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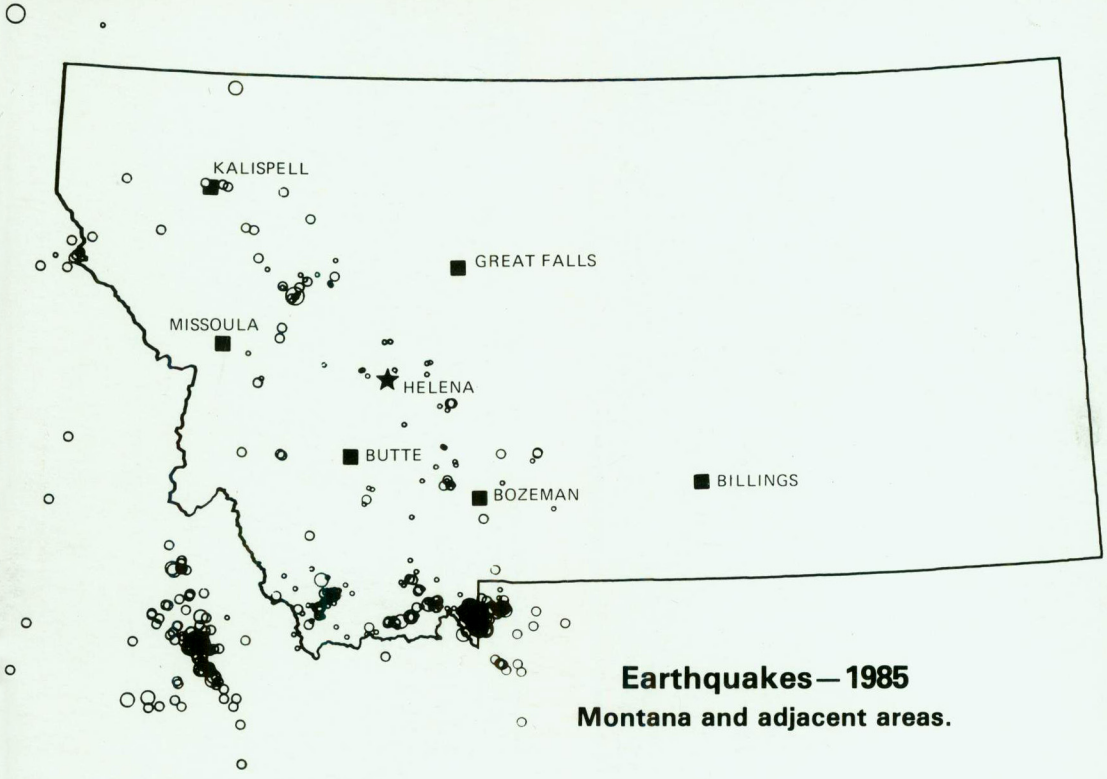
CURRENT GEOLOGICAL AND GEOPHYSICAL STUDIES IN MONTANA

compiled by

Richard B. Berg



Earthquakes—1985
Montana and adjacent areas.

Bulletin 125 **1986**

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

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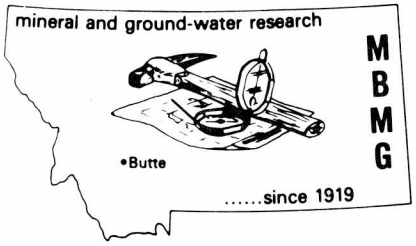

1986

About the cover . . .

Earthquakes—1985
Montana and adjacent areas

by
Michael C. Stickney

The Earthquake Studies Office (ESO) of the Montana Bureau of Mines and Geology, Montana College of Mineral Science and Technology, operates a network of nine seismograph stations in western Montana. Data from eight of these stations are continuously telemetered from remote sites using low-power FM radios and recorded at the ESO on drum recorders. The ninth station is located in Butte on the campus of Montana Tech where a seismograph has operated since 1936.

The arrival times of seismic waves from earthquakes recorded by the seismograph network are carefully measured, and with the assistance of a computer, times and locations of local earthquakes are calculated. Additional data from larger earthquakes are collected from other seismographs operated in the region by the U.S. Geological Survey, Army Corps of Engineers, University of Montana, University of Washington, Boise State University, Ricks College, Idaho National Engineering Laboratory and private individuals.

During 1985 the ESO located a total of 1,369 earthquakes, 715 of which had magnitudes of 2.0 or greater. The epicenter map shows the distribution of those earthquakes with magnitudes of 2.0 or greater. The size of the circles marking each epicenter is proportional to earthquake magnitudes, with the smallest circles representing magnitudes of 2.0 to 2.4 and the largest circles representing magnitudes of 4.5 to 5.4. Although occasional previous earthquakes have occurred in the north-central and extreme northeastern portions of Montana, seismic activity during 1985 was limited to the mountainous western third of the State. Quakes in northwestern and central-western Montana occurred along the Intermountain seismic belt, a broad zone of seismicity extending southeastward from northwestern Montana to Yellowstone National Park thence southwestward through western Wyoming, eastern Idaho, Utah and terminating in southern Nevada. The zone of seismicity extending westward from Yellowstone National Park defines the Idaho seismic zone and includes most of the earthquakes located by ESO with magnitudes greater than 3.5. The NW-trending group of epicenters in east-central Idaho, parallel to the Montana-Idaho border, marks the aftershock zone of the October 28, 1983 Borah Peak earthquake (magnitude 7.3). Clusters of seismic activity within the Idaho seismic zone also occurred near Clark Canyon Reservoir, in the southern Gravelly Range and near Hebgen Lake. The Hebgen Lake region was the site of a major swarm of earthquakes from October through December. This swarm included several thousand earthquakes, nearly 400 of which exceeded magnitude 2.5. The largest event of the swarm measured 4.9 and caused minor damage in West Yellowstone on November 11th. An earthquake measuring 4.8 occurred April 1 in the southern Swan Mountains northeast of Missoula. Although widely felt in western Montana, this earthquake caused no significant damage. The cluster of epicenters on the northern part of the Montana-Idaho border are attributed to rockbursts related to deep underground mining in the Wallace-Mullan, Idaho area.

Contents

Sheets

Preface

This annual list of current geological and geophysical studies 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.

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 the index map of Montana [**Sheet 1, back pocket**].

Completed theses are not included in this compilation. Special Publication 88, Compilation and Index of Theses on Montana Geology 1899-1982, may be ordered from the Montana Bureau of Mines and Geology, Butte, Montana 59701, for $10 postpaid.

Many of the studies listed here are far from being completed. We suggest that anyone who wants more information on a specific project should correspond directly with the investigator.

Richard B. Berg
Acting Chief, Geology and Mineral Resources Division
Montana Bureau of Mines and Geology

Butte
May 12, 1986

Areal Geology

1	Geology of the Stockett and Great Falls SE 7½-minute quadrangles. [1986]	M. J. Bartholomew and others, Montana Bureau of Mines and Geology
*2	Geology of the Dixon Mountain and Dell 7½-minute quadrangles, Beaverhead County. [1987]	M. J. Bartholomew, Montana Bureau of Mines and Geology; Robert Scholten, Pennsylvania State University
	Compilation of landslides in Montana (1:500,000-scale map). Maps at scales of 1:250,000 and 1:100,000 are anticipated. [September 1986]	M. J. Bartholomew, Edith M. Wilde, Montana Bureau of Mines and Geology; Roger B. Colton, USGS, Denver, Colorado; Earl E. Brabb, USGS, Menlo Park, California; Faith Daniel, South Dakota School of Mines and Technology
3	Geology of the Belt 1:100,000-scale quadrangle, central Montana. [1987]	Richard B. Berg, Susan M. Vuke-Foster, Montana Bureau of Mines and Geology; Roger B. Colton, USGS, Denver, Colorado
4	Compilation of geology for the Sidney 1:100,000-scale quadrangle. [1986]	Robert N. Bergantino, Susan M. Vuke-Foster, Montana Bureau of Mines and Geology
5	Preliminary geologic map of the Wolf Point 1°x2° quadrangle. [1986]	Robert N. Bergantino, Montana Bureau of Mines and Geology
6	Geologic map of the Jordan 1°x2° quadrangle. [1986]	Robert N. Bergantino, Montana Bureau of Mines and Geology
7	Geology of the Glendive 1:100,000-scale quadrangle, Montana and North Dakota. [August 1987]	Roger B. Colton, D. S. Fullerton, J. S. Gassaway, A. C. Banet, S. L. Durst, R. E. Eggleton, USGS, Denver, Colorado; Susan M. Vuke-Foster, Montana Bureau of Mines and Geology
8	Geology of the Baker and Wibaux 30x60-minute quadrangles, eastern Montana and adjacent North Dakota. [September 1986]	Roger B. Colton, USGS, Denver, Colorado; Susan M. Vuke-Foster, Michael C. Stickney, Edith M. Wilde, J. Elise Robocker, Kim C. Christensen, Montana Bureau of Mines and Geology

