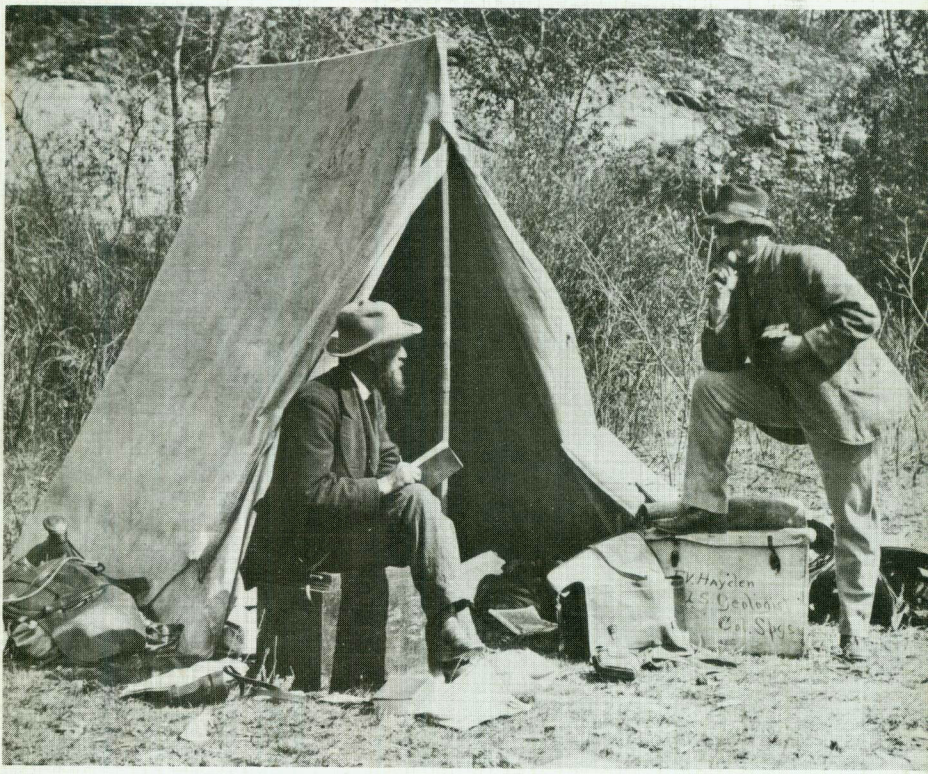
M
B
M
G

CURRENT GEOLOGICAL AND GEOPHYSICAL STUDIES IN MONTANA

compiled by

Richard B. Berg



William H. Jackson photo, courtesy U.S. Geological Survey.

Field camp of F. V. Hayden (seated) during Yellowstone Expedition, 1871.

Bulletin 112 1980

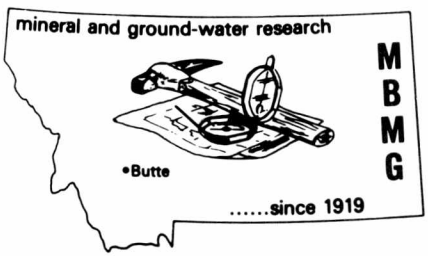
Montana Bureau of Mines and Geology
A Department of
Montana College of Mineral Science and Technology

Bulletin 112

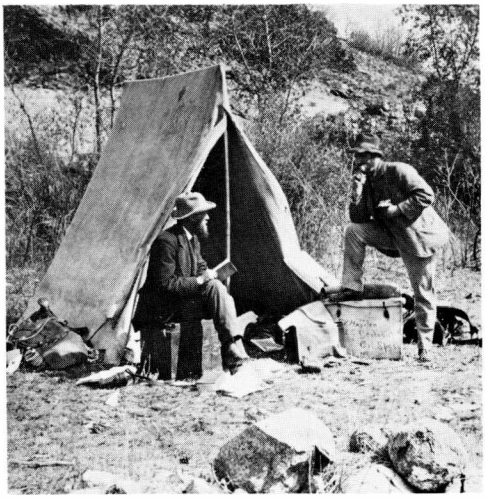
CURRENT GEOLOGICAL AND GEOPHYSICAL STUDIES IN MONTANA 1980

compiled by

Richard B. Berg



1980



About the cover . . .

Man-Who-Picks-Up-Rocks-Running was the Indian name given Ferdinand Vandiveer Hayden (1829-1887). Physician turned geologist, Hayden played a key role in establishing Yellowstone as the nation's first national park. In 1871, on leave as Professor of Geology at the University of Pennsylvania, Dr. Hayden led the newly created Geological Survey of the Territories north into Montana to investigate "implausible phenomena" in the headwaters of the Yellowstone and Missouri rivers. The 34-man expedition spent from July 20 to August 23, 1871, recording remarkable curiosities that would eventually prompt Congress to set aside a scenic preserve for all time. On March 1, 1872, President Grant signed the law creating Yellowstone National Park.

The photograph was taken by William Henry Jackson (1843-1942), considered by many as the foremost photographer of the early West. Jackson, an already successful illustrator living in Omaha, joined the Survey (at Hayden's request), in the summer of 1870, and spent nearly a decade in that service as its chief photographer. The value of Jackson's work is honored by historians to be one of the most important contributions of the "Hayden surveys".

The excellent photograph by Jackson was furnished by the archives of the U.S. Geological Survey. The identification of the gentleman pictured with Dr. Hayden is Walter Paris (1842-1906), a noted British watercolorist and architect. Paris, according to the *Dictionary of American Biography,* vol. 14 (1934), immigrated to the United States "about" 1872. This date, if accurate, raises more than casual doubt as to whether Paris was actually available at the time of the Yellowstone Expedition in 1871 (as referenced from a U.S.G.S. source). It is possible that the two men met while Hayden was in Washington, D.C. during the winter of 1873-74, at which time Hayden may have invited Paris to his camp for the upcoming field season. The Survey spent the summer and fall of 1874 in Colorado with some activity devoted to mapping along the Front Range in the vicinity of the Garden of the Gods. The creditability of the 1874 date is further substantiated by the identification on the supply case: *E. V. Hayden, U.S. Geologist, Col. Spgs.* [ed.]

Contents

Sheets

Preface

This is the twelfth annual list of geological and geophysical research published by the Montana Bureau of Mines and Geology. These lists would not be possible without the assistance of those who took the time to send us information on their research. We appreciate this cooperation and hope that you will find this list useful.

This annual list of geological and geophysical studies in Montana includes projects of the U.S. Geological Survey and the Montana Bureau of Mines and Geology, as well as studies by university faculty and graduate students. Many of these studies are still far from complete and no published information is available. It is suggested that anyone who wants further information on a particular project correspond directly with the investigator. Completed theses are not included in this list. However, more than 700 theses dealing with Montana geology are indexed in Montana Bureau of Mines and Geology Special Publication 77 (1977). Northwest Geology, published annually by the Geology Department, University of Montana, is also an excellent source of information on theses dealing with the geology of Wyoming, Montana, Idaho, Oregon and Washington.

Most studies are listed under one heading only, but because of the difficulty of assigning some studies to a single category, some are listed under more than one heading. The date following the entry is the expected date of completion. Many of the entries are numbered and plotted on the index maps. An asterisk (*) indicates that the area of study is plotted on the index map of southwestern Montana (**Sheet 2, back pocket**). All other numbered entries are plotted on **Sheet 1**, index map of Montana.

Information concerning current studies not included in this list may be sent to the Montana Bureau of Mines and Geology, Butte, Montana 59701.

