838	244	261	170	37	39	0	1	93	6	(201)	1.501	1.500-1.504
Putah Tuff Member N. of type locality:															
292	-----1.49	1,131	981	244	263	158	68	37	0	1	98	1	(200)	1.503	1.500-1.504
291	-----ND	ND	ND	ND	ND	ND	ND	ND	0	0	96	4	(234)	ND	ND
Thin tuff in Los Medanos Hills:															
157	-----1.44	1,006	875	247	274	186	38	41	1	4	85	10	(82)	1.502	1.502-1.504
Nomlaki Tuff Member at type locality:															
(top) 314D	----.90	1,372	1,052	518	169	102	177	28	24	0	68	0	(153)	1.501	1.500-1.502
314C	----.94	1,332	1,055	419	182	107	169	33	15	13	60	13	(135)	1.501	1.498-1.504
314B	----.87	1,168	965	387	181	103	162	28	26	8	55	10	(125)	1.501	1.498-1.504
(base) 314A	----1.08	1,453	1,003	420	161	99	168	32	30	6	51	13	(137)	1.501	1.500-1.504

stratified and commonly crossbedded and in places contains rounded hard pumice lapilli and detrital sedimentary material derived from the underlying part of the Tehama Formation, indicating that the Putah was water laid and reworked.

The mafic phenocryst assemblage in the Putah Tuff Member is dominated by hypersthene, with minor amounts of clinopyroxene and dark-brown hornblende (table 2). Indices of refraction of volcanic glass shards from 1.500 to 1.504, with a mode of 1.502 to 1.503. X-ray fluorescence spectroscopic analyses of glass from the Putah and its correlatives are given in table 2. Miller (1966) obtained a K/Ar age of 3.3 m.y. on glass from the Putah Tuff Member, a name adopted from his unpublished work.

The Geologic Map of California (Ukiah sheet, Jennings and Strand, 1960; Santa Rosa sheet, Koenig, 1963) uses the name Nomlaki for the tuff herein named the Putah Tuff Member. This usage is based on that of Kirby (1943). However, Miller (1966) concluded on the basis of feldspar composition and the refractive index of glass that the two tuffs are different. The Nomlaki is an ash-flow tuff whose source is in the southern Cascades, northeast of Sacramento Valley (Russell, 1931; Lydon, 1967). The source of the Putah, in contrast, appears to be in the central Coast Ranges to the west, because this tuff is thickest south of Putah Creek (Miller, 1966). Furthermore, minor-element and trace-element compositions of the volcanic glass from the two tuffs differ significantly. The Putah contains relatively high concentrations of Fe, Zr, and Zn, a characteristic of central Coast Range tuffs derived from the Sonoma Volcanics, whereas the Nomlaki contains relatively higher concentrations of Sr and lower Fe, Zr, and Zn, typical of tuffs derived from the southern Cascades (Sarna-Wojcicki, 1970; also see table 2). Although the K/Ar ages of the Putah and Nomlaki Tuff Members are very similar and the refractive indices of the glass are not very different (1.500–1.504 and 1.498–1.504), differences in trace-element and minor-element chemistry of the glass and the heavy-mineral abundances (table 2) support Miller's (1966) conclusion that the two are not correlative (Sarna-Wojcicki, 1970).

Trace-element composition and mafic phenocryst assemblages from the Putah Tuff Member also correlate well with those of a thin tuff 25–30 feet (7.5–9 m) above the base of the Wolfskill Formation of Weaver (1949) in the Los Medanos Hills north of Mount Diablo. This correlation serves as the basis for extending the name Tehama Formation to the Los Medanos Hills in place

of the Wolfskill Formation. No tuffs correlative with the Putah have been found in the Sonoma Volcanics or in Tertiary rocks in the Clear Lake area.

PROPOSAL OF THE NAME ORANGEBURG GROUP FOR OUTCROPPING BEDS OF EOCENE AGE IN ORANGEBURG COUNTY AND VICINITY, SOUTH CAROLINA

By GEORGE E. SIPLE and WILLIAM K. POOSER

Cooke (1936) replaced the Orangeburg Formation of Dall (1898) with the name McBean for all deposits of middle Eocene age in South Carolina. Subsequently, Cooke and MacNeil (1952) revised the Tertiary stratigraphic column wherein the McBean Formation was restricted to the *Ostrea sellaformis* zone representing the clastic updip equivalent of the Santee Limestone of late middle Claiborne age.

The name Orangeburg is herein reinstated for usage by the U.S. Geological Survey, raised in rank to group status, and restricted to Orangeburg and surrounding counties in South Carolina. The Orangeburg Group consists of the Congaree Formation, Warley Hill Marl, and restricted McBean Formation of Claiborne age and the Barnwell Formation of Jackson age in their outcrop areas in northwestern Orangeburg County. Above (northwest of) the Citronelle escarpment, a thin veneer of middle Miocene deposits (Hawthorn?) overlies the Barnwell Formation and in places might be indistinguishable from it.