Areal Geology (*continued*)

*9	Geology and mineral resources of the Butte North 15-minute quadrangle (excluding the SE¼). [1988]	Pamela Dunlap Derkey, Montana Bureau of Mines and Geology
10	Geology and mineral deposits of Silver Bow and Deer Lodge counties. [1987]	Robert E. Derkey, Montana Bureau of Mines and Geology
11	Geology and mineral deposits of the Deer Lodge quadrangle and the south half of the Avon quadrangle. [1986]	Robert E. Derkey, Montana Bureau of Mines and Geology
*12	Tertiary history of the area around Black Butte, Gravelly Range, Madison County. (Manuscript *in preparation*)	James T. Gutmann, Wesleyan University; Paul Pushkar, Wright State University; Malcolm C. McKenna, American Museum of Natural History
13	Geology of the Kalispell 1°x2° quadrangle in conjunction with continuing study of the Precambrian Belt basin. [1987]	Jack E. Harrison, USGS, Denver, Colorado
*14	Geologic mapping and associated studies of Dickie Peak 7½-minute quadrangle. [January 1988]	Sharon E. Lewis, Montana Bureau of Mines and Geology
15	Mapping principal coal beds in the Broadus 1:100,000-scale quadrangle. [1986]	Marguerite McClellan, USGS, Denver, Colorado
16	Geology of the Gipsy Lake 7½-minute quadrangle, Meagher County. [1987]	Henry McClernan, Montana Bureau of Mines and Geology
*17	Geologic mapping of the Lima Peaks and Gallagher Gulch 7½-minute quadrangles, with emphasis on structural analysis of Cordilleran thrust belt/Rocky Mountain foreland interactions—*continuing*.	William J. Perry, Jr., Betty Skipp, USGS, Denver, Colorado
18	Geology and mineral resources of the White Sulphur Springs 1°x2° quadrangle.	Mitchell W. Reynolds, USGS, Denver, Colorado
*19	Study of the Proterozoic and early Paleozoic structure of the southwest Montana cratonic region, including mapping of the Swamp Creek and Spur Mountain 7½-minute quadrangles.	Edward T. Ruppel, USGS, Denver, Colorado
	A bibliographic compilation of index maps delineating areas covered by geologic mapping in Montana—*continuing*.	Brenda Sholes, Montana Bureau of Mines and Geology
20	Detailed structural analysis of a portion of the Blackfoot thrust fault along the northwest flank of the Garnet Range near Potomac.	Michael B. Thomas, University of Montana

Areal Geology (*continued*)

21	Coal outcrop map of the Glendive 30x60-minute quadrangle, eastern Montana and adjacent North Dakota. [May 1986]	Susan M. Vuke-Foster, Montana Bureau of Mines and Geology; Roger B. Colton, Judith S. Gassaway, Sherry L. Durst, USGS, Denver, Colorado
22	Geology of the Butte 1°x2° quadrangle. [1986]	Chester A. Wallace, USGS, Denver, Colorado
23	Geology of Glacier National Park. [1986]	James W. Whipple, USGS, Spokane, Washington

Structural Geology/Tectonics

24	Structural modeling of the Beartooth front—*continuing*.	William E. Bonini, Princeton University
*25	A structural investigation of a basement-involved thrust system in southern Sphinx Mountain 15-minute quadrangle, Madison Range, southwestern Montana. [Summer 1986]	Jeffrey S. Brown, Western Michigan University
26	Structural and thermal analysis of the northwest flank of the Flint Creek Range, western Montana. [June 1987]	Stephen N. Buckley, University of Montana
*27	Mechanism of basement deformation in the cores of three foreland anticlines in Montana with comparisons to one anticline in Colorado and one in Wyoming. The Montana portion of this study will concentrate on the London Hills and Carmichael anticlines in the northern Tobacco Root Mountains and the Hinch Creek anticline in the northern Ruby Range. [Summer 1986]	Andrew Calder, Western Michigan University
*28	Structural geology and sedimentology of the Sphinx Mountain area, Madison Range and the Red Hill area, Gravelly Range. [Winter 1986]	Mark Caldwell, Western Michigan University
*29	The stratigraphy and structure of the Paleozoic and Mesozoic rocks of the west flank of the Armstead anticline area, Beaverhead County. [March 1986.]	Charles W. Clark, Oregon State University
30	Tectonic significance of the Pass fault, central Bridger Range, southwest Montana. This study relates the structural style and evolution of the Pass fault to the surrounding structural framework at the southeast margin of the Helena salient.	Carol J. Craiglow, Montana State University

Structural Geology/Tectonics (*continued*)

31	Structural study of a duplex beneath a major overthrust plate in the Montana disturbed belt: Surface and subsurface data. [June 1986]	David M. Dolberg, University of Montana
*32	Structure, metamorphism and lithostratigraphy of Archean rocks in the Madison-Gravelly terrane and their relationship to regional Archean regimes—*continuing*.	Eric Erslev, Colorado State University
33	Structure, ^{40}Ar-^{39}Ar age and strain history of the Madison mylonite zone in the southern Madison Range and the south Snowy block of the Beartooth Mountains. [1986]	Eric Erslev, Colorado State University
*34	Structural and geochronologic evolution of the Madison and Gravelly ranges during the Archean.	Eric Erslev, Colorado State University; Paul A. Mueller, University of Florida
35	Shear zones in Archean rocks exposed in the southwestern part of the Beartooth block.	Eric Erslev, Colorado State University
*36	Structure and petrology of the Archean basement complex, Ruby Range, southwestern Montana—*continuing*.	John M. Garihan, Furman University
*37	Structure and tectonics of foreland uplifts in the Ruby, Tobacco Root, Highland, Madison, Greenhorn and Gallatin ranges in southwestern Montana. [1987]	John M. Garihan, Furman University; Christopher J. Schmidt, Western Michigan University
*38	Development of cleavage in the frontal fold and thrust belt near Melrose. [April 1986]	Beth Geiger, University of Montana
39	Paleomagnetism of Mesozoic/Cenozoic granites, Bitterroot lobe, Idaho batholith. [September 1986]	John W. Geissman, Colorado School of Mines
40	Monitoring seismicity in northeastern Montana and southern Saskatchewan and studies of related structural geology.	Don Gendzwill, University of Saskatchewan
41	Study of the Libby thrust in the NE ¼ of the Fishtrap 7½-minute quadrangle, Sanders County. [May 1986]	Robert M. Hague, University of Idaho
*42	Structural significance of highly metamorphosed mafic dikes of the Tobacco Root Mountains. [1986]	Thomas B. Hanley, Columbus College
*43	Structural controls of the southern Highland Mountains and adjacent basins. [December 1987]	Debra Hanneman, Montana Tech
*44	Kinematic analysis of the Sandy Hollow "collision structure," Big Hole Canyon, Madison County. [Spring 1988]	Tom Hendrix, Grand Valley State College