Richard B. Berg
Economic Geologist
Montana Bureau of Mines and Geology

Butte
March 10, 1980

Areal Geology

	Statewide geologic atlas. As work is completed 2° quadrangle maps will be published at a scale of 1:250,000 (continuing).	Edward C. Bingler Montana Bureau of Mines and Geology
*1	Geology of the Polaris 15-minute quadrangle, Beaverhead County, Montana.	Willard E. Cox Montana Tech
*2	Structure of the northern Tendoy Range, southwestern Montana (1981).	Dean Dubois Pennsylvania State University
3	Geology of Glacier National Park.	Robert L. Earhart USGS, Denver, Colorado
*4	Petrology and structure of the pre-Belt rocks of the southern Madison Range (1981).	Eric A. Erslev Harvard University
	Compilation of geologic mapping of Archean metamorphic rocks, southwestern Montana.	David M. Fountain University of Montana
5	(See Economic Geology.)	William R. Greenwood
*6	Areal geology and geomorphology of the upper Gallatin valley and the adjacent Madison and Gallatin ranges (continuing).	William B. Hall University of Idaho
7	Study of the Belt basin; includes mapping the geology of the Kalispell 2° quadrangle and some work in the Wallace 2° quadrangle. Includes a mineral appraisal of the Wallace quadrangle (1986).	Jack E. Harrison USGS, Denver, Colorado
*8	Geology and geothermal potential of the upper (eastern) Centennial valley (winter 1980).	Matthew Mannick Montana State University
9	Geology of the White Sulphur Springs 2° quadrangle (1982).	Mitchell W. Reynolds USGS, Denver, Colorado
*10	Geology of the Dillon 2° quadrangle—part of CUSMAP (1982).	Edward T. Ruppel USGS, Denver, Colorado
11	(See Economic Geology.)	Kenneth F. Segerstrom
12	Compilation of geologic map of Bozeman 2° quadrangle (continuing).	Don Smith Montana State University
*13	Geology, geophysics and geothermal and groundwater resources of the eastern Centennial valley (final report available June 30, 1980).	John Sonderegger, Richard B. Berg, Montana Bureau of Mines and Geology; Matthew Mannick, Montana State University
14	Reconnaissance geologic mapping of the Peck Lake East, Sidney, Glendive and Richey 7½-minute quadrangles; geologic hazards maps are being prepared (1980).	Donald E. Trimble USGS, Denver, Colorado

Areal geology (*continued*)

15 Geology of the Butte 2° quadrangle—part of CUSMAP; also work on earthquake hazards and land use in the Helena area (1981). — Chester A. Wallace, USGS, Denver, Colorado

*16 Tectonic framework of the Pioneer Mountains; includes detailed and reconnaissance mapping in the Vipond Park, Stine Mountain and Maurice Mountain 15-minute quadrangles. Also isotopic, geochronological and petrologic studies of igneous and metamorphic rocks (1981). — E-an Zen, USGS, Reston, Virginia

Structural Geology and Tectonics

*17 Investigation of transition zone between Archean amphibolite-facies rocks to the north and greenschist-facies rocks to the south near Horse Creek in the Gravelly Range. — Richard B. Berg, Montana Bureau of Mines and Geology

18 Tectonic study of the Wolf Creek area utilizing Landsat photography (June 1983). — Marcus Borengasser, University of Missouri, Columbia

*2 (See Areal Geology.) — Dean Dubois

*19 Regional study of northwest-trending Laramide faults in the Madison, Tobacco Root and Ruby ranges (1982). — John Garihan, Furman University; Christopher Schmidt, Western Michigan University

*20 (See Geochemistry, Mineralogy and Petrology.) — Thomas B. Hanley

21 Air photo examination of the area covered by the White Sulphur Springs 2° sheet for evidence of Quaternary fault movements. — Thomas E. Hendrix, Grand Valley State Colleges

22 (See Geochemistry, Mineralogy and Petrology.) — Don Hyndman

*23 (See Stratigraphy, Sedimentary Petrology and Paleontology.) — Richard A. Klecker

24 Geology along the Beartooth highway, Gardiner Lake to Cooke City. A continuous strip map of Archean rocks and structures (1983-1984). — Leonard H. Larsen, University of Cincinnati

25 Geology and petrology of the Hell Roaring Lakes area, Beartooth Mountains. Large-scale mapping of Archean metasedimentary rocks; petrology, chemistry and structural analysis of polymetamorphic high-grade terrane (1981-1982). — Leonard H. Larsen, University of Cincinnati; Lawrence C. Rowan, USGS, Reston, Virginia

26 Determination of the sequence of thrusting in the disturbed belt, probably in the Sun River canyon area (June 1981). — Timothy Reed, Purdue University

Structural geology and tectonics (*continued*)

	Rock deformation in Montana. This study will include field observations of fault characteristics and displacements in areas of western Montana (1980).	Eugene C. Robertson USGS, Reston, Virginia
*27	The Medicine Lodge overthrust in the Tendoy Range, southwestern Montana (1981).	R. Scholten Pennsylvania State University
28	A description of the surface and cataclastic materials at the base of the Medicine Lodge thrust system in the Goldstone Mountain quadrangle, east-central Idaho and southwestern Montana (1980).	Daniel R. Tucker University of Southwestern Louisiana
	Variation in subsidence rates in Cretaceous time; whole of Montana and neighboring regions (December 1980).	E. H. T. Whitten Northwestern University
	Tectonic tilt measurements using lake levels, intermountain seismic belt. Sites at Hebgen Lake will be remeasured (continuing).	S. H. Wood USGS

Stratigraphy, Sedimentary Petrology and Paleontology

	Trace fossils of the "Phosphoria rock complex" (Permian) in western Wyoming and adjacent areas of Idaho, Montana and Utah. The relationships of the trace fossils to sedimentary environments and diagenesis will also be studied (1981).	Knut A. Andersson University of Wyoming
	Cenozoic nonmarine paleoecology and biostratigraphy of the West (1980).	J. P. Bradbury USGS
29	Depositional history of the Anderson and Dietz coal beds of southeastern Montana (continuing).	Gary A. Cole Montana Bureau of Mines and Geology
	Petrography and depositional setting of clastic carbonate units within the Newland Limestone (?) along the southern margin of the Belt basin, Jefferson and Gallatin counties, Montana (spring 1981).	Walter Coppinger Trinity University
*30	Description and stratigraphic position of trace fossils (worm burrows) in quartzites of Lower Paleozoic (?) age in Beaverhead County, Montana (spring 1981).	Walter Coppinger Trinity University
	Stratigraphic analysis of the western interior Cretaceous uranium basins. Includes investigation of the Eagle Sandstone in north-central Montana and the Hell Creek and Fox Hills formations of the Powder River basin (continuing).	H. W. Dodge USGS
31	Collection of Paleocene fossil plants in the Bighorn basin (continuing).	Erling Dorf Princeton University

Stratigraphy, sedimentary petrology and paleontology (*continued*)