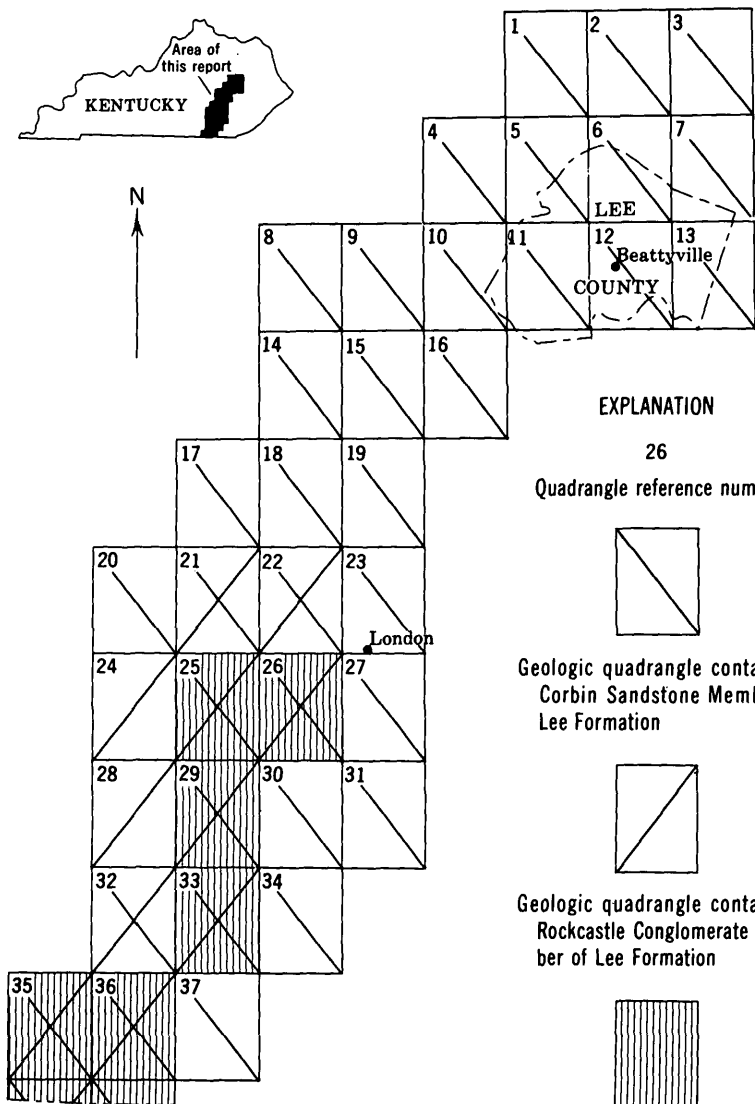
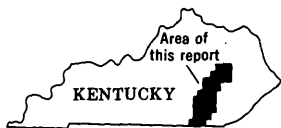
The term "Orangeburg Group" will be used in lieu of Jackson and Claiborne Groups to include the formational units indicated above, which occur above deposits of Wilcox (or Paleocene) age and below those of Pleistocene or middle Miocene age. The lithic components of the group include sand, clay, siltstone, glauconitic sand, and fuller's earth, combinations of which are characteristic of the individual formational units. Most of the distinguishable lithologic differences tend to lose their identity in these areas where the individual formations are pinching out to a featheredge and are affected in part by progressive overlap. The proximity of similar source material and the alluvial or colluvial disturbance of key beds or accumulations of faunal suites, generally considered typical of specific individual units, has facilitated this lack of facile discrimination.

**ABANDONMENT OF THE TERM BEATTYVILLE SHALE
MEMBER (OF THE LEE FORMATION)**

BY GORDON W. WEIR

Beattyville was introduced as a stratigraphic name in a table of formations for Kentucky as the "Beattyville Sub-Stage of the Lee Stage" in eastern Kentucky (Miller, 1917, p. 2-3). The unit name apparently was drawn from the town of Beattyville, Lee County, east-central Kentucky (fig. 2), but no type section was designated. The description was brief: "mainly shales; S. S. [sandstone]" ranging from 40 to 150 feet in thickness. Miller noted the following economic products of the unit: coal, bituminous sandstone, fire clay, and limonite ore. Above the Beattyville in Miller's table is the "Rockcastle Sub-Stage of the Lee Stage," a cliff-forming sandstone, ranging from 0 to 150 feet in thickness, in southeastern Kentucky. Above the Rockcastle, the table showed an unnamed shale unit, 300 to 600 feet thick, overlain in eastern Kentucky by the "Corbin Sub-Stage of the Lee Stage," a cliff-forming sandstone ranging from 0 to 150 feet in thickness. The 1917 table was incorporated without change in a later discussion of the Pennsylvanian System (Miller, 1919, p. 9-15), but the description of the Beattyville was not expanded. The minimum

FIGURE 2.—Index map of part of eastern Kentucky showing location of quadrangles containing Corbin Sandstone and Rockcastle Conglomerate Members of the Lee Formation and unit formerly designated as Beattyville Shale Member of the Lee Formation. Quadrangles included and source of information are: (1) *Stanton*, Weir (in press); (2) *Slade*, Weir (in press); (3) *Pomeroyton*, Weir and Richards (in press); (4) *Irvine*, H. P. Hoge and others (unpub. data); (5) *Cobhill*, D. C. Haney (unpub. data); (6) *Zachariah*, reconnaissance by G. W. Weir and C. L. Rice; (7) *Campton*, reconnaissance by G. W. Weir and C. L. Rice; (8) *Bighill*, Weir, and others (1971); (9) *Alcorn*, Rice (1972); (10) *Leighton*, C. L. Rice and D. C. Haney (unpub. data); (11) *Heidelberg*, reconnaissance by C. L. Rice and G. W. Weir; (12) *Beattyville*, reconnaissance by C. L. Rice and G. W. Weir; (13) *Tallega*, reconnaissance by G. W. Weir and C. L. Rice; (14) *Johnetta*, Gualtieri (1968); (15) *Sandgap*, Gualtieri (in press); (16) *McKee*, Weir and Mumma (in press); (17) *Mount Vernon*, Schlanger and Weir (1971); (18) *Livingston*, Brown and Osolnik (in press); (19) *Parrot*, Crowder (1963); (20) *Shopville*, Hatch (1964); (21) *Billows*, Hatch (1963b); (22) *Bernstadt*, Hatch (1963a); (23) *London*, Hatch (1963c); (24) *Dykes*, Smith (in press); (25) *Ano*, Stager (1962); (26) *London SW*, Stager (1963a); (27) *Lily*, Stager (1963b) (28) *Hail*, Smith and others (1973); (29) *Sawyer*, Puffett (1962); (30) *Vox*, Puffett (1963a); (31) *Corbin*, Puffett (1963b); (32) *Wiborg*, Smith (1970); (33) *Cumberland Falls*, Smith (1963); (34) *Wofford*, Smith (1967); (35) *Barthell* and part of *Oneida North*, Pomerene (1964b); (36) *Whitley City* and part of *Winfield*, Pomerene (1964a); (37) *Hollyhill*, Loney (1967).



EXPLANATION

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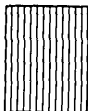
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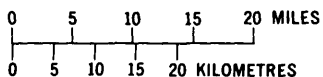
Geologic quadrangle containing
Corbin Sandstone Member of
Lee Formation



Geologic quadrangle containing
Rockcastle Conglomerate Mem-
ber of Lee Formation



Geologic quadrangle containing
unit formerly designated Beat-
tyville Shale Member of Lee
Formation



thickness of the "Beattyville Shales" was revised to zero (Miller, 1919, p. 147). Miller noted (1919, p. xiii) that the "Beattyville Shale" was "named from c.s. [coal series?] of Lee Co.", Kentucky.