Structural Geology/Tectonics (*continued*)

*45	Investigation of the timing and evolution of structures associated with the Ermont and Tendoy thrusts and Armstead anticline, southwest of Dillon. [Spring 1986]	Larry M. Johnson, University of Montana
46	Structural geology and tectonic evolution of the Bridger Range and adjacent areas, southwestern Montana. This study involves the analysis of fault reactivation and tectonism from the Proterozoic to Recent—*continuing*.	David R. Lageson, Montana State University
*47	Geology, structure and geometrical analysis of structural relations along the south part of the Georgetown thrust, southwestern Montana.	David Lidke, USGS, Denver, Colorado
*48	Deformation associated with a possible ductile thrust emplacement of the Butte Quartz Monzonite in the northern Highland Mountains. [1986]	Gerard Martin, Western Michigan University
*49	Investigation of the history of activity of the Madison Range fault along its 1959 rupture.	Elizabeth L. Mathieson, Stanford University
*50	Structural geology of the central Snowcrest Range. [Summer 1987]	Barry McBride, Western Michigan University
	Basement response to Laramide deformation in southwestern Montana. [June 1986]	Erick W. Miller, Montana State University
*51	Geometric, mesofabric and petrofabric study of the Hossfeldt anticline and the hanging wall rocks of the Lombard thrust. The field area encompasses the northeastern portion of the Three Forks 15-minute quadrangle as well as part of the Toston and Radersburg 15-minute quadrangles. [December 1986]	Michael M. Mitchell, University of Tennessee, Knoxville
52	Cenozoic history of the Yellowstone River valley between Livingston and Gardiner—*continuing*.	John Montagne, Montana State University
53	Analysis of variation in strain and deformational style across the brittle-ductile transition zone in the northern Jocko Mountains and Reservation Divide north of Missoula. The Wallace, Shepard and Mount Shields formations of the Belt Supergroup will be studied. [June 1986]	Kathleen Ort, University of Montana
*54	Structural evolution of the southern margin of the Belt basin in and adjacent to the Highland Mountains, southwestern Montana. [1988]	J. Michael O'Neill, USGS, Denver, Colorado
55	Leopard rock protolith for polyphase deformed amphibolite, Beartooth Mountains—*continuing*.	John C. Palmquist, Lawrence University

Structural Geology/Tectonics (*continued*)

*56	Structural and stratigraphic characterization of the northern Tendoy Mountains, with emphasis on the structural configuration of shelf-to-basin Mississippian carbonate rocks in the McKenzie thrust system (formerly northern Tendoy, Limekiln and Johnson thrust sheets)—*continuing*.	William J. Perry, Jr., Charles A. Sandberg, USGS, Denver, Colorado; William J. Sando, U.S. National Museum
57	Structural modeling of the Phanerozoic sedimentary rocks in the northwestern corner of the Beartooth block. [early 1987]	Elizabeth A. Robbins, Eric A. Erslev, Colorado State University
*58	Helium surveys conducted in the overthrust belt of Wyoming and Montana to determine whether complex geology of the area has a significant effect on the migration pathways for gases. These surveys will also try to determine whether soil-gas helium can be used to find the location and extent of thrust sheets. [1987].	Alan R. Roberts, USGS, Denver, Colorado
59	Petrology, geochemistry and structural evolution of the eastern boundary of the Boulder batholith. [1989]	Carolyn Rutland, Western Michigan University; Susan Swapp, SUNY Binghamton; Christopher Schmidt, Western Michigan University
*60	Archean structural and petrologic evolution of the Spanish Peaks area, southwestern Montana. [June 1986]	Kenneth J. Salt, Montana State University
*61	Calcite twin strain and cleavage development in the Kootenai Formation in the Sandy Hollow duplex zone between Melrose and Dillon. [Fall 1986-Winter 1987]	Christopher Schmidt, Western Michigan University; Thomas E. Hendrix, Grand Valley State College
*62	Development of minor structures and solution cleavage in the frontal thrust belt adjacent to foreland anticlines in Pole Canyon (near Cardwell) and the Camp Creek-McCartney Creek area (near Melrose). [Fall 1986]	Christopher Schmidt, Western Michigan University
	Nature of control of earlier structures on basin and range faulting, southwestern Montana—*continuing*.	Christopher Schmidt, Western Michigan University; John M. Garihan, Furman University; Hugh Dresser, Montana Tech; J. M. O'Neill, USGS, Denver, Colorado
	Study of the tectonic and sedimentary development of the Sevier orogenic belt in western Montana—*continuing*.	James Schmitt, David Lageson, Montana State University

Structural Geology/Tectonics (*continued*)

*63	Neotectonics in the Madison, Tobacco Root and Ruby ranges: Evidence from tectonic geomorphologic parameters. [1987]	Nick Schneider, Southern Illinois University
64	A breccia and retrograde metamorphic zone is exposed intermittently within the blastomylonites of the Bitterroot dome on the eastern edge of the Bitterroot Mountains. This study will define the geometric, mineralogical and strain relationships between the regional mylonitization and the local brecciation. [Fall 1986]	Eileen L. Shannon, Western Michigan University
	Crustal study of southwestern Montana using seismic refraction—*continuing*.	Steven D. Sheriff, University of Montana
	Exploratory trenching of Neogene faults in western Montana to determine movement histories. [July 1986]	Michael Stickney, Mervin J. Bartholomew, Montana Bureau of Mines and Geology
	Tectonic evolution of southwestern Montana, especially as reflected in the sedimentary record—*continuing*.	W. Thomas Straw, Western Michigan University
	Fission-track dating of selected plutonic rocks of the western Helena structural salient to determine timing of thrusting. [Fall 1986]	Jean Talanda, Western Michigan University
	[See Areal Geology.]	Michael B. Thomas
	Paleomagnetic study of thrust sheet rotations in the Helena and Wyoming salients of the northern Rocky Mountains. [Completed, GSA Special Paper, *in review*.]	R. Van der Voo, University of Michigan
	A comparison of the thermal profiles of two adjacent thrust slabs northwest of Missoula.	Christopher Weiss, University of Montana
*65	Determination of finite strain in Precambrian (pre-Belt) rocks of the Ruby Range, Madison County, Montana from analysis of deformed conglomerates. [1986]	Jay Zimmerman, Southern Illinois University

Stratigraphy, Sedimentary Petrology and Paleontology

66	Study of the detailed sedimentologic and ichnologic facies assemblages of what presently appears to be a number of depositionally "stacked" nearshore clastic deposits in the uppermost Lower Cretaceous Bootlegger Member of the Blackleaf Formation.	R. W. Arnott, University of Alberta

Stratigraphy, Sedimentary Petrology and Paleontology (*continued*)

67	Study of paleogeography and fluvial sedimentology of the uppermost Hell Creek Formation. [1987]	Edward S. Belt, Amherst College; J. David Archibald, San Diego State University
	[See Structural Geology.]	Mark Caldwell
	[See Structural Geology.]	Charles W. Clark
68	Stratigraphy and vertebrate faunas of the Hell Creek and Tullock formations in Garfield and McCone counties.	William A. Clemens, University of California, Berkeley
	Chronostratigraphy of mid-Cretaceous hydrocarbon source rocks, western interior—*continuing*.	William A. Cobban, USGS, Denver, Colorado
	An evaluation of the Fox Hills Formation (Late Cretaceous), including the definition and correlation of the formation and its members, as well as environments of deposition in the subsurface and in outcrop in the Williston basin of North Dakota and eastern Montana. [Fall 1986]	Daniel J. Daly, North Dakota Geological Survey
69	Coal geology and sedimentology of the Morrison Formation in the Stockett-Sand Coulee area near Great Falls. [1986]	John A. Daniel, South Dakota School of Mines and Technology; M. J. Bartholomew, Montana Bureau of Mines and Geology
70	Coal stratigraphy of the Culbertson and Circle 1:100,000-scale quadrangles—*continuing*.	Pamela Dunlap Derkey, Montana Bureau of Mines and Geology
	Diagenesis of the Devonian Jefferson Formation and Mississippian Mission Canyon Formation in western Montana. [1988]	S. L. Dorobek, Washington State University
71	Detailed paleoecologic analysis of the macrofauna across the Cenomanian-Turonian (Cretaceous) stage boundary near Great Falls and Mosby, Montana. [August 1986]	William Elder, University of Colorado
	Magnetic stratigraphic correlations in the Belt basin of Montana and Idaho—*continuing*.	Donald P. Elston, USGS, Flagstaff, Arizona
	Stratigraphy, sedimentation, paleontology and history of tertiary basins of western Montana and eastern Idaho—*continuing*.	Robert W. Fields, University of Montana
*72	Biostratigraphy, magnetic polarity stratigraphy and geochronology of Oligocene strata, Black Butte area, Madison County. [1986]	John J. Flynn, Rutgers University; Malcolm C. McKenna, Andre Wyss, American Museum of Natural History
	Studies of Paleocene silcrete, southeastern Montana.	Judith S. Gassaway, USGS, Denver, Colorado