Sedimentological study of the shelf-to-basin transitions in the Middle Belt carbonate rocks (Wallace Formation) in the southwestern part of the Belt basin. Work is now concentrated in Mineral and Ravalli counties (end of 1980).	Dave Eby University of Texas at Dallas
32 Paleontology, stratigraphy and Tertiary history of the Missoula and Bitterroot valleys (1980).	Robert W. Fields University of Montana
*33 Tertiary geology and paleontology of the Sage Creek-Dell areas of Beaverhead County (1980).	Robert W. Fields University of Montana
34 Plant remains, detailed stratigraphy and sedimentology of the Middle Eocene Sepulcher Formation in northwestern Yellowstone National Park and vicinity ("Gallatin petrified forests") are being studied to provide a better paleoenvironmental reconstruction (1982 ?).	Lanny H. Fisk Michigan State University
Environments of coal deposition in the U.S. western interior coal basins. Includes work in the Powder River basin of Wyoming and Montana (1982).	Romeo M. Flores USGS, Denver, Colorado
Paleoenvironmental study of a possible Permian opportunistic fauna. Stratigraphic, petrographic and paleontological study of five Permian localities in southwestern Montana where a molluscan fauna of scaphopods, bellerophontacean gastropods and a few characteristic bivalves occur (June 1980).	Sheila Fountain University of Montana
35 Stratigraphic framework and depositional environments of the Sepulcher and Lamar River formations, Yellowstone National Park, Wyoming and Montana.	William J. Fritz University of Montana
36 Stratigraphic and paleontologic study of Paleocene and Eocene sediments in Clark's Fork drainage, Carbon County (1980).	Philip D. Gingerich University of Michigan
Regional paleogeographic study of Mississippian strata in the western United States, including western Montana—also a study of Late Devonian strata. (June 1980 publication date for SEPM Paleogeography Symposium.)	Raymond C. Gutschick University of Notre Dame
Facies changes of lower Mississippian carbonate cycles from the Big Snowy Range to the Sawtooth Range, Montana (September 1980).	Forest Haines Adrian College
A field study of the LaHood Formation (Belt) from the Bridger Range to the Highland Mountains for the purpose of determining sedimentary processes and depositional environment (1980?).	David Hawley Hamilton College

Stratigraphy, sedimentary petrology and paleontology (*continued*)

37	Paleobotany and stratigraphy of the Fort Union Formation of the northern Big Horn basin, Montana and Wyoming.	Leo J. Hickey Smithsonian Institution
*38	Study of Mississippian stratigraphy (and biostratigraphy) and structure of the southeast flank of the Armstead anticline, Beaverhead County (June 1980).	Gail D. Hildreth Oregon State University
39	Paleontology of the Two Medicine Formation (Upper Cretaceous) between Augusta, Lewis and Clark County, and the Canadian border. Primarily a study of the dinosaurs and associated vertebrates.	John R. Horner Princeton University
40	(See Geomorphology and Glacial Geology.)	Gary C. Hughes
*41	Depositional environments of sandstones and mapping of facies in the Kootenai Formation (Lower Cretaceous), southwestern Montana (1981).	W. Calvin James University of Notre Dame
*23	Stratigraphy and structure of the Dixon Mountain-Little Water Canyon area, Beaverhead County, Montana (June 1980).	Richard A. Klecker Oregon State University
	Sedimentology of the Upper Cretaceous nonmarine Two Medicine Formation, Blackfoot Indian Reservation and area to the south (June 1981).	John Lorenz Princeton University
*42	Stratigraphy and petrology of Upper Precambrian and Lower Paleozoic sandstone in the Beaverhead Range of east-central Idaho and southwestern Montana (1981).	David McCandles Pennsylvania State University
43	A Late Pleistocene fauna from Blacktail Cave, Lewis and Clark County, Montana.	William Melton University of Montana
	Lower upper Cretaceous strata—stratigraphy and petroleum potential. Includes work in southwestern Montana (continuing).	E. Allen Merewether USGS, Denver, Colorado
	Stratigraphy, petrology and depositional history of the Sawtooth and Rierdon formations (Jurassic) on the south flank of Belt Island, southwestern Montana (summer 1981).	James H. Meyers Muskingum College
*44	Late Oligocene and Early Miocene facies and cyclic sedimentation, upper Ruby River basin, Madison County, Montana (June 1980).	Stewart Monroe Central Michigan University
*45	Petrology of the Bozeman Group, upper Ruby River basin, Madison County, Montana.	Stewart Monroe Central Michigan University
*46	Palynomorphs from Tertiary strata in Medicine Lodge Creek valley, Beaverhead County, Montana (1981).	Karl R. Newman Colorado School of Mines

Stratigraphy, sedimentary petrology and paleontology (*continued*)

*47	Geology and vertebrate paleontology of Tertiary sediments in upper Horse Prairie, Beaverhead County (1980).	Ralph Nichols University of Montana
	Flysch tectonics in the western United States (continuing).	Tor H. Nilsen USGS, Menlo Park, California
	Paleozoic stratigraphy, correlations, facies and porosity study, Montana, Wyoming, North Dakota and South Dakota (Madison Project, Water Resources Division, USGS). (Continuing study—preliminary study completed for central and eastern Montana, Powder River basin and western South Dakota.)	James A. Peterson USGS, Missoula, Montana
	Stratigraphy, regional correlation and depositional environment of the Bonner Formation (Precambrian Missoula Group), southwestern Montana (March 1980).	David Quattlebaum University of Montana
48	Paleoecology, taphonomy and systematics of the megafauna of the uppermost part of the Bearpaw Shale, Pierre Shale and Fox Hills Formation of eastern Montana (1980).	Jeremy Reiskind University of North Dakota
49	Heavy mineral analysis of rocks from the Fort Union (Paleocene)-Wasatch (Eocene) boundary near Decker, Montana (March 1980).	James H. Reynolds Montana State University
*50	The structure and stratigraphy of the Little Sheep Creek area near Lima, Beaverhead County, Montana (June 1980).	R. Kumbe Sadler Oregon State University
*51	Tertiary geology of Horse Prairie basin, Beaverhead County (1981).	R. Scholten Pennsylvania State University
*52	Depositional environments and diagenesis of the Flathead Quartzite (Middle Cambrian) and the Flathead-Wolsey transitional strata in southwestern Montana (July 1980).	Jay N. Shearer Indiana University, Bloomington
	Sedimentology of selected areas of the Knobloch, Dietz and Anderson coal beds and associated rocks in southeastern Montana (September 1981).	Mark A. Sholes Montana Bureau of Mines and Geology
	Analysis and classification of lithic types from Montana archaeological sites (continuing).	Don Smith Montana State University
	Stratigraphy, sedimentation and tectonic history of the Madison Limestone in central and south-central Montana (continuing).	Don Smith Montana State University
*53	Cenozoic geology and vertebrate paleontology of a portion of the Red Rock Hills and Sage Creek basin, Beaverhead County. Emphasis is on Eocene and Oligocene rocks and faunas (spring 1980).	Alan R. Tabrum University of Montana

Stratigraphy, sedimentary petrology and paleontology (*continued*)

	Cambrian and Lower Ordovician paleontology and stratigraphy in the United States (1980).	Michael E. Taylor USGS, Denver, Colorado
	Tertiary paleoclimatic interpretation from sedimentation patterns, paleosols, fauna and other evidence in the Tertiary basins of central and western Montana.	Gray Thompson University of Montana
*54	Conodont biostratigraphy of the upper Cambrian rocks in the northern Tobacco Root Mountains (September 1980).	Robert Votaw Indiana University Northwest, Gary
55	The depositional environments of the Early Cretaceous Thermopolis, Muddy and Mowry formations in the southern Madison and Gallatin ranges, and the age of these formations using fossil pollen (June 1980).	Susan Vuke University of Montana
	Study of the depositional environment of the Bear Gulch Limestone (Mississippian) of central Montana. Will include sedimentary facies analysis of the Bear Gulch and underlying and correlative units, with attention to the geochemistry of the Bear Gulch, and geometry of the depositional basin (1980).	Loretta Ann Williams Princeton University
	Precambrian Belt sedimentation and tectonics, northwestern Montana (continuing).	Don Winston University of Montana