Many later workers used the name Beattyville to designate a unit of shale, siltstone, and minor sandstone and coal that underlies the cliff-forming sandstone of east-central Kentucky, which was generally misidentified as the Rockcastle Conglomerate Member (Robinson, 1927; Robinson and others, 1927; Miller and others, 1929; McFarlan, 1943, 1954; Huddle, 1963). Most geologists considered the Beattyville to be a subdivision of the Lee Formation of Pennsylvanian age, but some classed the Beattyville as the upper part of the Chester [series], a subdivision of the Mississippian System (Robinson, 1927; Miller and others, 1929).

In contrast to the prevailing use at that time in east-central Kentucky of the terms Rockcastle and Beattyville, Eyl (1927) correctly identified the cliff-forming conglomeratic sandstone, 0 to 150 thick, in northern Lee County as "Corbin Conglomerate" of the Lee [Formation]" and left unnamed the underlying part of the Lee. McFarlan (1958, p. 72) also noted that the cliff-forming conglomerate of east-central Kentucky is not the same unit as the type Rockcastle Conglomerate Member (of the Lee Formation) described by Campbell (1898a, b). Recent detailed mapping by the U.S. Geological Survey in cooperation with the Kentucky Geological Survey (fig. 2), and reconnaissance by C. L. Rice and the author, confirm McFarlan's note and Eyl's identification. The cliff-forming conglomerate sandstone of east-central Kentucky is continuous with the Corbin Sandstone Member of the Lee Formation, which close to its type area near Corbin about 15 miles south of London, southeastern Kentucky is more than 170 feet above the Rockcastle Conglomerate Member (Campbell, 1898a, b). Thus, "Beattyville Shale" as originally and subsequently used in east-central Kentucky included the equivalent of all the Pennsylvanian section below the Corbin in southeastern Kentucky.

The name Beattyville Shale Member (of the Lee Formation) was applied in southeastern Kentucky on some maps southwest of London to a different part of the Pennsylvanian section—to the shale and sandstone beneath the type Rockcastle Conglomerate Member. On most maps in southeastern Kentucky, however, the name Beattyville was not used; the strata underlying the Rockcastle Conglomerate Member of the Lee Formation were subdivided into informal units of shale and sandstone.

In summary, the stratigraphic name Beattyville Shale Member has no practical meaning. Because it was poorly defined, has been applied to different stratigraphic intervals, and is neither necessary nor useful in describing the Pennsylvanian stratigraphy of eastern Kentucky, the name Beattyville is herein abandoned.

REFERENCES

- Adkison, W. L., 1973, Lithologic characteristics of upper Oligocene and Miocene rocks drilled at Elk Hills, Kern County, California: U.S. Geol. Survey Bull. 1375, 113 p.
- Albers, J. P., and Stewart, J. H., 1972, Geology and mineral deposits of Esmeralda County, Nevada: Nevada Bur. Mines and Geology Bull. 78, 80 p.
- Anderson, C. A., and Blacet, P. M., 1972a, Geologic map of the Mayer quadrangle, Yavapai County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-996.
- 1972b, Geologic map of the Mount Union quadrangle, Yavapai County, Arizona: U.S. Geol. Survey Geol. Quad. Map GQ-997.
- Anderson, C. A., and Russell, R. D., 1939, Tertiary formations of northern Sacramento Valley, California: California Jour. Mines and Geology, v. 35, no. 3, p. 219-253.
- Armstrong, A. K., 1972, Pennsylvanian carbonates, paleoecology, and rugose colonial corals, north flank, eastern Brooks Range, arctic Alaska: U.S. Geol. Survey Prof. Paper 747, 21 p.
- Arnold, Ralph, and Johnson, H. R., 1910, Preliminary report on the McKittrick-Sunset oil region, Kern and San Luis Obispo Counties, California: U.S. Geol. Survey Bull. 406, 225 p.
- Baars, D. L., 1972, Devonian System, in Geologic atlas of the Rocky Mountain region, United States of America: Denver, Colo., Rocky Mountain Assoc. Geologists, p. 90-99.
- Bailey, W. C., 1939, Wasco oil field [California]: California Oil Fields, v. 24, no. 3, p. 66-71.
- Bayley, R. W., 1972, A preliminary report on the geology and gold deposits of the Rochford district, Black Hills, South Dakota: U.S. Geol. Survey Bull. 1332-A, 24 p.
- Berdan, J. M., and Copeland, M. J., 1973, Ostracodes from Lower Devonian formations in Alaska and Yukon Territory: U.S. Geol. Survey Prof. Paper 825, 47 p.
- Berryman, W. M., 1973, Lithologic characteristics of Pliocene rocks cored at Elk Hills, Kern County, California: U.S. Geol. Survey Bull. 1332-D, 56 p.
- Black, D. F. B., and Cuppels, N. P., 1973, Strodes Creek Member (Upper Ordovician)—A new map unit in the Lexington Limestone of north-central Kentucky: U.S. Geol. Survey Bull. 1372-C, 16 p.
- Bostock, H. S., 1940, Keremeos, Similkameen district, British Columbia: Canada Geol. Survey Map 341A.
- Brainerd, A. E., and Johnson, J. H., 1934, Mississippian of Colorado: Am. Assoc. Petroleum Geologists Bull., v. 18, no. 4, p. 531-542.
- Brainerd, A. E., Baldwin, H. L., Jr., and Keyte, I. A., 1930, Stratigraphic