Stratigraphy, Sedimentary Petrology and Paleontology (*continued*)

73	Taxonomy and biostratigraphy of bryozoans in the Otter Formation of the Little Belt and Little Snowy mountains. [Winter 1986]	Ernest H. Gilmour, Eastern Washington University
	Stratigraphic study of fossiliferous units and study of pachycephalosaurian dinosaurs, Judith River Formation, Hill County.	Mark Goodwin, University of California, Berkeley
	Depositional environments of the Fort Union and Wasatch formations, Powder River basin. [1988]	John H. Hanley, USGS, Denver, Colorado
*74	Tertiary geology of the Melrose-Rocker basins. [December 1986]	Debra Hanneman, Montana Tech
75	The relationship between diagenesis and regional porosity development and distribution in the Sun River Member of the Castle Reef Formation (Upper Mississippian), Sawtooth Range, northwestern Montana. [June 1986]	Mary K. Harris, University of Idaho
76	Paleontological study of the nonmarine Mollusca of the Crazy Mountains field, Sweet Grass and Wheatland counties, Montana. The study concerns the biostratigraphy of the Judith River through Fort Union (Melville) formation sequence, concentrating on the Paleocene section. [1987]	Joseph H. Hartman, University of Minnesota
77	Facies mapping of the Belfry Member of the Fort Union Formation. [June 1986]	Leo J. Hickey, Peabody Museum, Yale University
78	Paleobotany and facies of the Fort Union Formation in the northern Big Horn basin, Montana and Wyoming. [1989]	Leo J. Hickey, Peabody Museum, Yale University
79	Petrography, palynology and origin of coals in the Red Lodge and Bridger coal fields, Carbon County. [1987]	Roy Jensen, South Dakota School of Mines and Technology
80	Paleontology of a Cambrian outcrop near Noxon. This is part of a larger project dealing with Cambrian paleontology in Idaho.	Dave Kachek, University of Idaho
	Studies of the Cretaceous stratigraphy and molluscan paleontology of Montana. [1988]	Erle G. Kauffman, University of Colorado
	Study of the stratigraphic framework of Tertiary coal in the Powder River basin. [1987]	Bion H. Kent, USGS, Denver, Colorado
	Stratigraphy, depositional environments, paleontology, and age of the Libby Formation, Proterozoic Belt Supergroup, northwest Montana and northeast Idaho. [Spring, 1987]	David L. Kidder, University of California, Santa Barbara

Stratigraphy, Sedimentary Petrology and Paleontology (*continued*)

	Collection of Paleocene fossil mammals from the Crazy Mountain basin of south-central Montana and from the northern Powder River basin of southeastern Montana to document changes in mammalian faunal composition across the middle-late Paleocene boundary. [1995]	David W. Krause, Department of Anatomical Sciences, Health Sciences Center, State University of New York, Stony Brook
81	Tectonic controls on the structure, sedimentology and stratigraphy of the southern portion of the Upper Cretaceous Golden Spike Formation, central-western Montana.	Thomas L. Mackie, Washington State University
	Study of petroleum source rock characteristics and depositional setting of Upper Mississippian and Lower Pennsylvanian beds in Utah, Idaho, Wyoming and Montana. [1986]	Edwin K. Maughan, USGS, Denver, Colorado
	Stratigraphy and petrology of carbonate sediments in the Ellis Group of western Montana: The influence of tidal currents, storms and tectonic uplift facies patterns—*continuing*.	James H. Meyers, Winona State University
	Depositional and diagenetic environments of the Jurassic Rierdon Formation (Ellis Group) south and southeast of the Belt Island tectonic uplift. [June 1986]	Dennis Michaud, Indiana University, Bloomington
82	Study of mammalian faunas of the Judith River Formation, Hill County	Marisol Montellano, University of California, Berkeley
83	Metal and sediment geochemistry in the Missouri River and Lake Helena. [1986]	Johnnie N. Moore, University of Montana
84	Sedimentation and sediment chemistry of the Clark Fork River. [1986]	Johnnie N. Moore, University of Montana
85	Palynology of the thrust belt, western United States. Includes microstratigraphic analysis of uninterupted sedimentary sequences crossing the Cretaceous-Tertiary boundary in the Hell Creek area, Garfield County. [1988]	Douglas J. Nichols, USGS, Denver, Colorado
	Modeling global ecologic catastrophes in geologic time. Includes work on the Hell Creek Formation in Montana. [1989]	Douglas J. Nichols, USGS, Denver, Colorado
*86	Continuing biostratigraphic study of the Lower Triassic Dinwoody Formation in southwestern Montana. [1987?]	Richard A. Paull, Rachel K. Paull, University of Wisconsin, Milwaukee
	[See Structural Geology.]	William J. Perry, Jr., William J. Sando, Charles A. Sandberg
	Study of metals in Mississippian shales in western Montana. [1986]	Forrest G. Poole, USGS, Denver, Colorado

Stratigraphy, Sedimentary Petrology and Paleontology (*continued*)

	Sedimentology and diagenetic history of the Mission Canyon Formation (Mississippian Madison Group), central Montana. [September 1986]	Dan C. Quigley, Washington State University
	Study of cementation and dolomitization of the Cambrian Meagher Formation in southwestern Montana and the possible relationship to the limestone-dolomite "transition zone." [May 1986]	Steven K. Reid, University of Idaho
	Stratigraphy and vertebrate paleontology across the Cretaceous/Tertiary boundary (Hell Creek and Tullock formations in McCone and Powder River counties). [January 1987]	J. Keith Rigby, Jr., University of Notre Dame
	Study of dilution effect on sediment derived from the Stillwater Complex.	Dale Ritter, Southern Illinois University; Susan Howes, Lamar University; Marvin Kauffman, American Geological Institute
87	Middle Cambrian agnostoid trilobites of North America and Greenland (includes work in northwestern Montana). [February 1988]	R. A. Robison, University of Kansas
	Identification and correlation of coal-forming depositional environments and time-stratigraphic units across the intermontane basins of the Rocky Mountains—*continuing*.	Henry W. Roehler, USGS, Denver, Colorado
88	Tertiary geology and vertebrate paleontology of the Smith River basin, Meagher County.	Anthony Runkel, University of Montana
*89	Stratigraphy and structure of Mississippian rocks in the Tendoy Range, Beaverhead County.	William J. Sando, U.S. National Museum, Washington, D.C.
90	Sedimentology and provenance of pre-volcanic Eocene conglomerates in the Gallatin Range, southwest Montana. [1988]	James Schmitt, Montana State University
91	Sedimentary/tectonic evolution of the Crazy Mountains basin. [1989]	James Schmitt, Jack Horner, Montana State University; James R. Steidtmann, University of Wyoming
92	Study of processes of sedimentation during evolution of the Eocene Absaroka-Gallatin volcanics, northern Gallatin Range, southwestern Montana. [1988]	James Schmitt, Montana State University
*93	Detailed lithofacies analysis and sedimentology of the late Precambrian LaHood Formation, southwestern Montana. [1989]	James Schmitt, Montana State University