Geochemistry, Mineralogy and Petrology

*56	(See Isotope Geology and Geochronology.)	Clark Bean and David Towell
57	Igneous geology of Gordon Butte, Martinsdale, Montana (northern Crazy Mountains) (1980).	Francis X. Bellini University of Cincinnati
58	(See Isotope Geology and Geochronology.)	M. E. Bickford
59	Geology of volcanic rocks, Gallatin Range (continuing).	Robert A. Chadwick Montana State University
60	Geology of post-Lowland Creek volcanics in southwestern Montana (continuing).	Robert A. Chadwick Montana State University
	Formation and characteristics of clinker in the Powder River basin (1981).	Donald A. Coates USGS, Denver, Colorado
61	A basinwide reconnaissance trace-element survey of selected units of the Belt Supergroup (Precambrian), with a view toward quantifying regional geochemical differences that may be related to deposition, redistribution or concentration of ore metals in these rocks. Includes study of the geochemistry of quartzites of the Spokane Formation near Rogers Pass, Lewis and Clark County, Montana (1981).	Jon J. Connor USGS, Denver, Colorado

Geochemistry, mineralogy and petrology (*continued*)

*62	Electron microprobe study of coexisting garnet and cordierite in Precambrian metapelite from the Ruby Range, southwestern Montana (July 1980).	Peter S. Dahl Kent State University
63	Geochemistry of the Mammoth coal seam, Bull Mountains, central Montana (1982).	John Daniel and Frank Diebold Montana Tech
64	Investigation of the variations in proximate, ultimate and metal concentration values of the Rosebud coal seam, Colstrip, Montana (1982).	Dave Dobb, Dave Beuerman, Bill Christaens and Frank Diebold Montana Tech
	Evaluation of leachable salt loads, source of selenium, and its transport mechanism(s) in saline-seep-affected areas of Montana (September 1980).	Joseph J. Donovan, John L. Sonderegger, Montana Bureau of Mines and Geology
65	A study of differentiation processes within the Shonkin Sag laccolith, Highwood Mountains, north-central Montana. Petrologic (especially textural) evidence for large-scale magma immiscibility will be investigated (June 1980).	Carolyn L. Edmond University of Montana
66	(See Economic Geology.)	W. C. Elliott, G. C. Ulmer, D. P. Gold
67	Reconnaissance study of orbicular granites in the Beartooth Mountains (1983).	George W. Fisher Johns Hopkins University
68	Investigation of techniques for determining the inorganic-organic affinities of selected trace metals in the Rosebud coal seam, Colstrip, Montana (1983).	Martin Foote, Douglas Drew, Frank Diebold Montana Tech
	Geochemistry of Archean quartzofeldspathic gneisses, southwestern Montana.	David M. Fountain University of Montana
69	Geochemical constraints on the origin of Proterozoic anorthosites, western United States (includes Bitterroot anorthosite, Montana) (1982).	Steven A. Goldberg University of Oregon
70	Petrogenesis of the Slough Creek tuff and associated rocks of the Mount Wallace Formation (continuing).	James T. Gutmann Wesleyan University
*71	Chemistry of minerals in the intrusive rocks of the Pioneer batholith.	Jane M. Hammarstrom, Virginia Polytech Institute and State University
*20	Structure, petrology and geochemistry of Precambrian metamorphosed basic intrusions of the Tobacco Root Mountains. Am interested in their use as a tool in unraveling structural sequence and tectonic conditions in mid Precambrian time (continuing).	Thomas B. Hanley Columbus College
	(See Energy.)	J. R. Hatch

Geochemistry, mineralogy and petrology (*continued*)

72	Mapping of kimberlitic diatremes in Montana and geochemical studies of xenoliths and ultramafic igneous rocks (continuing).	B. Carter Hearn USGS, Reston, Virginia
	Geochemical survey of Cretaceous rocks that are overburden to mineable coal in the Northern Great Plains coal regions (continuing).	T. K. Hinkley USGS
22	Petrology, structural geology, tectonics and chemistry of the Bitterroot (northern) lobe of the Idaho batholith, Montana and Idaho (continuing).	Don Hyndman University of Montana
73	Anion geochemistry of the Rosebud coal seam, Colstrip, Montana (1982).	Margaret Ikeda, Frank Diebold Montana Tech
74	Investigation of differentiation processes in the Square Butte laccolith of central Montana. Mineralogy, textures and chemical analyses suggest magma immiscibility rather than crystal settling was the main process of differentiation (May 1980).	George Kendrick University of Montana
	Clay minerals of Montana soils.	Murray Klages Montana State University
75	Continued geologic mapping of igneous bodies of Crazy Mountains. Coffin Butte and Little Elk dome in the northern part are targeted (1982-1983).	Leonard H. Larsen University of Cincinnati
24	(See Structural Geology.)	Leonard H. Larsen
25	(See Structural Geology.)	Leonard H. Larsen, Lawrence C. Rowan
*76	Mapping, geochemical sampling and fission track age-dating of numerous Tertiary volcanic deposits in Sage and Blacktail creeks, Beaverhead and Madison counties, Montana (June 1983).	Kim L. Marcus Western Washington University
	Determination of proper sample preparation procedures and chemical extractants needed to estimate element availability of rocks to plants. Work is concentrated in areas of active strip mines (continuing).	James M. McNeal USGS, Denver, Colorado
77	Geochemical, petrographic and isotopic study of the late Archean granites of the eastern Beartooth Mountains (July 1982).	Paul Mueller, University of Florida J. L. Wooden, NASA
78	Petrologic and chemical study of contact-metamorphosed iron formation and interbedded pelitic rocks, located below the base of the Stillwater mafic intrusion (summer 1980).	J. J. Papike, D. T. Vaniman, T. C. Labotka, State University of New York, Stony Brook

Geochemistry, mineralogy and petrology (*continued*)

*79	Field mapping, petrology and geochemistry of volcanic rocks in the Gravelly Range, Madison County, Montana. Primary areas of concentration are Black Butte, Lion Mountain and Divide Mountain.	Paul Pushkar Wright State University
80	Detailed study of the stratigraphy and petrology of the Stillwater Complex, including the determination of stratigraphic variation of modal mineral proportions, major element chemistry and selected trace element chemistries. The ultimate goal is to develop a reasonable petrogenetic model for the formation of the Complex (continuing).	L. D. Raedeke, I. S. McCallum University of Washington
81	Major element, trace element, rare earth element and strontium isotope compositions of rocks from a small volcanic field overlying the northern edge of the Sapphire tectonic block in west-central Montana.	Bruce K. Reitz Kansas State University
*82	A petrologic study of skarn genesis in the North Doherty pluton area, southern Jefferson County. The study emphasizes the determination of physicochemical parameters (fO_2, fCO_2, fH_2O) that may have controlled skarn formation.	Edward M. Ripley Indiana University, Bloomington
	Petrography and origin of silica in silicified logs in and associated with coal in southeastern Montana (1982).	Mark A. Sholes Montana Bureau of Mines and Geology
83	A study of Sr isotope systematics and major and trace element chemistry of granitic rocks, inclusions and country rocks from the northeast border zone of the Idaho batholith (summer 1981).	Robert D. Shuster University of Kansas
	Preparation of volcano map of Idaho and Montana at a scale of 1:1,000,000 (continuing).	R. L. Smith USGS
*84	Petrology and geochronology of the southern part of the Pioneer batholith.	Lawrence W. Snee Ohio State University
*85	The petrogenesis of the Tertiary volcanics of the Gravelly Range. Work includes major element, trace element and Sr isotope studies (May 1980).	Malia Kay Spaid-Reitz Kansas State University
*86	The origin and evolution of the Tobacco Root batholith: A mineralogical and geochemical study.	Charles J. Vitaliano Indiana University, Bloomington
	A comparison between the anorthosites of Lunar Highlands and terrestrial anorthosites, including Montana.	Alex Volborth, Elizabeth Hill Montana Tech
*87	Geology and geochemistry of volcanic rocks south of Dillon, Montana; have mapped pyroclastics, basalts and rhyolite domes (fall 1980).	Richard Wice Western Washington University