- sections in southern Rocky Mountains of Colorado: *Kansas Geol. Soc. Guidebook*, 4th Ann. Field Conf., p. 74-96 [see Beulah section, Pueblo County].
- 1933, Pre-Pennsylvanian stratigraphy of Front Range in Colorado: *Am. Assoc. Petroleum Geologists Bull.*, v. 17, no. 4, p. 375-396.
- Briggs, R. P., 1973, The Lower Cretaceous Figuera Lava and Fajardo Formation in the stratigraphy of northeastern Puerto Rico: *U.S. Geol. Survey Bull.* 1372-G, 10 p.
- Briggs, R. P., and Seiders, V. M., 1972, Geologic map of the Isla de Mona quadrangle, Puerto Rico: *U.S. Geol. Survey Misc. Geol. Inv. Map* I-718.
- Brookins, D. G., Berdan, J. M., and Stewart, D. B., 1973, Isotopic and paleontologic evidence for correlating three volcanic sequences in the Maine coastal volcanic belt: *Geol. Soc. America Bull.*, v. 84, no. 5, p. 1619-1628.
- Brown, W. R., and Osolnik, M. J., 1974, Geologic map of the Livingston quadrangle, southeast Kentucky: *U.S. Geol. Survey Geol. Quad. Map* GQ-1179. (In press.)
- Burchett, R. R., Dreezen, V. H., Reed, E. C., and Prichard, G. E., 1972, Bedrock geologic map showing thickness of overlying Quaternary deposits, Lincoln quadrangle and part of Nebraska City quadrangle, Nebraska and Kansas: *U.S. Geol. Survey Misc. Geol. Inv. Map* I-729.
- Cairnes, C. E., 1944, Hope, Yale, and New Westminster districts, British Columbia: *Canada Geol. Survey Map* 737A.
- Campbell, M. R., 1898a, Description of the Richmond quadrangle [Kentucky]: *U.S. Geol. Survey Geol. Atlas*, Folio 46.
- 1898b, Description of the London quadrangle [Kentucky]: *U.S. Geol. Survey Geol. Atlas*, Folio 47.
- Cannon, W. F., and Simmons, G. C., 1973, Geology of part of the southern complex, Marquette district, Michigan: *U.S. Geol. Survey Jour. Research*, v. 1, no. 2, p. 165-172.
- Cashion, W. B., compiler, 1973, Geologic and structure map of the Grand Junction quadrangle, Colorado and Utah: *U.S. Geol. Survey Misc. Geol. Inv. Map* I-736.
- Cater, F. W., Pinckney, D. M., Hamilton, W. B., Parker, R. L., Weldin, R. D., Close, T. J., and Zilka, N. T., 1973, Mineral resources of the Idaho primitive area and vicinity, Idaho: *U.S. Geol. Survey Bull.* 1304, 431 p.
- Clark, L. M., and Clark, Alexander, 1935, The Vaqueros in the Temblor Range [abs.]: *Am. Assoc. Petroleum Geologists Bull.*, v. 19, no. 1, p. 137.
- Clark, S. H. B., 1973, The McHugh Complex of south-central Alaska: *U.S. Geol. Survey Bull.* 1372-D, 11 p.
- Cobban, W. A., and Scott, G. R., 1972, Stratigraphy and ammonite fauna of the Graneros Shale and Greenhorn Limestone near Pueblo, Colorado: *U.S. Geol. Survey Prof. Paper* 645, 108 p.
- Cooke, C. W., 1936, Geology of the Coastal Plain of South Carolina: *U.S. Geol. Survey Bull.* 867, 196 p.
- Cooke, C. W., and MacNeil, F. S., 1952, Tertiary stratigraphy of South Carolina: *U.S. Geol. Survey Prof. Paper* 243-B, p. 19-29.
- Cornwall, H. R., 1972, Geology and mineral deposits of southern Nye County, Nevada: *Nevada Bur. Mines and Geology Bull.* 77, 49 p.
- Crowder, D. F., 1963, Geology of the Parrot quadrangle, Kentucky: *U.S. Geol. Survey Geol. Quad. Map* GQ-236.
- Cunningham, G. M., and Barbat, W. F., 1932, Age of producing horizon at

- Kettleman Hills, California: *Am. Assoc. Petroleum Geologists Bull.*, v. 16, no. 4, p. 417-421.
- Dall, W. H., 1898, A table of the North American Tertiary horizons, correlated with one another and with those of western Europe, with annotations: *U.S. Geol. Survey Ann. Rept.* 18, pt. 2c, p. 323-348.
- Daly, R. A., 1912, Geology of the North American Cordillera at the forty-ninth parallel: *Canada Geol. Survey Mem.* 38, 857 p. [1915?] (also issued as: *Canada Dept. Interior, Rept. Chief Astronomer*, 1910, v. 2 and 3, p. 1-799, 1913.)
- Dibblee, T. W., Jr., 1952, Cuyama Valley and vicinity: *Am. Assoc. Petroleum Geologists-Soc. Econ. Paleontologists and Mineralogists-Soc. Econ. Geologists Joint Ann. Mtg.*, Los Angeles, California, March, 1952, p. 82-84.
- 1962, Displacements on the San Andreas rift zone and related structures in Carrizo Plain and vicinity, *in* *Geology of Carrizo Plain and San Andreas fault—Guidebook*, 1962; Bakersfield, Calif., San Joaquin Geol. Soc., p. 5-12.
- 1973, Stratigraphy of the southern Coast Ranges near the San Andreas fault from Cholame to Maricopa, California: *U.S. Geol. Survey Prof. Paper* 764, 45 p.
- Dickinson, W. R., 1963, Tertiary stratigraphic sequence of the Hancock Ranch area, Monterey and Kings Counties, California, *in* *Geology of Salinas Valley and the San Andreas fault—AAPG and SEPM, Pacific Secs.*, 1963, *Guidebook*: [Los Angeles, Calif.] *Am. Assoc. Petroleum Geologists, Pacific Sec.*, p. 47-54.
- 1966a, Table Mountain serpentinite extrusion in California Coast Ranges: *Geol. Soc. America Bull.*, v. 77, no. 5, p. 451-471.
- 1966b, Structural relationships of San Andreas fault system, Cholame Valley and Castle Mountain Range, California: *Geol. Soc. America Bull.*, v. 77, no. 7, p. 707-725.
- Dickinson, W. R., and Vigrass, L. W., 1965, *Geology of the Suplee-Izee area, Crook, Grant, and Harney Counties, Oregon*: *Oregon Dept. Geology and Mineral Industries Bull.* 58, 109 p.
- Dodge, T. A., 1942, Amphibolites of the Lead area, northern Black Hills, South Dakota: *Geol. Soc. America Bull.*, v. 53, no. 4, p. 561-583.
- Doell, R. R., and Dalrymple, G. B., 1973, Potassium-argon ages and paleomagnetism of the Waianae and Koolau Volcanic Series, Oahu, Hawaii: *Geol. Soc. America Bull.*, v. 84, no. 4, p. 1217-1242.
- Dolgoff, Abraham, 1963, Volcanic stratigraphy of the Pahranaagat area, Lincoln County, southeastern Nevada: *Geol. Soc. America Bull.*, v. 74, no. 7, p. 875-899.
- Drewes, Harald, Williams, F. E., and Eaton, G. P., 1973, Mineral resources of the Chiricahua Wilderness area, Cochise County, Arizona: *U.S. Geol. Survey Bull.*, 1385-A, p. A1-A53.
- Dyson, J. L., 1967, Geology and mineral resources of the southern half of the New Bloomfield quadrangle, Pennsylvania: *Pennsylvania Geol. Survey Atlas*, 137cd, 86 p.
- Enlows, H. E., 1951, The igneous geology of Chiricahua National Monument, Arizona: *Tulsa Geol. Soc. Digest*, v. 19, p. 105-107.
- 1955, Welded tuffs of the Chiricahua National Monument, Arizona: *Geol. Soc. America Bull.*, v. 66, no. 10, p. 1215-1246.

