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

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CONTRIBUTIONS TO STRATIGRAPHY

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By GEORGE V. COHEE and WILNA B. WRIGHT

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 p€ 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 Moutain 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 Granodiorite.	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 Formation).	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 northwestern Wyoming.
Bowser Formation	Middle Jurassic	Cook Inlet area, southern Alaska.
Branch Canyon Sandstone.	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 Anarchist 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 Dibble (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 Superstitution 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 (Saucesian).	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. (Snavely 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 Thorofare 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); undelies 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 Conglomerate.	Precambrian Y (middle Keweenawan).	Northwestern Michigan and northern Wisconsin.
Consumnes Formation (of Amador Group).	Late Jurassic or older.	Central California
Council Grove Group	Early Permian	Kansas, Oklahoma, Nebraska.
Coyote Sandstone Member (of Madera Limestone).	Pennsylvanian	New Mexico
		Central Arizona
Crazy Basin Quartz Monzonite.	Precambrian	
Crystal Lake Tuff	late Oligocene	Southwestern Colorado.
Cubero Sandstone Tongue.	Late Cretaceous	West-central New Mexico.
Cymric Shale Member (of Temblor Formation).	late Oligocene	California
Dakota Sandstone	Early and Late Cretaceous.	Northwestern Colorado.
Dakota Sandstone	Early and Late Cretaceous.	West-central New Mexico.
Deer Mountain Member (of Albee Formation).	Early and (or) Middle Ordovician.	West-central Maine
Depoe Bay Basalt	middle Miocene	Northwestern Oregon and southwestern Washington.
Devilwater Shale Member (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 prevously 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 Keweenawan).	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 alaskite 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.)
Ellemeham 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 Snavely, 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 (middle Keweenawan).	Isle Royale, northern Michigan).
Graneros Shale	Late Cretaceous	Eastern Colorado
Gravelly Flat Formation.	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 (middle Keweenawan).	Northern Michigan
Grove Creek Member (of Snowy Range Formation) (of Gallatin 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 (1943) 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 LaClede 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 Claytsone	Early Cretaceous	Southern California
Hiko Tuff	middle Miocene	Southeastern Nevada
Hill Point Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Horseshoe Bend Formation.	Permian(?)	Northern California
Huckleberry Formation	Precambrian Y (post-Belt).	Northeastern Washington and northwestern Idaho.
Huginnin Porphyrite (of Central Mine Group).	Precambrian Y (middle Keweenawan).	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 Conglomerate (of Eagle River Group).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Jacalitos Formation	early Pliocene	Southern California
Jelm Formation (of Chugwater Group).	Late Triassic	Wyoming and northwestern 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
LaClede 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 northwestern New Mexico.
Lee Formation	Late Mississippian and Early Pennsylvanian.	Virginia, Kentucky, and Tennessee.
Leola Volcanics	Precambrian Y (post-Belt).	Northeastern Washington and northwestern 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 Aziscohos 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.)
LaClede 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): LaClede, 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 Formation).	early and middle Miocene.	Southern California --
Meiklejohn Formation -	Early Cretaceous ----	South-central Nevada.
Melozi Formation (of Shaktolik Group).	Late Mississippian --	Alaska ----------
Mesaverde Formation --	Late Cretaceous -----	Wyoming ----------
Middle Point Flow (of Portage Lake Volcanics).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Milk Creek Formation --	late Miocene and Pliocene.	Arizona ----------
Miller Mountain Formation.	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 Central Mine Group).	Precambrian Y (middle Keweenawan).	Isle Royale, northern Michigan.
Monk Formation ------	Precambrian Y (post-Belt).	Northeastern Washington and northwestern 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 Bighorn 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 Formation (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 Jurrasic. (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.)
Paguate 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.)
Pattiway 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 Díaz 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 northwestern 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 LaClede 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.)
Scoville 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.	Oliogocene	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 Colorado.
Snowy Range Formation (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): Picayune 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 Superstitution 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. (Piperingos, 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 Formation (of Montana Group).	Late Cretaceous	Central Montana
Telegraph Creek Member (of Cody Shale).		
Telegraph Creek Member (of Colorado Shale).		
Telegraph Creek Formation.	Late Cretaceous	Montana and Wyoming.
Temblor Formation	late Oligocene to middle Miocene.	Southern California (restricted).
Thatcher Limestone Member (of Graneros Shale).	Late Cretaceous	Southeastern Colorado.
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 Snavely, 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 Lupher (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. (Imlay, 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 Washing 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 Lupher (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 ----
Wygal Sandstone Member (of Temblor Formation).	late Oligocene -------	California ----------
Yakima Basalt --------	middle and late Miocene to late Pliocene.	Oregon and Washington.