Geochemistry, mineralogy and petrology (*continued*)

*16	(See Areal Geology.)	E-an Zen

Isotope Geology and Geochronology

*56	A stable isotope study of the North Doherty intrusive complex, Jefferson County, Montana, including $^{18}O/^{16}O$ variations and major element and trace element distributions (December 1980).	Clark Bean, David Towell Indiana University, Bloomington
58	Chemical, isotopic and petrographic studies of the age of emplacement, and magma genesis, northeastern border zone of the Idaho batholith (isotopic studies should be completed summer 1980, and chemical and petrographic studies summer 1981).	M. E. Bickford University of Kansas
*88	Oxygen isotope study of coexisting quartz and magnetite in Precambrian metamorphosed iron formations from southwestern Montana (July 1980).	Peter S. Dahl Kent State University
*76	(See Geochemistry, Mineralogy and Petrology.)	Kim L. Marcus
*89	Geochronology of the older tonalites of the Madison Range.	Paul Mueller, University of Florida; J. L. Wooden, NASA; Eric Erslev, Harvard University
77	(See Geochemistry, Mineralogy and Petrology.)	Paul Mueller, J. L. Wooden
*90	Oxygen isotope investigation of the Vipond Park batholith (continuing).	J. R. O'Neil USGS
81	(See Geochemistry, Mineralogy and Petrology.)	Bruce K. Reitz
83	(See Geochemistry, Mineralogy and Petrology.)	Robert D. Shuster
*84	(See Geochemistry, Mineralogy and Petrology.)	Lawrence W. Snee
*85	(See Geochemistry, Mineralogy and Petrology.)	Malia Kay Spaid-Reitz
91	Investigation of isotopes of the upper mantle. Will include Sm-Nd chronology of the Stillwater Complex (continuing).	Mitsunobu Tatsumoto USGS
*16	(See Areal Geology.)	E-an Zen

Geophysics

	Heat flow and radioactive heat production studies of western Montana (September 1980).	David D. Blackwell Southern Methodist University
92	Bedrock configuration of the Ovando-Nevada valley area by gravitational methods.	Jon Cantwell University of Montana
93	Geophysical investigation near Hot Springs-Camp Aqua area, Lake County, Montana (continuing).	Doug Dresser, Jim Halvorson, Charles Wideman, Montana Tech

Geophysics (*continued*)

	Development of polarity zonation related to details of stratigraphy of upper Fort Union (Paleocene) and lower Wasatch (Eocene) formations in north-central and western Powder River basin (continuing).	Donald P. Elston USGS, Flagstaff, Arizona
*94	Gravity and seismic survey of the Toston, Montana, region (continuing).	Jim Halvorson, Bob Balkenbush, Charles Wideman, Montana Tech
*95	Geophysical investigation of the Warm Springs State Hospital region, Deer Lodge Valley, Montana (December 1979).	Jim Halvorson, Charles Wideman Montana Tech
	Gravity measurement in the area north and west of the Pioneer Mountains (1980).	William F. Hanna USGS, Denver, Colorado
96	Geophysical studies of the Choteau 2° quadrangle (1980).	M. Dean Kleinkopf USGS, Denver, Colorado
97	Geophysical studies of the Wallace 2° quadrangle (1981).	M. Dean Kleinkopf USGS, Denver, Colorado
98	Gravity and aeromagnetic profiles of the Big Snowy uplift (central Montana) and Selway-Bitterroot and Blue Joint areas of western Montana (continuing).	M. Dean Kleinkopf USGS, Denver, Colorado
99	Magnetotelluric soundings on the Blackfoot Indian Reservation along the disturbed belt and in the Perma area of the central Belt basin; also interpretations of aeromagnetic and gravity surveys of the Flathead Indian Reservation (continuing).	M. Dean Kleinkopf USGS, Denver, Colorado
100	Gravity survey of the Cardwell, Montana, area (June 1980).	Rich Lawson, Lester Dye, Charles Wideman, Montana Tech
	Delineation of the Montana mineral belt by satellite and geophysical remote sensors (December 1981).	David M. L'Heureux Purdue University
*101	Geophysical investigation of Thexton Hot Springs, Madison County, Montana (March 1980).	Mark McRae, Jim Halvorson, Charles Wideman, Montana Tech
102	Geologic aspects of geophysical exploration for stratigraphic traps; includes work in the Bell Creek oil field of southeastern Montana (continuing).	Robert T. Ryder USGS, Denver, Colorado
*103	Gravity and magnetic survey of the eastern portion of the Centennial valley, Beaverhead County, Montana (February 1980).	James Schofield, Charles Wideman Montana Tech
104	Measurements of petrophysical properties of drill core from Blacktail Mountain (northwestern Montana) will be used to interpret electrical ground geophysical surveys in more detail (continuing).	B. D. Smith USGS
*13	(See Areal Geology.)	John Sonderegger, Richard Berg, Matthew Mannick

Geophysics (*continued*)

105	A geophysical study of the Kalispell valley between Kalispell and the north end of Flathead Lake (June 1980).	Michael Stickney University of Montana
106	Reconnaissance geophysical survey in the immediate vicinity of West Yellowstone, Montana.	John Wetstein, Lester Dye, Charles Wideman, Montana Tech

Economic Geology

*107	Geochemical exploration in the Butte 2° quadrangle (1982).	John C. Antweiler USGS, Golden, Colorado
	Geology of barite deposits in Montana (1981).	Richard B. Berg, Montana Bureau of Mines and Geology
*108	Geochemical exploration of Dillon 2° quadrangle (part of CUSMAP). Includes an evaluation of the effects of metalliferous sedimentary rocks on geochemical dispersion patterns, and geochemical characterization of different types of mineral occurrences within the quadrangle (1980).	Byron R. Berger USGS, Denver, Colorado
	Lead and zinc resources of the western United States. One of the goals of this project is to develop an understanding of the genesis and occurrence of polymetallic deposits.	Joseph A. Briskey, Hal T. Morris USGS, Menlo Park, California
61	(See Geochemistry, Mineralogy and Petrology.)	Jon J. Connor
109	Alteration petrology of the Flathead mine, Hog Heaven mining district, Sanders County, Montana (thin-section and x-ray analysis of drill core) (June 1980).	C. Carey Cossaboom University of Montana
*110	Study of the controls of ore deposition in the Polaris mining district, Beaverhead County (June 1980).	Thomas E. Davis Montana State University
111	Investigation of mineral and geothermal resources of the Flathead Indian Reservation. Includes geochemical and geophysical studies of target areas where geologic mapping and the results of reconnaissance geochemical studies suggest a potential for base and precious metal deposits (1980).	Robert L. Earhart USGS, Denver, Colorado
66	A suite of stratigraphically controlled samples from above, below and including a platinum group element-rich zone was collected from the West Fork Adit of the Stillwater Igneous Complex. Major and trace element, petrographic, oxygen isotope and intrinsic oxygen fugacity geothermometric analyses will be performed on this suite to attempt to determine the petrogenesis of the platinum rich zone (December 1980).	W. C. Elliott, G. C. Ulmer, Temple University; D. P. Gold, Pennsylvania State University

Economic geology (*continued*)