- Evans, G. L., and Meade, G. E., 1945, Quaternary of the Texas High Plains: Texas Univ. Pub. 4401, p. 485-507.
- Evernden, J. F., Savage, D. E., Curtis, G. H., and James, G. T., 1964, Potassium-argon dates and the Cenozoic mammalian chronology of North America: *Am. Jour. Sci.*, v. 262, no. 2, p. 145-198.
- Eyl, W. C., 1927, Oil and gas structural geologic map of Lee County, Kentucky: Kentucky Geol. Survey, ser. 6 [reprinted ser. 9, 1949].
- Foster, H. L., Weber, F. R., Forbes, R. B., and Brabb, E. E., 1973, Regional geology of Yukon-Tanana Upland, Alaska: *Am. Assoc. Petroleum Geologists Mem.* 19, p. 388-395.
- Gester, G. C., 1917, Geology of a portion of the McKittrick district, a typical example of the West Side San Joaquin Valley oil fields, and a correlation of the oil sands of the West Side fields: *California Acad. Sci. Proc.*, 4th ser., v. 7, p. 207-227.
- Gester, G. C., and Galloway, John, 1933, Geology of Kettleman Hills oil field, California: *Am. Assoc. Petroleum Geologists Bull.*, v. 17, no. 10, p. 1161-1193.
- Gill, J. R., and Cobban, W. A., 1973, Stratigraphy and geologic history of Montana Group and equivalent rocks, Montana, Wyoming, and North and South Dakota: *U.S. Geol. Survey Prof. Paper* 776, 37 p.
- Green, J. C., 1964, Stratigraphy and structure of the Boundary Mountain anticlinorium in the Errol quadrangle, New Hampshire-Maine: *Geol. Soc. America Spec. Paper* 77, 78 p.
- Gualtieri, J. L., 1968, Geologic map of the Johnetta quadrangle, Rockcastle and Jackson Counties, Kentucky: *U.S. Geol. Survey Geol. Quad. Map* CQ-685.
- 1974, Geologic map of the Sand Gap quadrangle, Jackson County, Kentucky: *U.S. Geol. Survey Geol. Quad. Map* GQ-1100. (In press.)
- Harwood, D. S., 1973, Bedrock geology of the Cupsuptic and Arnold Pond quadrangles, west-central Maine: *U.S. Geol. Survey Bull.* 1346, 90 p.
- Hatch, N. L., Jr., 1963a, Geology of the Bernstadt quadrangle, Kentucky: *U.S. Geol. Survey Geol. Quad. Map* GQ-202.
- 1963b, Geology of the Billows quadrangle, Kentucky: *U.S. Geol. Survey Geol. Quad. Map* GQ-228.
- 1963c, Geology of the London quadrangle, Kentucky: *U.S. Geol. Survey Geol. Quad. Map* GQ-245.
- 1964, Geology of the Shopville quadrangle, Kentucky: *U.S. Geol. Survey Geol. Quad. Map* GQ-282.
- Hayden, F. V., 1869, Preliminary field report [third annual] of the United States Geological Survey of Colorado and New Mexico: Washington, D.C., 155 p.
- Hietanen, Anna, 1973, Origin of andesitic and granitic magmas in the northern Sierra Nevada, California: *Geol. Soc. America Bull.*, v. 84, no. 6, p. 2111-2118.
- Hill, M. L., Carlson, S. A., and Dibblee, T. W., Jr., 1958, Stratigraphy of Cuyama Valley-Caliente Range area, California: *Am. Assoc. Petroleum Geologists Bull.*, v. 42, no. 12, p. 2973-3000.
- Huber, N. K., 1973, The Portage Lake Volcanics (middle Keweenaw) on Isle Royale, Michigan: *U.S. Geol. Survey Prof. Paper* 754-C, p. C1-C32.
- Huddle, J. W., 1963, Coal beds of the Licking River reserve district, *in* Huddle, J. W., Lyons, E. J., Smith, H. L., and Ferm, J. C., 1963, Coal