BEULAH LIMESTONE AND HARDSCRABBLE 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. (Snavely 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 SW¼ 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 Hardscrabble Limestone			Mississippian	Leadville 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

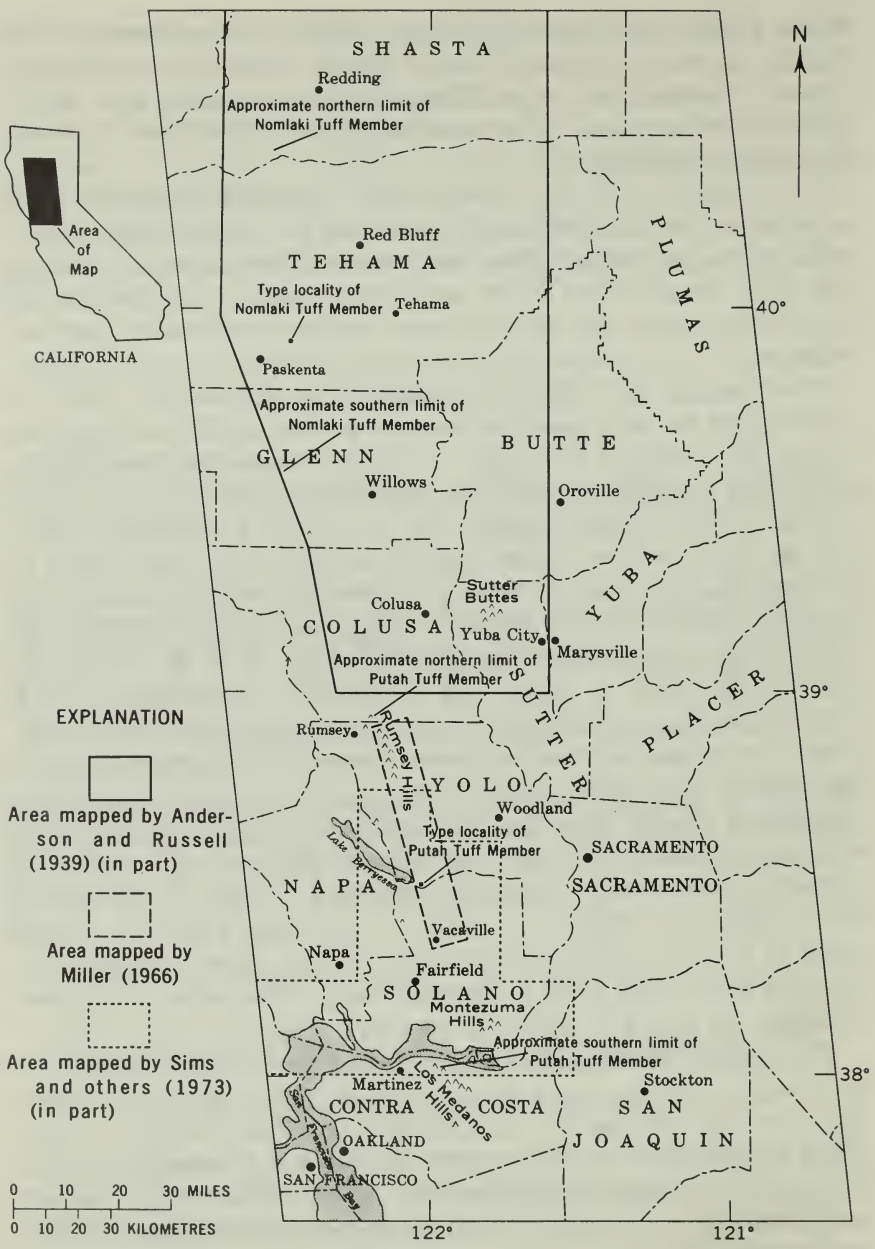


FIGURE 1.—Map of Sacramento Valley, Calif., showing distribution of the Nomlaki and Putah Tuff Members of the Tehama Formation and boundaries of areas in which the Tehama Formation has been mapped previously.