5	Evaluation of the mineral potential of the Selway-Bitterroot Wilderness Area; this project includes geologic mapping at a scale of 1:125,000 (1981).	William R. Greenwood USGS, Denver, Colorado
112	Mineral resource potential of the Blue Joint Wilderness Area, Ravalli County, Montana (1980).	William R. Greenwood USGS, Denver, Colorado
113	Geochemical exploration of Choteau 2° quadrangle—part of CUSMAP (1980).	D. J. Grimes USGS
7	(See Areal Geology.)	Jack E. Harrison
114	Study of the gold, tungsten and associated sulfide minerals in the Jardine district, Park County. Study will emphasize origin, transport and concentration mechanisms of the metals with respect to sedimentological, structural, metamorphic and hydrothermal factors (spring 1980).	Jeffrey W. Hedenquist Johns Hopkins University
*115	Geology of three gypsum deposits, Beaverhead County (in press).	Willis M. Johns, Montana Bureau of Mines and Geology
	(See Geophysics.)	David M. L'Heureux
117	Geology of small satellite chromite deposits northwest and southeast of the Stillwater Complex (continuing).	Bruce R. Lipin USGS, Reston, Virginia
	Mineral resource potential of the Square Butte Wilderness study area (1980).	M. E. MacLachlan USGS
*118	Geochemical exploration, Tobacco Root Mountains, Madison County, Montana.	Henry McClernan, Don Lawson Montana Bureau of Mines and Geology
119	Geochemical exploration of the Newland Creek area, Meagher County, Montana.	Henry McClernan, Don Lawson Montana Bureau of Mines and Geology
	Investigation of factors affecting the application of selected plants as biogeochemical indicators of uranium concentration (1982).	Steve McGrath, Frank Diebold Montana Tech
*120	Gold solubilities and transport mechanisms near Sheep Mountain, Beaverhead County, Montana (June 1980).	Scott Monroe Western Washington University
	Mineral resource potential of the Reservoir North Wilderness study area, RARE II (1980).	Melville R. Mudge USGS, Denver, Colorado
121	Mineral resource appraisal of the Blackfoot Indian Reservation (1980).	Melville R. Mudge USGS, Denver, Colorado

Economic geology (*continued*)

122	Mineral resources of the Choteau 2° quadrangle, including stratigraphic studies of Paleozoic and Mesozoic rocks—part of CUSMAP (continuing).	Melville R. Mudge USGS, Denver, Colorado
*123	Mineral resource potential of the Middle Mountain-Tobacco Root Wilderness study area, RARE II (1980).	J. Michael O'Neill USGS, Denver, Colorado
*124	Mineral resources of the Eastern Pioneer Mountains Wilderness Area (1980).	Robert C. Pearson USGS, Denver, Colorado
*125	Mineral resource potential of the Bear Trap Primitive Area (1980).	Darrell M. Pinckney USGS
126	Mineral resource potential of the Middle Fork of the Judith River, RARE II (1980).	Mitchell W. Reynolds USGS, Denver, Colorado
*127	Mineral resource potential of the West Pioneer Wilderness study area, RARE II (1981).	Edward T. Ruppel USGS, Denver, Colorado
11	Platinum resources of the Stillwater Complex; includes a geologic map of the East Boulder plateau sector (1980).	Kenneth F. Segerstrom USGS, Denver, Colorado
*128	Mineral resource potential of the Madison-Gallatin Wilderness Area (1982).	Frank S. Simons USGS, Denver, Colorado
129	Mineral resource potential of the Rattlesnake Wilderness study area, RARE II (1980).	Chester A. Wallace USGS, Denver, Colorado
130	Mineral resource potential of the Sapphire Wilderness study area, RARE II (1981).	Chester A. Wallace USGS, Denver, Colorado
131	Genesis of vermiculite associated with the Rainy Creek igneous complex, northeast of Libby, Montana (May 1980).	David C. Weekes Montana Tech
*132	Study of element distribution accompanying mineralization using geochemical soil surveys in the Argenta district, Beaverhead County, Montana (December 1980).	John C. Welch Purdue University
*133	Ore deposits, Virginia City area, southwestern Montana.	Ken L. Wier USGS, Denver, Colorado
*134	Mineral resource potential of the Centennial Mountains Wilderness study area (1980).	Irving J. Witkind USGS, Denver, Colorado

Energy

*135	Uranium, thorium and rare-earth mineralization in the Tendoy Mountains, Beaverhead County, Montana (December 1980).	James Anderson Western Washington University

Energy (*continued*)

136 Coal resources of the Fort Peck Indian Reservation (1980).	Harold H. Arndt USGS, Denver, Colorado
137 Coal resources of the Sidney NE quadrangle, Richland County, Montana, and McKenzie County, North Dakota.	Gary Berg USGS, Billings, Montana
Sulfur in coal and lignite (continuing).	Alfred J. Bodenlos USGS, Reston, Virginia
138 Investigation of the uranium resources of the Ekalaka 2° quadrangle (1980).	C. G. Bowles USGS
Geochemistry of sedimentary organic matter, crude oil and natural gas; includes the analysis of 150 samples from the Montana disturbed belt (continuing).	G. E. Claypool USGS
(See Geochemistry, Mineralogy and Petrology.)	Donald A. Coates
139 Ash mineralogy of the Anderson, Dietz, Canyon and Knobloch coal beds of southeastern Montana (December 1980).	Gary A. Cole Montana Bureau of Mines and Geology
140 Coal petrographic composition of the Anderson, Canyon and Knobloch coal beds of southeastern Montana (continuing).	Gary A. Cole Montana Bureau of Mines and Geology
Geologic and mining information on active and proposed coal mines in Montana; mines are located in the Bull Mountain coal field, Red Lodge coal field and the coal fields of southeastern Montana (August 1980).	Gary A. Cole Montana Bureau of Mines and Geology
141 Coal geology of the Anderson, Dietz, Canyon and Wall coal beds of southeastern Montana, emphasizing structure, thickness isopachs and coal reserves/resources.	Gary A. Cole Montana Bureau of Mines and Geology
142 Coal geology of the Bull Mountain coal field (1980).	C. W. Connor USGS
143 Coal resources of the Birney 1° quadrangle (1980).	William C. Culbertson USGS, Denver, Colorado
63 (See Geochemistry, Mineralogy and Petrology.)	John Daniel, Frank Diebold
64 (See Geochemistry, Mineralogy and Petrology.)	Dave Dobb, Dave Beuerman, Bill Christaens, Frank Diebold
(See Stratigraphy, Sedimentary Petrology and Paleontology.)	H. W. Dodge
144 Investigation of geothermal potential in the Little Bitterroot valley near Camas, Sanders County (June 1981).	Joseph J. Donovan, John L. Sonderegger, Montana Bureau of Mines and Geology; Charles Wideman, Montana Tech

Energy (*continued*)