- reserves of eastern Kentucky: U.S. Geol. Survey Bull. 1120, p. 55-80.
- Imlay, R. W., 1973, Middle Jurassic (Bajocian) ammonites from eastern Oregon: U.S. Geol. Survey Prof. Paper 756, 100 p.
- Imlay, R. W., and Detterman, R. L., 1973, Jurassic paleobiogeography of Alaska: U.S. Geol. Survey Prof. Paper 801, 34 p.
- Izett, G. A., Wilcox, R. E., and Borchardt, G. A., 1972, Correlation of a volcanic ash bed in Pleistocene deposits near Mount Blanco, Texas, with the Guaje Pumice Bed of the Jemez Mountains, New Mexico: *Jour. Quaternary Research*, v. 2, no. 4, p. 554-578.
- Jennings, C. W., and Strand, R. G., compilers, 1960, Geologic map of California—Ukiah sheet: California Div. Mines and Geology, scale 1:250,000.
- Johnson, H. R., 1909, Geology of the McKittrick-Sunset district, California [abs.]: *Science, new ser.*, v. 30, p. 63-64.
- Johnson, J. H., 1945, A résumé of the Paleozoic stratigraphy of Colorado: *Colorado School Mines Quart.*, v. 40, no. 3, 109 p.
- Johnson, W. D., Jr., 1973, Geologic map of the Delaware quadrangle, western Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-1087.
- Kaye, C. A., 1959, Geology of the San Juan metropolitan area, Puerto Rico: U.S. Geol. Survey Prof. Paper 317-A, p. 1-48.
- Keefe, W. R., 1972, Geologic map of the west half of the Neihart 15-minute quadrangle, central Montana: U.S. Geol. Survey Misc. Geol. Inv. Map I-726.
- Kehn, T. M., 1973, Sturgis Formation (Upper Pennsylvanian), a new map unit in the western Kentucky coal field: U.S. Geol. Survey Bull. 1394-B, 24 p.
- Kirby, J. M., 1943, The Rumsey Hills area: California Div. Mines Bull. 118, p. 601-605.
- Koenig, J. B., 1963, Geologic map of California—Santa Rosa sheet: California Div. Mines and Geology, scale 1:250,000.
- Landis, E. R., Dane, C. H., and Cobban, W. A., 1973, Stratigraphic terminology of the Dakota Sandstone and Mancos Shale, west-central New Mexico: U.S. Geol. Survey Bull. 1372-J, 44 p.
- Lipman, P. W., Steven, T. A., Luedke, R. G., and Burbank, W. S., 1973, Revised volcanic history of the San Juan, Uncompahgre, Silverton, and Lake City calderas in the western San Juan Mountains, Colorado: U.S. Geol. Survey Jour. Research, v. 1, no. 6, p. 627-642.
- Lochman-Balk, Christina, 1950, Status of Dry Creek shale of central Montana: *Am. Assoc. Petroleum Geologists Bull.*, v. 34, no. 11, p. 2200-2222.
- Loney, R. A., 1967, Geologic map of the Hollyhill quadrangle, McCreary and Whitley Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-615.
- Love, J. D., 1973, Harebell Formation (Upper Cretaceous) and Pinyon Conglomerate (uppermost Cretaceous and Paleocene), northwestern Wyoming: U.S. Geol. Survey Prof. Paper 734-A, 54 p.
- Lupher, R. L., 1941, Jurassic stratigraphy of central Oregon: *Geol. Soc. America Bull.*, v. 52, no. 2, p. 219-269.
- Lydon, P. A., 1967, The origin of Tuscan Buttes and the volume of the Tuscan Formation in northern California: California Div. Mines and Geology Spec. Rept. 91, p. 17-26.
- MacLeod, N. S., and Snavely, P. D., Jr., 1973, Volcanic and intrusive rocks of the central part of the Oregon Coast Range: Oregon Dept. Geology and Mineral Industries Bull. 77, p. 47-74.

- Maher, J. C., 1950, Pre-Pennsylvanian rocks along the Front Range of Colorado: U.S. Geol. Survey Oil and Gas Prelim. Chart 39.
- Marsh, O. T., 1960, Geology of the Orchard Peak area, California: California Div. Mines Spec. Rept. 62, 42 p.
- McFarlan, A. C., 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., 531 p. [reprinted 1961].
- 1954, Geology of the Natural Bridge State Park area: Kentucky Geol. Survey, ser. 9, Spec. Pub. 4, 31 p.
- 1958, Behind the scenery in Kentucky: Kentucky Geol. Survey, ser. 9, Spec. Pub. 10, 144 p.
- McLellan, S. D., 1927, The geology of the San Juan Islands: Washington Univ., Pub. Geology, v. 2, 185 p.
- McTaggart, K. C., and Thompson, R. M., 1967, Geology of part of the northern Cascades in southern British Columbia: Canadian Jour. Earth Sci., v. 4, no. 6, p. 1199-1228.
- Meyerhoff, H. A., and Smith, I. F., 1931, The geology of the Fajardo district, Porto Rico: Sci. Survey Porto Rico and Virgin Islands, v. 2, pt. 3, p. 201-360.
- Miller, A. M., 1917, Table of geological formations for Kentucky: Lexington, Ky., 7 p.
- 1919, The geology of Kentucky: Kentucky Dept. Geology and Forestry, Ser. 5, Bull. 2, 392 p.
- Miller, F. K., McKee, E. H., and Yates, R. G., 1973, Age and correlation of the Windermere Group in northeastern Washington: Geol. Soc. America Bull., v. 84, no. 11, p. 3723-3730.
- Miller, Raymond, and Briggs, G. H., Jr. [1929], Geologic map of Powell County, Kentucky: Kentucky Geol. Survey, ser. 6.
- Miller, W. L., 1966, Petrology of the Putah Tuff Member of the Tehama Formation, Yolo and Solano Counties, California: Davis, Calif., Univ. California, M.S. thesis.
- Misch, P. H., 1952, Geology of the northern Cascades of Washington: Mountaineer, v. 45, no. 12, p. 4-22.
- Mixon, R. B., Southwick, D. L., and Reed, J. C., Jr., 1972, Geologic map of the Quantico quadrangle, Prince William and Stafford Counties, Virginia, and Charles County, Maryland: U.S. Geol. Survey Geol. Quad. Map GQ-1044.
- Monroe, W. H., 1973a, Geologic map of the Bayamón quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Inv. Map I-751.
- 1973b, Stratigraphy and petroleum possibilities of middle Tertiary rocks in Puerto Rico: Am. Assoc. Petroleum Geologists Bull., v. 57, no. 6, p. 1086-1099.
- Myers, D. A., 1973, The upper Paleozoic Madera Group in the Manzano Mountains, New Mexico: U.S. Geol. Survey Bull. 1372-F, 13 p.
- Nilsen, T. H., Dibblee, T. W., Jr., and Addicott, W. O., 1973, Lower and middle Tertiary stratigraphic units of the San Emigdio and western Tehachapi Mountains, California: U.S. Geol. Survey Bull. 1372-H, 23 p.
- Noble, D. C., and McKee, E. H., 1972, Description and K-Ar ages of volcanic units of the Caliente volcanic field, Lincoln County, Nevada, and Washington County, Utah: Isochron/West, no. 5, p. 17-24.
- Owen, D. D., 1856, Report of the geological survey in Kentucky, made during the years 1854 and 1855: Frankfort, Ky., 416 p.