*94	Sedimentary and tectonic history of the Three Forks basin, southwestern Montana. [1989]	James Schmitt, Montana State University; Debra Hanneman, Montana Tech
	[See Structural Geology.]	James Schmitt, David Lageson
	Investigation of the Bakken Formation in the Williston basin, Montana and North Dakota, with emphasis on physical parameters, organic matter content and source rock maturity. [1986]	James W. Schmoker, USGS, Denver, Colorado
95	A revision of the stratigraphy and depositional paleoenvironments of the Mississippian rocks, Garnet Range-Bearmouth area, Granite County. [June 1987]	Richard C. Schneider, Oregon State University
96	Coal stratigraphy of the Glendive 1:100,000-scale quadrangle. [1986]	Mark A. Sholes, Pamela Dunlap Derkey, Montana Bureau of Mines and Geology
	Sedimentology, stratigraphy and diagenetic history of the upper part of the Jefferson Formation and Logan Gulch Member of the Three Forks Formation, southwestern Montana. [September 1986]	Tad M. Smith, Washington State University
	[See Structural Geology.]	W. Thomas Straw
	Tectonic controls on Mesozoic sedimentation in the foreland basin of western and central Montana—*continuing*.	Lee J. Suttner, Indiana University, Bloomington
	Petrology of bentonites and K-bentonites in the Montana disturbed belt and Sweetgrass arch. [December 1986]	G. R. Thompson, University of Montana
	Petrology, geochemistry, stratigraphy and sedimentary geology of Tertiary playa deposits, central and western Montana. [June 1987]	G. R. Thompson, University of Montana
97	Stratigraphy, gravity and burial diagenesis of sediments in the Deer Lodge valley. [December 1986]	G. R. Thompson, University of Montana
	Depositional environment, diagenesis and petroleum potential of the Permian Shedhorn Sandstone in southwest Montana and northwest Yellowstone National Park. [May 1987]	Janet Bauder Thornburg, University of Colorado
98	Petrology and depositional environments of the Hulett Sandstone Member of the Sundance Formation in the northern Bighorn basin—*continuing*.	John Utgaard, Southern Illinois University

Stratigraphy, Sedimentary Petrology and Paleontology (*continued*)

	Stratigraphy, structural setting and sediment-dispersal system of the middle part of the Missoula Group of the Belt Supergroup. [1992]	Chester A. Wallace, USGS, Denver, Colorado
	Study of the existence, magnitude and timing of major extinction episodes of fossil floras and faunas in Phanerozoic time. [1986]	Bruce R. Wardlaw, National Museum of Natural History, Washington, D.C.
	Taxonomic, paleoecologic, evolutionary and biostratigraphic study of Mississippian crinoids in central and western Montana. [January 1987]	G. D. Webster, Washington State University
99	Sedimentology of the Altyn Formation (Precambrian) of Glacier National Park: A study of microbiotas, stromatolites and evaporitic dolomites in shallowing-upward cycles—*continuing*.	Brain White, Smith College
	Determination of diagenetic features in samples from the Fox Hills Formation using scanning electron microscope (SEM) analysis. [June 1986]	Edith M. Wilde, Jannette L. Downey, Montana Bureau of Mines and Geology
	Stratigraphy and sedimentology of the Ravalli Group, middle Belt carbonate and Missoula Group of the Belt Supergroup—*continuing*.	Don Winston, University of Montana
	Analysis of fossil plant collections from the Tongue River Member of the Fort Union Formation. [1987]	J. A. Wolfe, USGS, Denver, Colorado
	Detailed sedimentologic and stratigraphic study of the Shepard Formation (Belt Supergroup) in the southern Mission, Swan, and Lewis and Clark ranges. [March 1986]	Marvin Woods, University of Montana
100	Facies relationships, depositional characteristics and paleochemistry of possible lacustrine environments in the Paleocene Fort Union Formation of the northern Bighorn basin. [December 1986]	Richard F. Yuretich, University of Massachusetts

Geochemistry, Mineralogy and Petrology

101	Petrologic and geochemical studies of the alkaline complexes at Rainy Creek, Haines Point, Bobtail Creek, Warland Creek and the Skalkaho area constitute part of a study of thorium resources. [1986]	Theodore J. Armbrustmacher, USGS, Denver, Colorado
	Determination of geochemical attributes of precious-metal deposits in southwestern Montana and the relation of these deposits to the genesis of batholithic rocks. [September 1986]	Byron R. Berger, USGS, Denver, Colorado
*102	Geochemical study of the mass transfer associated with the formation of talc deposits, Ruby Range—*continuing*.	John B. Brady, Smith College

Geochemistry, Mineralogy and Petrology (*continued*)

	Geochemistry and economic geology of hydrothermal vein carbonate-fluorspar deposits, western Montana—*continuing*.	D. G. Brookins, University of New Mexico
*103	Stream sediment sampling and geochemical prospecting eastern flank, Snowcrest Range. [July 1986]	Patrick Burkhart, Wright State University
104	Geochemical and analytical studies of the platinum-group elements including samples from the Stillwater Complex. [1986]	Robert R. Carlson, USGS, Denver, Colorado
105	Evolution of the volcanic field in the Yellowstone Plateau-Island Park area of Wyoming, Idaho and Montana. [1986]	Robert L. Christiansen, USGS, Menlo Park, California
	Geochemistry of sedimentary organic matter, crude oil and natural gas. Will include a report on the hydrocarbon generation and oil and gas potential of the northern Montana disturbed belt—*continuing*.	Jerry L. Clayton, USGS, Denver, Colorado
106	Study of the basal-zone sulfides in the Stillwater Complex.	G. K. Czamanske, USGS, Menlo Park, California
*107	Trace-element partitioning in coexisting garnet-clinopyroxene and garnet-biotite in high-grade metamorphic rocks in the Ruby Range. [May 1986]	Peter S. Dahl, Robert C. Hendricks, Kent State University
*108	Geochemistry of the Lowland Creek Volcanics. [1990]	Pamela Dunlap Derkey, Montana Bureau of Mines and Geology
109	Geology and mineral deposits of Cretaceous-Tertiary volcanic rocks in the vicinity of the Boulder batholith. [1988]	Robert E. Derkey, Montana Bureau of Mines and Geology
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	S. L. Dorobek
110	Examination of the Cu/Ni distribution in the disseminated and net-textured sulfides in the Stillwater Complex based on Cu/Ni assay patterns.	L. J. Drew, USGS, Reston, Virginia
	[See Structural Geology.]	Eric Erslev
111	Petrologic investigation of selected gravel terraces in the Bighorn basin, Carbon County. [March 1986]	Charles O. Frank, Southern Illinois University
*112	Petrographic and geochemical study of the Precambrian rocks in the Stone Creek area of the Ruby Mountains, Madison County. [Spring 1986]	Bruce Garbaccio, California State University, Los Angeles

Geochemistry, Mineralogy and Petrology (*continued*)