	Development and evaluation of petroleum geochemical prospecting techniques; includes geochemical and remote-sensing reconnaissance studies in several basins, one of which is the Powder River basin (continuing).	Terrence J. Donovan USGS, Flagstaff, Arizona
111	(See Economic Geology.)	Robert L. Earhart
	Compilation and collection of coal resource data.	David Fine, Montana Bureau of Mines and Geology
	(See Stratigraphy, Sedimentary Petrology and Paleontology.)	Romeo M. Flores
68	(See Geochemistry, Mineralogy and Petrology.)	Martin Foote, Douglas Drew and Frank Diebold
145	Geology and coal resources of the Scobey area, northern Daniels County, Montana, and the Moose Jaw district, Saskatchewan (to be put on open file summer 1980).	Jim Gruber USGS, Billings, Montana
	Chemical analysis and geologic evaluation of coal in the western United States; includes research on the changes in the chemical composition of coal with increasing rank and on the distribution of Zn, Cd, Pb, Ni, Co and Mo in coal (1981).	J. R. Hatch USGS
*146	Structural control of ground-water flow in relation to a linear uranium anomaly between Virginia City and the northern part of the Madison Range (June 1980).	Graham S. Hayes Montana State University
	Uranium concentration at hot springs sites associated with the Boulder batholith and the application of these data to uranium prospecting (1981).	Pat Heald, Frank Diebold Montana Tech
	(See Geochemistry, Mineralogy and Petrology.)	T. K. Hinkley
	(See Geochemistry, Mineralogy and Petrology.)	Margaret Ikeda, Frank Diebold
	Regional geothermal hydrology of southwestern Montana, including (a) temperature, discharge, chemical character and areal distribution of the waters; (b) the nature of local and regional hydrogeologic controls on occurrence; and (c) conceptual models of selected hydrothermal systems (June 30, 1980).	Robert B. Leonard USGS, Water Resources Division Helena, Montana
*8	(See Areal Geology.)	Matthew Mannick
147	Coal resources of the Crow Indian Reservation north of T. 6 S., Big Horn County.	William J. Mapel USGS, Denver, Colorado
148	Coal resources of the Blackfoot Indian Reservation (1981).	William J. Mapel USGS, Denver, Colorado

Energy (*continued*)

Collection, evaluation, characterization and integration of new data on the coal beds of the Fort Union region of eastern Montana (July 1981).	Robert E. Matson, Montana Bureau of Mines and Geology
Compilation and collection of Montana coal resource data (September 1985).	Robert E. Matson, Montana Bureau of Mines and Geology
Sedimentological controls on distribution and quality of the Knobloch, Anderson and Dietz coal in parts of southeastern Montana (October 1981).	Robert E. Matson, Montana Bureau of Mines and Geology
(See Economic Geology.)	Steve McGrath, Frank Diebold
(See Geochemistry, Mineralogy and Petrology.)	James M. McNeal
Lower upper Cretaceous strata—stratigraphy and petroleum potential; includes work in southwestern Montana (continuing).	E. Allen Merewether USGS, Denver, Colorado
149 Characterization of natural gas resources in low-permeability reservoirs of the Northern Great Plains; includes work in the Bowdoin field in north-central Montana (continuing).	Dudley D. Rice USGS, Denver, Colorado
150 Coal resource and quality assessment for Prairie Dog Creek, Powder River County, Montana (continuing).	Gary B. Schneider USGS, Denver, Colorado
Petroleum reservoir rocks of the western United States; includes a detailed study of the Madison Limestone in Montana (continuing).	P. A. Scholle USGS
Energy development in the Northern Great Plains to 2010 AD (January 1982).	Arnold J. Silverman University of Montana
*13 (See Areal Geology.)	John Sonderegger, Richard Berg, Matthew Mannick
151 Coal geology of the Twomile Creek and Cedar Coulee quadrangles, Roosevelt and Richland Counties (report being edited).	Mary Alice Spencer USGS, Billings, Montana
152 Geology and coal resources of the Fox Lake 7½-minute quadrangle, Richland County, Montana.	Mary Alice Spencer USGS, Billings, Montana
Thorium resources in the United States; includes investigation of carbonatite dikes in Colorado, Arkansas and Montana (continuing).	Mortimer H. Staatz USGS, Denver, Colorado
153 Coal resources of the Piche quadrangle, Richland County.	Steven A. Strausz, Mary Alice Spencer, USGS, Billings, Montana
154 Uranium potential of the Bozeman 2° quadrangle.	Gray Thompson University of Montana

Energy (*continued*)

*155 Ground-water resources and geothermal potential of the Toston-Radersburg basin, Broadwater County (June 1980). — Glen M. Wyatt, Montana State University

Hydrogeology

156 Compilation of data for hydrogeological maps for Montana atlas. Work is in progress on the Hardin, Ekalaka and Miles City 2° quadrangles (continuing). — Robert N. Bergantino, Thomas W. Patton, Marvin R. Miller, Joseph J. Donovan, Peter M. Norbeck, Fred A. Schmidt, John L. Sonderegger, Dennis Gemmell, Montana Bureau of Mines and Geology

Hydrogeological investigations in Montana—delineation of aquifers, characterization of water in them by use, quantity and quality, isopach and structure contour maps of aquifers (continuing). — Robert N. Bergantino. Thomas W. Patton, Marvin R. Miller, Joseph J. Donovan, Peter M. Norbeck, John L. Sonderegger, Fred A. Schmidt, Dennis Gemmell, Montana Bureau of Mines and Geology

157 Stratigraphy, structure and sedimentological history of the East Decker coal mine site, with emphasis on coal field hydrology (continuing). — Robert A. Chadwick, Don Smith, Montana State University

158 The upper North Fork Flathead River: A hydrologic state of the watershed report. This research uses a variety of hydrologic, geomorphic and engineering methods to describe the interrelationships between water/sediment transport and the potential fluvial-geomorphic impacts of fossil fuel development in the watershed (May 1980). — Chuck Dalby, University of Montana

(See Geochemistry, Mineralogy and Petrology.) — Joseph J. Donovan, John L. Sonderegger

144 (See Energy.) — Joseph J. Donovan, John L. Sonderegger, Charles Wideman

A study of the effects of compaction on the temporal and spatial release of meltwater from snow (September 1980). — Thomas Grady, Montana State University

Describe and characterize geologic framework, hydrologic properties and chemical quality of water from aquifers in the Northern Great Plains of eastern and central Montana. Final products will include basic data reports, interpretive maps and digital models of the Powder River, Judith and Bull Mountain basins (September 30, 1981). — William R. Hotchkiss, USGS, Water Resources Division, Helena, Montana

159 Baseline surface-water data collection in areas of increasing mining activity, Troy site (1983). — Don C. Lawson, John L. Sonderegger, Montana Bureau of Mines and Geology

Hydrogeology (*continued*)

(See Energy.)	Robert B. Leonard
160 Development of saline seeps in the Mott area, northern Stillwater County. Local and regional hydrologic factors plus geologic controls are being investigated (October 1980).	Barney D. Lewis USGS, Water Resources Division Billings, Montana
161 Hydrologic studies for EMRIA project in five areas of southeastern Montana: (1) Prairie Dog Creek area (expected to be completed in early 1980); (2) West Otter area (October 1980); (3) Corral Creek area (October 1980); (4) Horse Creek area (October 1981); (5) Beaver Creek area (October 1981).	Neal E. McClymonds USGS, Water Resources Division Helena, Montana
Ground-water quality data system collection, analysis, storage and retrieval (continuing).	Marvin R. Miller, Wayne A. Van Voast, Thomas W. Patton, Robert N. Bergantino, John L. Sonderegger, Joseph J. Donovan, Martin Fouts, Fred A. Schmidt, Montana Bureau of Mines and Geology
Geohydrology of the Paleozoic rocks of the Powder River and Williston basins in eastern Montana, western North and South Dakota and northeastern Wyoming (September 1980).	William R. Miller USGS, Water Resources Division Billings, Montana
162 Availability of ground water for irrigation use in the Hogeland-Turner area, Montana.	Thomas W. Patton, Montana Bureau of Mines and Geology
163 Ground-water resources of Bull Mountains basin, central Montana (September 1981).	Ronald P. Rioux USGS, Water Resources Division Helena, Montana
Statewide water-level monitoring.	Fred A. Schmidt, Montana Bureau of Mines and Geology
164 Ground-water monitoring (both water level and quality) in the Poplar River area.	Fred A. Schmidt, Montana Bureau of Mines and Geology
Hydrologic investigations to determine potential impact of mining on ground-water systems in Powder River basin of southeastern Montana.	Steven E. Slagle USGS, Water Resources Division Helena, Montana
Compile and evaluate quality and quantity data for ground- and surface-water systems in the Fort Union coal region of east-central Montana. Define baseline conditions for use in monitoring changes caused by future energy developments (September 1981).	Steven E. Slagle USGS, Water Resources Division Helena, Montana
*13 (See Areal Geology.)	John Sonderegger, Richard Berg, Matthew Mannick
165 Mining-related hydrologic evaluations near the Big Sky mine, southeastern Montana (continuing).	Wayne A. Van Voast, John J. McDermott, Montana Bureau of Mines and Geology, Billings