- Patton, W. W., Jr., 1973, Reconnaissance geology of the northern Yukon-Koyukuk province, Alaska: U.S. Geol. Survey Prof. Paper 774-A, 17 p.
- Pease, M. H., Jr., 1972, Geologic map of the Eastford quadrangle, Windham and Tolland Counties, Connecticut: U.S. Geol. Survey Geol. Quad. Map GQ-1023.
- Pease, M. H., Jr., and Briggs, R. P., 1972, Geologic map of the Río Grande quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-733.
- Pipiringos, G. N., 1972, Upper Triassic and pre-Morrison Jurassic rocks, *in* Segerstrom, Kenneth, and Young, E. J., General geology of the Hahns Peak and Farwell Mountain quadrangles, Routt County, Colorado: U.S. Geol. Survey Bull. 1349, p. 18-29.
- Pomerene, J. B., 1964a, Geology of the Whitley City quadrangle, Kentucky, and the Kentucky part of the Winfield quadrangle: U.S. Geol. Survey Geol. Quad. Map GQ-260.
- 1964b, Geology of the Barthell quadrangle and part of the Oneida North quadrangle, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-314.
- Puffett, W. P., 1962, Geology of the Sawyer quadrangle, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-179.
- 1963a, Geology of the Vox quadrangle, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-224.
- 1963b, Geology of the Corbin quadrangle, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-231.
- Reed, C. A., 1950, A preliminary announcement of a new mammalian fossil locality in the Pliocene of Arizona: *Plateau*, v. 22, no. 4, p. 75-77.
- Reed, J. C., Jr., and Zartman, R. E., 1973, Geochronology of Precambrian rocks of the Teton Range, Wyoming: *Geol. Soc. America Bull.*, v. 84, no. 2, p. 561-582.
- Reed, R. D., and Hollister, J. S., 1936, Structural evolution of southern California: *Am. Assoc. Petroleum Geologists Bull.*, v. 20, no. 12, p. 1529-1704.
- Rice, C. L., 1972, Geologic map of the Alcorn quadrangle, east-central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-963.
- Richter, D. H., and Jones, D. L., 1973, Reconnaissance geologic map of the Nabesna A-2 quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-749.
- Rinehart, C. D., and Fox, K. F., Jr., 1972, Geology and mineral deposits of the Loomis quadrangle, Okanogan County, Washington: *Washington Div. Mines Geology Bull.* 64, 124 p.
- Robinson, L. C., 1927, Areal and structural geologic map of Wolfe County, Kentucky: *Kentucky Geol. Survey, Ser. 6* [reprinted, *Ser. 9*, 1950].
- Robinson, L. C., McFarlan, A. C., and Miller, A. M., 1927, Geologic map of Menifee County, Kentucky: *Kentucky Geol. Survey, Ser. 6* [reprinted, *Ser. 9*, 1950].
- Roehler, H. W., 1973a, Stratigraphy of the Washakie Formation in the Washakie Basin, Wyoming: U.S. Geol. Survey Bull. 1349, 40 p.
- 1973b, Stratigraphic divisions and geologic history of the Laney Member of the Green River Formation in the Washakie basin in southwestern Wyoming: U.S. Geol. Survey Bull. 1372-E, 28 p.
- Rose, R. L., and Colburn, I. P., 1963, Geology of the east-central part of the Priest Valley quadrangle, California, *in* *Geology of Salinas Valley and the San Andreas fault—AAPG and SEPM, Pacific Secs., Ann. Spring*

- Field Trip 1963, Guidebook: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., p. 38-45.
- Ruppel, E. T., 1972, Geology of pre-Tertiary rocks in the northern part of Yellowstone National Park, Wyoming: U.S. Geol. Survey Prof. Paper 729-A, 66 p.
- Russell, R. D., 1931, The Tehama Formation of northern California: Berkeley, Calif., Univ. California, Ph.D. thesis.
- Russell, R. D., and Vanderhoof, V. L., 1931, A vertebrate fauna from a new Pliocene formation in northern California: California Univ., Dept. Geol. Sci. Bull., v. 20, no. 2, p. 11-21.
- Sarna-Wojcicki, A. M., 1970, Correlation of Late Cenozoic pyroclastic deposits in the Central Coast Ranges of California: Berkeley, Calif., Univ. California, Ph.D. thesis.
- Schlanger, S. O., and Weir, G. W., 1971, Geologic map of the Mount Vernon quadrangle, Rockcastle County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-902.
- Scott, G. R., and Taylor, R. B., 1974, Reconnaissance geologic map of the Beulah quadrangle, Pueblo County, Colorado: U.S. Geol. Survey Misc. Field Studies Map MF-551.
- Segerstrom, Kenneth, and Young, E. J., 1972, General geology of the Hahns Peak and Farwell Mountain quadrangles, Routt County, Colorado: U.S. Geol. Survey Bull. 1349, 63 p.
- Sevon, William, 1969, Sedimentology of some Mississippian and Pleistocene deposits of northeastern Pennsylvania, in Subitzky, Seymour, ed., Geology of selected areas in New Jersey and eastern Pennsylvania and guidebook of excursions: New Brunswick, N.J., Rutgers Univ. Press, p. 214-234.
- Sharp, R. V., and Duffield, W. A., 1973, Reinterpretation of the boundary between the Cosumnes and Logtown Ridge Formations, Amador County, California: Geol. Soc. America Bull., v. 84, no. 12, p. 3969-3976.
- Siegfus, S. S., 1939, Stratigraphic features of Reef Ridge Shale in southern California: Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 24-44.
- Sims, J. D., Fox, K. F., Jr., Bartow, J. A., and Helley, E. J., compilers, 1973, Preliminary geologic map of Solano County and parts of Napa Contra Costa, Marin, and Yolo counties, California: U.S. Geol. Survey Misc. Field Studies Map MF-484.
- Smith, J. G., 1973, Geologic map of the Duffer Peak quadrangle, Humboldt County, Nevada: U.S. Geol. Survey Misc. Geol. Inv. Map I-606.
- Smith, J. H., 1963, Geology of the Cumberland Falls quadrangle, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-274.
- 1967, Geologic map of the Wofford quadrangle, Whitley County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-617.
- 1970, Geologic map of the Wiborg quadrangle, McCreary County, Kentucky: U.S. Geol. Survey Geol. Map GQ-867.
- in press, Geologic map of the Dykes quadrangle, Pulaski County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-1197.
- Smith, J. H., Pomerene, J. B., and Ping, R. G., 1973, Geologic map of the Hail quadrangle, McCreary and Pulaski Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-1058.
- Smith, W. H., and Smith, G. E., 1967, Description of late Pennsylvanian strata from deep diamond drill cores in the southern part of the Illinois basin: Illinois State Geol. Survey Circ. 411, 27 p.