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, percent	Ti, ppm	Ba, ppm	Mn, ppm	Zr, ppm	Rb, ppm	Sr, ppm	Zn, ppm	Dark-green hornblende	Dark-brown hornblende	Hypersthene	Clinopyroxene	(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.

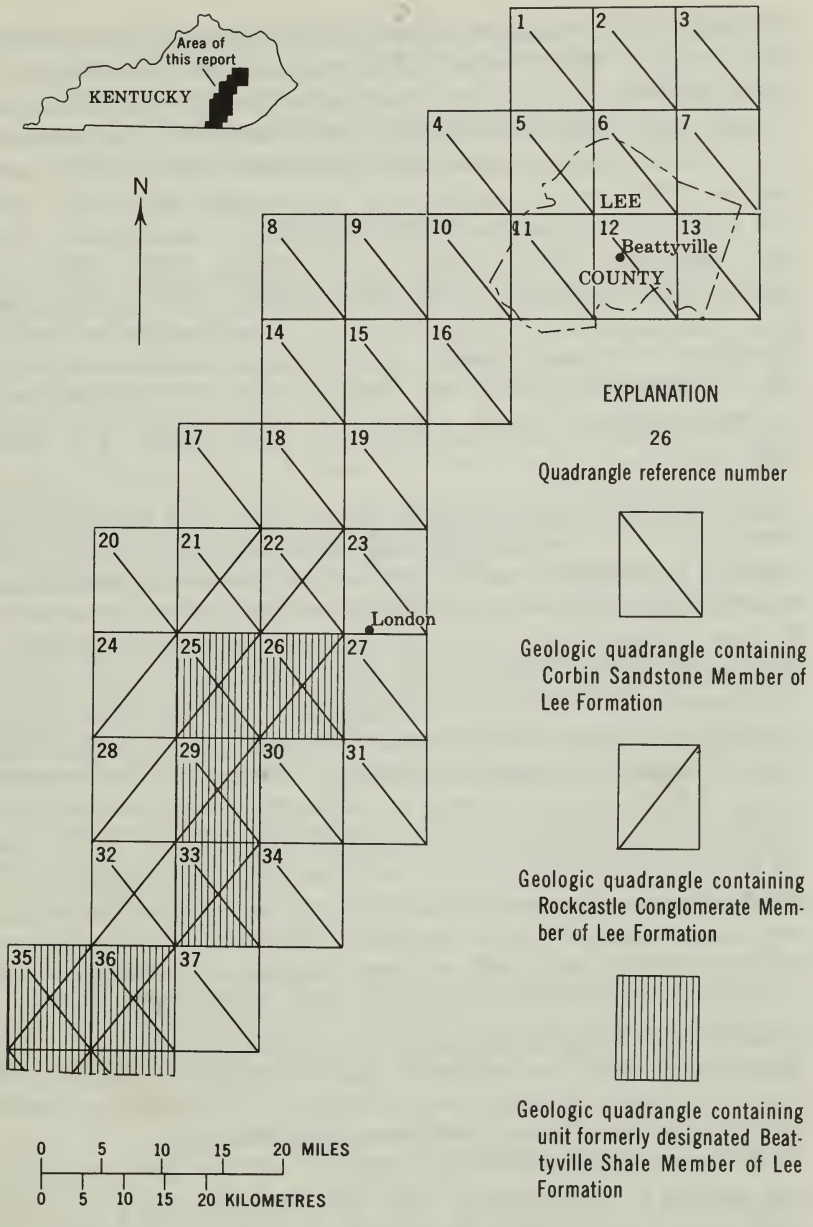
The term "Orangeburg Group" will be used in lieu of Jackson and Claiborne Groups to include the formational units indicated above, which occur above deposits of Wilcox (or Paleocene) age and below those of Pleistocene or middle Miocene age. The lithic components of the group include sand, clay, siltstone, 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*, Weis (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. Wein 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).


Area of this report
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0 5 10 15 20 MILES
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EXPLANATION
26
Quadrangle reference number
Geologic quadrangle containing Corbin Sandstone Member of Lee Formation
Geologic quadrangle containing Rockcastle Conglomerate Member of Lee Formation
Geologic quadrangle containing unit formerly designated Beattyville 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.

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