*113	Descriptive geochemistry of metamorphosed mafic dikes of the Tobacco Root Mountains. Major, minor and limited trace element analyses of medium- to fine-grained, generally discordant, garnetiferous tholeiites. [1986]	Thomas B. Hanley, Columbus College
	Study of kimberlitic diatremes in Montana including chemical and isotopic analysis of mineral separates—*continuing*.	B. Carter Hearn, USGS, Reston, Virginia
114	Trace element chemistry of fine-grained rocks from the Stillwater Complex with emphasis on the platinum-group elements and Cu, Ni and Ag. [1987]	Rosalind T. Helz, USGS, Reston, Virginia
*115	Mineralogic and geochemical study of amphibolites in the Tobacco Root Mountains, Madison County. (Preliminary draft of manuscript completed 1986.)	David F. Hess, Western Illinois University; Charles J. Vitaliano, Indiana University
	Study of alkaline igneous rocks of the central Montana province—*continuing*.	Donald W. Hyndman, University of Montana
116	Study of the mafic dikes associated with the Idaho batholith, Montana and Idaho—*continuing*.	Donald W. Hyndman, University of Montana
117	Geology and geochemistry of the Hog Heaven volcanic field and associated mineralization. [1988]	Ian Lange, University of Montana
118	Petrogenesis of anorthosites of the Stillwater Complex. [1987]	Patricia J. Loferski, USGS, Reston, Virginia
	Early and middle Cenozoic volcanic centers, western conterminous United States. [1988]	R. G. Luedke, USGS, Reston, Virginia
119	Igneous history of the Highwood Mountains. [1986]	I. S. McCallum, A. J. Irvine, H. O'Brien, University of Washington
120	An analysis of the Deer Lodge basin sediments (from drill cuttings) to determine burial diagenesis, stratigraphy and depositional history. [December 1986]	Paul J. McLeod, University of Montana
121	Archean geology of southwestern Montana, including the Beartooth Mountains, northern Madison Range and Tobacco Root Mountains—*continuing*.	Dave Mogk, Montana State University
122	Study of Sr and O isotopic systematics in Archean granitoid and associated rocks in the southern Beartooth Range. Also major, minor and trace-element geochemistry. [1988]	Carla W. Montgomery, Northern Illinois University

Geochemistry, Mineralogy and Petrology (*continued*)

123	Stable isotope geochemistry and phase equilibria study of the Boehls Butte and Bitterroot anorthosites and surrounding Beltian metasediments. [May 1986]	C. I. Mora, University of Wisconsin, Madison
*124	Origin of quartz-olivine basaltic andesite of the Block Mountain area, southwest Montana. Study of petrogenesis of Block Mountain lavas through field mapping, petrography and major-trace-isotopic geochemistry. Also includes age dating and relation to regional structure and similar rocks in the Clamo and Challis volcanics. [June 1988]	Ellen Mullen Morris, Todd Feeley, University of Arkansas
	Geochemistry and geochronology of the Archean basement of southwestern Montana. [1990]	Paul A. Mueller, University of Florida; Joe L. Wooden, USGS, Menlo Park, California; Dave Mogk, Montana State University; Eric Erslev, D. Henry, Colorado State University
	[See Structural Geology.]	John C. Palmquist
125	Investigation of the chemistry and mineralogy of the association of sulfide minerals, magnetite and graphite with platinoids in the Stillwater Complex.	Mike Paseczyk, Alex Volborth, Montana Tech
*126	Study of Tertiary volcanic centers in the Gravelly Range.	Paul Pushkar, Wright State University; James T. Gutman, Wesleyan University
	Chemical and isotopic evidence of the origins of natural gases. [1986]	Dudley D. Rice, USGS, Denver, Colorado
127	Archean geology of the Lake Plateau, central Beartooth Mountains. [June 1986]	Doug Richmond, Montana State University
128	Chemical evolution of the Elkhorn Mountains Volcanics with a comparison to the Boulder batholith—*continuing*.	Carolyn Rutland, Western Michigan University; Thomas A. Vogel, Michigan State University
	[See Structural Geology.]	Carolyn Rutland, Susan Swapp, Christopher Schmidt
129	Outcrop-scale mapping of intrusive structures and magmatic textures in the Stillwater Complex as part of an investigation of the internal structure of magmatic systems. [1986]	Michael P. Ryan, USGS, Reston, Virginia
	[See Structural Geology.]	Kenneth J. Salt
*130	Petrology and origin of an Archean rock package, Ruby Range, southwestern Montana. [June 1986]	Michael J. Schaefer, University of Montana
	[See Structural Geology.]	Eileen L. Shannon

Geochemistry, Mineralogy and Petrology (*continued*)

131	Petrology and geochronology of basement rocks in the vicinity of Jardine, Park County. [June 1987]	A. K. Sinha, Virginia Polytechnic Institute and State University
132	Petrology and isotope geochemistry of lavas from the Gardiner River area, Yellowstone National Park. [June 1987]	A. K. Sinha, Virginia Polytechnic Institue and State University
	Petrology, geochemistry and geochronology of Archean iron-rich metasedimentary rocks of southwestern Montana. [1987]	Dan Stanley, University of Florida
133	Alteration petrology at the Flathead mine and associated ash-flow tuffs. [1986]	Graham R. Thompson, University of Montana
134	Provenance of Archean metasedimentary rocks in the southwest Beartooth Mountains, Montana-Wyoming. [December 1986]	Peter Thurston, Montana State University
	Determination of the thermodynamic properties of water adsorbed on the surface of the Rosebud coal seam. [June 1986]	Judi Todd, Doug Coe, Frank Diebold, Montana Tech
*135	Detailed petrologic, petrochemical and structural study of the Tobacco Root batholith, Madison County—*continuing*.	Charles J. Vitaliano, Indiana University; John Smith, Standard Oil of California; David F. Hess, Western Illinois University
*136	Metabasites of the Tobacco Root Mountains.	Charles J. Vitaliano, Indiana University; Thomas B. Hanley, Columbus College
*137	Orthoamphibolites of the Tobacco Root Mountains.	Charles J. Vitaliano, Indiana University; David F. Hess, Western Illinois University
*138	The 10-N pluton, Whitehall area, southwestern Montana.	Charles J. Vitaliano, John A. Rupp, Indiana University
139	Petrology of anorthosites of the Stillwater Complex—*continuing*.	Alex Volborth, Montana Tech
	Study of the development of bentonites through diagenesis from the disturbed belt and Sweetgrass arch. [June 1986]	Susan C. Walker, University of Montana
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	Edith M. Wilde, Jannette L. Downey
140	Geologic and petrologic survey of the Garnet-Coloma area, Garnet Range. Geochemical analyses were conducted from samples collected along two traverses within the Garnet stock and from numerous volcanic rocks which were found to intrude the peripheral meta-sediments. [June 1986]	Kurtis Wilkie, Iowa State University

Geochemistry, Mineralogy and Petrology (*continued*)

	The relationships of structure to volcanism and mineralization within the Hog Heaven volcanic field (early Oligocene), northwestern Montana. [March 1986]	Richard E. Zehner, University of Montana
141	Mineralogy of the Black Pine mine, Granite County—*continuing*.	Lester Zeihen, Montana Tech
*142	Petrologic studies of igneous rocks in the Pioneer Mountains.	E-an Zen, Jane M. Hammarstrom, USGS, Reston, Virginia

Isotope Geology and Geochronology

143	Distribution of the Anderson and Knoblock clinker in the Ashland area. Fission-track ages of clinker will be used to shed light on downcutting history of the Tongue River. [1986]	Donald A. Coates, Edward L. Heffern, USGS, Denver, Colorado
	[See Structural Geology.]	Eric Erslev
	[See Structural Geology.]	Eric Erslev, Paul Mueller
144	The purpose of this study is to explore the effectiveness of using stable isotopes to chemically distinguish water from different geologic formations. Samples of ground water were collected from wells completed in alluvium, sub McKay coal, McKay coal, overburden, Rosebud coal and spoils near Colstrip, Montana. [September 1986]	Rodger F. Ferreira, John Lambing, USGS, Helena, Montana
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	John J. Flynn, Malcolm C. McKenna, Andre Wyss
145	Study of the chloride flux out of Yellowstone National Park—*continuing*.	Irving Friedman, USGS, Denver, Colorado
	[See Areal Geology.]	James T. Gutmann, Paul Pushkar, Malcolm C. McKenna
	Collection of ash from Cenozoic deposits in southwestern Montana for radiometric and fission track dating.	Debra Hanneman, Montana Tech
	[See Geochemistry, Mineralogy and Petrology.]	B. Carter Hearn
146	Stable isotope ratios of runoff and geothermal water in and around Yellowstone National Park and the constraints on the hydrology of the geothermal features. [1986]	T. Kurtix Kyser, University of Saskatchewan
	Radiometric dating of some Quaternary deposits in western Montana using U-series decay. [July 1986]	Sharon E. Lewis, Montana Bureau of Mines and Geology