Hydrogeology (*continued*)

Investigation of possible techniques to predict ground-water quality in mined lands (continuing).	Wayne A. Van Voast, John J. McDermott, Montana Bureau of Mines and Geology, Billings
Investigation of soluble salts in coal overburden and the qualities of ground waters in spoils (1982).	Wayne A. Van Voast, John J. McDermott, Keith S. Thompson Montana Bureau of Mines and Geology, Billings
Shallow aquifer evaluation, southeastern Montana (continuing).	Wayne A. Van Voast, John J. McDermott, Keith S. Thompson Montana Bureau of MInes and Geology, Billings
166 Hydrologic evaluations of the CX area, southeastern Montana (continuing).	Wayne A. Van Voast, Keith S. Thompson, John J. McDermott, Montana Bureau of Mines and Geology, Billings
167 Occurrence and chemical quality of water in bedrock aquifers, Great Falls area, Cascade County (May 1980).	Kathleen R. Wilke USGS, Water Resources Division Helena, Montana
168 Ground-water resources of Lake Creek valley, northwestern Montana (September 1981).	Kathleen R. Wilke, R. Gale McMurtrey, USGS, Water Resources Division, Helena, Montana
*155 (See Energy.)	Glen M. Wyatt

Geomorphology and Glacial Geology

169 Late Cenozoic terraces in the Dearborn River basin, Lewis and Clark County (summer 1981).	Michael G. Foley University of Missouri, Columbia
170 Late Pleistocene diversion, incision and paleohydraulics of the Dearborn River, Lewis and Clark County (summer 1981).	Michael G. Foley University of Missouri, Columbia
*171 Quaternary geology and geomorphology of the upper Madison valley (March 1980).	Steve Gary University of Montana
*172 Glacial and Quaternary geology of Bear Gulch, Tobacco Root Range (June 1981).	Robert D. Hall, Indiana University/ Purdue University, Indianapolis
*173 Glacial geology of Cataract Creek and North Willow Creek valleys, Tobacco Root Range (December 1980).	Robert D. Hall, Janet Heiny, Kym Kodidek, Philip Ward, Indiana University/Purdue University, Indianapolis
*174 Glacial geology and mass wasting in South Willow Creek valley, Tobacco Root Range (August 1981).	Robert D. Hall, William T. Morgan Indiana University/Purdue University, Indianapolis
*6 (See Areal Geology.)	William B. Hall

Geomorphology and glacial geology (*continued*)

40 Cenozoic geology and geomorphology of the Dry Creek valley, Gallatin County, Montana (April 1980).	Gary C. Hughes Montana State University
175 Continuing study of the Yellowstone Valley south of Livingston and its glacial, geomorphic and recent structural features.	John Montagne Montana State University
*176 Continuing study of the geomorphic features of the Madison valley and their relation to glaciation, recent range-front faulting and collapse of the valley.	John Montagne Montana State University
*177 Photogeology study of the southern portion of the Deer Lodge valley, Montana.	James D. Schofield Montana Tech

Environmental and Engineering Geology and Environmental Geochemistry

179 Earthquake-hazard-reduction studies in the Helena area (March 1981).	Edward C. Bingler, Montana Bureau of Mines and Geology
*180 Earthquake-hazard evaluation of the Townsend valley area, central western Montana—proposed (September 1981).	Edward C. Bingler, Montana Bureau of Mines and Geology
Physical and geologic characteristics of catastrophic rockfall avalanches. This study includes work in Montana as well as other western states (continuing).	Robert D. Brown USGS, Menlo Park, California
181 Investigation of erosion and sediment transport in the Bitterroot valley. Samples were collected for suspended and bed load using a Helley-Smith sampler. Gravel bars were examined for particle size distribution and stability at various flow rates.	Kenn D. Cartier, Robert R. Curry University of Montana
182 Mapping landslide deposits in the Ekalaka and Jordan 2° quadrangles (1980).	Roger B. Colton USGS, Denver, Colorado
158 (See Hydrogeology.)	Chuck Dalby
183 A study of selective placement of coal strip mine overburden near Colstrip, Montana. Four interim reports are available (June 1982).	D. J. Dollhopf, J. D. Goering Montana Agricultural Experiment Station, Montana State University
Evaluation of Corette flyash as a tailings pond amendment to neutralize sulfide tailings, fix metals and reduce seepage losses (October 1981).	Joseph J. Donovan, John L. Sonderegger, Montana Bureau of Mines and Geology
Determination of the behavior of the bedrock and surficial deposits in response to past and present coal mining in selected areas of the Powder River basin (1985).	Richard C. Dunrud USGS, Denver, Colorado

Environmental and engineering geology and environmental geochemistry (*continued*)

Geochemical survey of vegetation in the western energy regions (continuing).	J. A. Erdman USGS
Chemical modeling of copper industry waste disposal systems and extraction of valuable metals (1982).	Dennis Jenke, Frank Diebold, Montana Tech; Gordon Pagenkopf, Montana State University
Neotectonic compilation of active (Late Cenozoic) faults in southern Montana (September 1980).	Willis M. Johns and others, Montana Bureau of Mines and Geology
184 Basic geologic map compilation preliminary to construction of regional geotechnical derivative maps will be completed in Lodge Grass and Crow Agency quadrangles, Montana, in addition to Wyoming areas (1980).	S. P. Kanizay USGS
159 (See Hydrogeology.)	Don C. Lawson, John Sonderegger
Complete study of possible role of system dynamics simulation modeling in regional environmental impact statement (EIS) process using northern Powder River basin coal development as a test case (continuing).	Robert K. Mark USGS, Menlo Park, California
Engineering geologic studies in the Powder River basin. Includes the study of surface subsidence over abandoned underground coal mines and areas of burning coal beds and the investigation of regional geotechnical properties and associated slope stability processes (1980).	Frank N. Osterwald USGS, Denver, Colorado
Element availability—soils. Includes work in the Northern Great Plains (continuing).	R. C. Severson USGS
185 Study of redistribution of snow by wind in alpine catchments in the Bridger Range (spring 1981).	W. Bruce Tremper Montana State University
14 (See Areal Geology.)	Donald E. Trimble

Late Entries

Structural geology of the Rogers Pass quadrangle, Lewis and Clark County, Montana.	M. L. Bregman Ohio Wesleyan University
Depositional environments and diagenesis of the Flathead (Middle Cambrian) and the overlying Flathead-Wolsey transitional strata in southwestern Montana (fall 1980).	Jay N. Shearer Indiana University, Bloomington

Back Pocket

Sheet 1—Index map of Montana.

Sheet 2—Index map of southwestern Montana.

Production Information

Camera-ready copy prepared on EditWriter 7500 by MBMG.

Stock: Cover — 17 pt. Kivar
Text — 60 lb. Mountie Matte
Sheet — 50 lb. Offset Book

Composition: *Univers* type
Heads — 1st order (14 pt. theme, leaded 4 pt.);
2d order (11 pt. theme, leaded 2 pt.);
Text — 10 pt. theme, leaded 1 pt.

Presswork: Heidelberg Sorkz

Ink: Leber

Order: 1,500 copies