- Snively, P. D., Jr., MacLeod, N. S., and Wagner, H. C., 1973, Miocene tholeiitic basalts of coastal Oregon and Washington and their relations to coeval basalts of the Columbia Plateau: *Geol. Soc. America Bull.*, v. 84, no. 2, p. 387-424.
- Staatz, M. H., Tabor, R. W., Weis, P. L., Robertson, J. F., Van Noy, R. M., and Pattee, E. C., 1972, *Geology and mineral resources of the northern part of the North Cascades National Park, Washington*: U.S. Geol. Survey Bull. 1359, 132 p.
- Stager, H. K., 1962, *Geology of the Ano quadrangle, Kentucky*: U.S. Geol. Survey Geol. Quad. Map GQ-171.
- 1963a, *Geology of the London SW quadrangle [Kentucky]*: U.S. Geol. Survey Geol. Quad. Map GQ-195.
- 1963b, *Geology of the Lily quadrangle, Kentucky*: U.S. Geol. Survey Geol. Quad. Map GQ-218.
- Steven, T. A., and Lipman, P. W., 1973, *Geologic map of the Spar City quadrangle, Mineral County, Colorado*: U.S. Geol. Survey Geol. Quad. Map GQ-1052.
- Steven, T. A., and Ratté, J. C., 1973, *Geologic map of the Creede quadrangle Mineral and Saguache Counties, Colorado*: U.S. Geol. Survey Geol. Quad. Map GQ-1053.
- Stock, Chester, 1920, *An early Tertiary vertebrate fauna from the southern coast ranges of California*: California, Univ., Dept. Geology Bull., v. 12, no. 4, p. 267-276.
- 1948, *A peculiar new carnivore from the Cuyama Miocene, California*: Southern California Acad. Sci. Bull., v. 46, pt. 2, p. 84-89.
- Stock, Chester, and Bode, F. D., 1935, *Occurrence of Lower Oligocene mammal-bearing beds near Death Valley, California*: Natl. Acad. Sci. Proc., v. 21, no. 10, p. 571-579.
- Stuckless, J. S., and O'Neil, J. R., 1973, *Petrogenesis of the Superstition-Superior volcanic area as inferred from strontium- and oxygen-isotope studies*: *Geol. Soc. America Bull.*, v. 84, no. 6, p. 1987-1998.
- Stuckless, J. S., and Sheridan, M. F., 1971, *Tertiary volcanic stratigraphy in the Goldfield and Superstition Mountains, Arizona*: *Geol. Soc. America Bull.*, v. 82, no. 11, p. 3235-3240.
- Tailleur, I. L., Mamet, B. L., and Dutro, J. T., Jr., 1973, *Revised age and structural interpretations of the Nuka Formation at Nuka Ridge, Northwestern Alaska*: *Am. Assoc. Petroleum Geologists Bull.*, v. 57, no. 7, p. 1348-1352.
- Thomasson, H. G., Jr., Olmsted, F. H., and LeRoux, E. F., 1960, *Geology, water resources and usable ground-water storage capacity of part of Solano County, California*: U.S. Geol. Survey Water-Supply Paper 1464, 693 p.
- Tschudy, R. H., 1973, *Stratigraphic distribution of significant Eocene paly-nomorphs of the Mississippi Embayment*: U.S. Geol. Survey Prof. Paper 743-B, 24 p.
- Van Covering, Martin, and Allen, H. B., 1943, *Devils Den oil field [Calif.]*: California Div. Mines Bull. 118, p. 496-501.
- Ver Planck, W. E., Jr., 1952, *Gypsum in California*: California Div. Mines Bull. 163, 151 p.
- Wagner, C. M., and Schilling, K. H., 1923, *The San Lorenzo Group of the San Emigdio region, California*: California Univ., Dept. Geol. Sci. Bull., v. 14, no. 6, p. 235-276.

- Walker, J. F., 1926, Geology and mineral deposits of Windermere map area, British Columbia: Canada Geol. Survey Mem. 148, 69 p.
- Waters, A. C., and Krauskopf, Konrad, 1941, Protoclastic border of the Colville batholith: Geol. Soc. America Bull., v. 52, no. 9, p. 1355-1417.
- Weaver, C. E., 1949, Geology of the Coast Ranges immediately north of San Francisco Bay region, California: Geol. Soc. America Mem. 35, 242 p.
- Weir, G. W., 1974, Geologic map of the Slade quadrangle, east-central Kentucky: U.S. Geol. Survey, Quad. Map GQ-1183. (In press.)
- 1974, Geologic map of the Stanton quadrangle, Powell and Estill Counties, Kentucky: U.S. Geol. Survey, Geol. Quad. Map GQ-1182. (In press.)
- Weir, G. W., Lee, K. Y., and Cassity, P. E., 1971, Geologic map of the Big-hill quadrangle, east-central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-900.
- Weir, G. W., and Mumma, M. D., 1974, Geologic map of the McKee quadrangle, Jackson and Owsley Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-1125. (In press.)
- Weir, G. W., and Richards, P. W., 1974, Geologic map of the Pomeroyton quadrangle, east-central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-1184. (In press.)
- White, W. S., 1972, The base of the upper Keweenaw, Michigan and Wisconsin: U.S. Geol. Survey Bull. 1354-F, 23 p.
- Williams, R. N., Jr., 1936, Recent developments in the North Belridge oil field [Calif.]: California Oil Fields, v. 21, no. 4, p. 5-16.
- Wolff, R. G., and Huber, N. K., 1973, The Copper Harbor Conglomerate (middle Keweenaw) on Isle Royale, Michigan, and its regional implications: U.S. Geol. Survey Prof. Paper 754-B, 15 p.
- Wood, G. H., Jr., 1973, Geologic map of the Pottsville quadrangle, Schuylkill County, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map GQ-1028.