Isotope Geology and Geochronology (*continued*)

	Study of zircon crystals recovered from bentonite bed near the top of the middle Belt carbonate.	Kenneth R. Ludwig, USGS, Denver, Colorado
	[See Geochemistry, Mineralogy and Petrology.]	Carla W. Montgomery
	[See Geochemistry, Mineralogy and Petrology.]	C. I. Mora
	[See Geochemistry, Mineralogy and Petrology.]	Ellen Mullen Morris, Todd Feeley
	[See Geochemistry, Mineralogy and Petrology.]	Paul A. Mueller, Joe L. Wooden, Dave Mogk, Eric Erslev, D. Henry
147	Geochronology of the Cretaceous-Tertiary boundary as defined by the last appearance of dinosaurs, the major palynological break and the geochemical iridium anomaly in the Hell Creek area.	Charles W. Naeser, USGS, Denver, Colorado
	Hafnium isotopes in Archean detrital zircons will be used to assess quantities of pre-3.0 Ma continental crust. Sample of Archean zircons will be obtained from crust, in sandstones from southwestern Montana. [1987]	P. Jonathan Patchett, University of Arizona
*148	Quaternary dating and neotectonics. Includes obsidian hydration dating of pre-1959 faulting and ages of scarps in the Hebgen, Montana earthquake area—*continuing*.	Kenneth L. Pierce, USGS, Denver, Colorado
	[See Geochemistry, Mineralogy and Petrology.]	Dudley D. Rice
149	Study of the Spar Lake copper-silver deposits in conjunction with stable isotope studies of ore deposits. Also sulfur isotope studies of the Yellowstone geothermal system. [1986]	Robert O. Rye, USGS, Denver, Colorado
	[See Geochemistry, Mineralogy and Petrology.]	A. K. Sinha
150	Pb isotopic studies of Precambrian metamorphic rocks in the Beartooth Mountains. [1986]	J. S. Stacey, USGS
151	Sm-Nd analyses of mineral separates from the Stillwater Complex. Also studies of Pb isotopes from the Stillwater Complex—*continuing*.	Mitsunobu Tatsumoto, USGS, Denver, Colorado
152	Study of the stable isotopic compositions of alteration minerals associated with the Zortman-Landusky gold deposits to characterize the formation temperatures and origin of the fluids associated with the mineralization and alteration episodes. [September 1986]	Mark R. Wilson, University of Saskatchewan

Geophysics

	[See Structural Geology.]	William E. Bonini
153	Columbia University's Mark II airborne spectroradiometer system will be used to acquire airborne spectroradiometer data at mineralized sites including the Cotter basin, Montana. [1986]	Frank C. Canney, USGS, Denver, Colorado
	Determination of crustal thickness and structure by seismic refraction within southwest Montana and northeast Idaho. [March 1986]	Garry J. Carlson, University of Montana
	Crustal study of northwestern Montana using seismic refraction techniques. [June 1986]	William P. Clement, University of Montana
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	Donald P. Elston
*154	A study of the paleomagnetics of mineralized terranes will include the Pioneer batholith. [1986]	Donald P. Elston, USGS, Flagstaff, Arizona
*155	A controlled-source audiomagnetotelluric and gravity survey of the Ennis Hot Springs geothermal area, southwestern Montana. [May 1986]	Gunnar Emilsson, Dave Semmens, William Sill, Charles Wideman, Montana Tech
	[See Structural Geology.]	John W. Geissman
	[See Structural Geology.]	Don Gendzwill
*156	A magnetic and gravity investigation in the Beaverhead basin, southwestern Montana. [May 1986]	Linda Gosse, University of Arkansas
	Paleomagnetic determinations on the Late Cretaceous Elkhorn Mountains Volcanics, western Montana. [1986]	C. S. Gromme, USGS
	Geophysical studies include numerical modeling of gravity data to define geologic models across the Libby thrust zone and the Purcell anticlinorium. [1987]	M. Dean Kleinkopf, USGS, Denver, Colorado
*157	Shallow seismic reflection surveying to map intra-Tertiary stratigraphy in the Beaverhead basin, southwestern Montana. [June 1987]	Robert Lankston, University of Arkansas
*158	Regional Bouguer gravity profile and modeling from the Beaverhead valley near Twin Bridges to the Madison valley near Cameron. [1986]	William Moorse, Western Michigan University
	BLM wilderness geophysical studies. [October 1986]	Calvin K. Moss, USGS, Denver, Colorado
159	Gravity study of the Boulder Baldy 7½-minute quadrangle, Big Belt Mountains. The purpose of the study is to delineate the size and depth extent of an intrusive body that crops out in the area. [April 1986]	Richard Allan Payne, Henry McClernan, Charles Wideman, Montana Tech

Geophysics (*continued*)

*160	Delineation of a feeder dike in Wolverine basin in the Gravelly Range using gravity and magnetic determinations. Also investigation of the occurrence of banded iron-formations in the Gravelly Range. [1986]	William A. Randall, Jr., Wright State University
	[See Structural Geology.]	Steven D. Sheriff
*161	Study of earthquakes in the Yellowstone-Hebgen Lake region. The University of Utah records the 16-station Yellowstone network including 3 stations in the West Yellowstone basin.	Robert B. Smith, University of Utah
	Seismic monitoring and analysis of earthquake data, western Montana and adjacent parts of Idaho and Wyoming—*continuing*.	Michael C. Stickney, Montana Bureau of Mines and Geology
162	Thermal inertia mapping of a number of areas including the Boulder batholith. [1986]	Kenneth Watson, USGS, Denver, Colorado
	[See Structural Geology.]	Christopher Weiss

Economic Geology

	Geochemical exploration in western Montana—*continuing.*	John C. Antweiler, USGS, Denver, Colorado
163	An estimation of the grade (*in situ)* and tonnage relationship for the Mouat orebody in the Stillwater Complex; also alternative exploration strategies for copper and nickel in the Stillwater Complex will be appraised. [1986]	E. D. Attanasi, USGS, Reston, Virginia
164	Geostatistical anaysis of the internal structure and spatial distribution of ore deposits in the Stillwater Complex. [1986]	W. J. Bawiec, USGS, Reston, Virginia
*165	Chloritic alteration of Archean metamorphic rocks in the Highland Mountains—*continuing*.	Richard B. Berg, Montana Bureau of Mines and Geology
	Geology of Montana barite deposits. (Preliminary information available in MBMG Open-File Report 95.) [Publication available 1987.]	Richard B. Berg, Montana Bureau of Mines and Geology
	[See Geochemistry, Mineralogy and Petrology.]	Byron R. Berger
	The distribution of talc in the soil as a tool for exploration of concealed talc bodies. [June 1986]	Alice M. Blount, Rutgers University
	[See Geochemistry, Mineralogy and Petrology.]	John B. Brady
	[See Geochemistry, Mineralogy and Petrology.]	D. G. Brookins
	[See Geophysics.]	Frank C. Canney
	[See Geochemistry, Mineralogy and Petrology.]	Robert R. Carlson
	[See Areal Geology.]	Pamela Dunlap Derkey

Economic Geology (*continued*)

	Mines and prospects computerized data base for Montana. Information on metallic mines and prospects in Silver Bow, Deer Lodge, and Lewis and Clark counties is being entered first—*continuing*.	Pamela Dunlap Derkey, Robert E. Derkey, Montana Bureau of Mines and Geology
	[See Areal Geology.]	Robert E. Derkey
	[See Geochemistry, Mineralogy and Petrology.]	Robert E. Derkey
166	Physicochemical conditions during formation of ore deposits, Boulder batholith region, Montana. [1990]	Robert E. Derkey, Montana Bureau of Mines and Geology; Hiroharu Matsueda, Akita University, Akita, Japan
	[See Geochemistry, Mineralogy and Petrology.]	L. J. Drew
167	Map showing mines, prospects and mineral occurrences in the Butte 1°x2° quadrangle. Also the development of ore deposit models to contribute to the mineral resource appraisal of the Butte quadrangle. [1986]	James E. Elliott, USGS, Denver, Colorado
	[See Geophysics.]	Donald P. Elston
168	Field studies of sulfide occurrences in the Stillwater Complex as part of a study of world nickel and cobalt resources—*continuing*.	M. J. Foose, USGS, Reston, Virginia
*169	Metal distribution in the Golden Sunlight deposit near Whitehall. [May 1987]	M. Gareau, A. J. Sinclair, University of British Columbia
	Bedded Precambrian iron deposits of southwestern Montana.	Harold L. James, USGS, Port Townsend, Washington
*170	The nature and distribution of gold and associated vein mineralization at the Red Pine mine, western Tobacco Root Mountains. [1986]	Teresa Kinley, Montana State University
	Study of Ravalli Group Cu, Pb, Zn, Ag mineralization in the eastern Belt basin—*continuing*.	Ian Lange, University of Montana
171	Geology of chromite. Includes geochemical investigation of the Stillwater Complex.	Bruce R. Lipin, USGS, Reston, Virginia
	Gold deposits in carbonate units of the Belt Supergroup. [1987]	Henry G. McClernan, Don C. Lawson, Montana Bureau of Mines and Geology
	Development of geochemical exploration techniques for stratabound Cu-Ag deposits in Montana. [October 1986]	Elwin L. Mosier, USGS, Denver, Colorado
	[See Geochemistry, Mineralogy and Petrology.]	Mike Paseczyk, Alex Volborth
	[See Stratigraphy, Sedimentary Petrology and Paleontology.	Forrest G. Poole

Economic Geology (*continued*)

	[See Geophysics.]	William A. Randall, Jr.
	[See Areal Geology.]	Mitchell W. Reynolds
	[See Isotope Geology and Geochronology.]	Robert O. Rye
	[See Geochemistry, Mineralogy and Petrology.]	Dan Stanley
	[See Geochemistry, Mineralogy and Petrology.]	Graham R. Thompson
	[See Isotope Geology and Geochemistry.]	Mark R. Wilson
	[See Geochemistry, Mineralogy and Petrology.]	Richard E. Zehner
	[See Geochemistry, Mineralogy and Petrology.]	Lester Zeihen
172	Magmatic sulfide deposits of the Stillwater Complex.	M. L. Zientek, USGS, Menlo Park, California

Energy

	[See Geochemistry, Mineralogy and Petrology.]	Theodore J. Armbrustmacher
	Data collection, validation and entry in the National Coal Resource Data System (NCRDS) in cooperation with the Montana Bureau of Mines and Geology—*continuing*.	M. D. Carter, USGS, Denver, Colorado
	Construction of a preliminary oil generation model for the Bakken Formation in Montana and North Dakota. [1987]	Ronald R. Charpentier, USGS, Denver, Colorado
	[See Geochemistry, Mineralogy and Petrology.]	Jerry L. Clayton
	[See Isotope Geology and Geochronology.]	Donald A. Coates, Edward L. Heffern
173	Geology and coal resources of the Terret Ranch area, Powder River County. [1986]	David Coppock, Bureau of Land Management, Billings
174	Geology and coal resources of the Tongue River area, northern Powder River County. [1986]	David Coppock, Bureau of Land Management, Billings
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	John A. Daniel, M. J. Barththolomew
	[See Stratigraphy, Sedimentrary Petrology and Paleontology.]	Pamela Dunlap Derkey
	Hydrocarbon field size-distribution studies for major reservoirs of Upper Cretaceous, Lower Cretaceous and Permian age in the Powder River basin. [1987]	Gordon L. Dolton, USGS, Denver, Colorado
	National Coal Resource Data System (NCRDS). This is a program of the USGS, in cooperation with State agencies, to establish a national computerized coal data base—*continuing*.	Jannette L. Downey, Edith M. Wilde, Montana Bureau of Mines and Geology

Energy (*continued*)

	[See Geophysics.]	Gunnar Emilsson, Dave Semmens, William Sill, Charles Wideman
	Environments of coal deposition in western interior coal basins. [1989]	Romeo M. Flores, USGS, Denver, Colorado
175	Coal resource assessment of the Terry Badlands Wilderness study area, Prairie County, Montana.	Judith S. Gassaway, USGS, Denver, Colorado
176	Geology and coal resources of the Kirby-Birney coal field, Big Horn and Powder River counties, northern Powder River basin. [1986]	Jim Gruber, Bureau of Land Management-Solid Minerals, Billings
177	Geology and coal resources of the Moorhead-East Moorhead coal field, Big Horn and Powder River counties. [1986]	Bill Hansen, Bureau of Land Management-Solid Minerals, Billings
	Water management, water policy and coal development in eastern Montana focusing on the Yellowstone and Tongue River basins—*continuing*.	David H. Hickcox, Ohio Wesleyan University
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	Roy Jensen
178	Coal resource potential of the Terry Badlands, Cow Creek-Antelope Creek and Burnt Lodge-Seven Blackfoot BLM wilderness study areas, east-central Montana. [1986]	Daniel A. Jobin, USGS, Denver, Colorado
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	Bion H. Kent
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	Edwin K. Maughan
	[See Areal Geology.]	Marguerite McClellan
*179	Oil and gas in overthrust terrains including the central and northern Tendoy Mountains, Beaverhead County. [1986]	William J. Perry, Jr., USGS, Reston, Virginia
	Petroleum geology and resource assessment of the Williston basin. [1987]	James A. Peterson, U.S. Geological Survey and University of Montana
	Geostatistical analysis of the coal resources of the Powder River basin. [1989]	Frances W. Pierce, USGS, Denver, Colorado
	Geology and oil and gas resource potential of the U.S. western overthrust belt. [1986]	Richard B. Powers, USGS, Denver, Colorado
	[See Structural Geology.]	Alan R. Roberts
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	Henry W. Roehler
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	James W. Schmoker

Energy (*continued*)

	Coal petrographic studies of Montana coals and correlation of petrographic data with chemical and sedimentologic data. [1986]	Mark A. Sholes, Montana Bureau of Mines and Geology
180	Coal crop, coal correlation and coal resources of the Baker and Wibaux 1:100,000-scale quadrangles. [1986]	Mark A. Sholes, Susan M. Vuke-Foster, Montana Bureau of Mines and Geology
	[See Stratigraphy, Sedimentary Petrology and Paleontology.]	Mark A. Sholes, Pamela Dunlap Derkey
181	A compilation of site-specific geothermal investigations including Jackson, Radersburg, White Sulphur Springs and Ennis. [December 1986]	John L. Sonderegger, Montana Bureau of Mines and Geology
	[See Geochemistry, Mineralogy and Petrology.]	Judi Todd, Doug Coe, Frank Diebold
182	Coal resource evaluation of the Baker, Glendive, Sidney and Wibaux 1:100,000-scale quadrangles.	Edith M. Wilde, Jannette L. Downey, Montana Bureau of Mines and Geology

Hydrogeology

183	Preliminary ground-water map of the Wolf Point 1°x2° quadrangle. [1986]	Robert N. Bergantino, Montana Bureau of Mines and Geology
184	Hydrogeologic evaluation of ground-water resources in Sullivan Flats basin, near Niarada, in the northwest corner of the Flathead Indian Reservation. [June 1987]	David Briar, University of Montana
185	A study of the physical and chemical interrelationships of the Clark Fork River and shallow valley aquifers from Warm Springs to Milltown. [October 1988]	Tom Brooks, USGS, Helena, Montana
*186	Study of the coarse bed load movement in Squaw Creek, Gallatin County. [Squaw Creek is a high-gradient mountain stream.] [June 1986]	Nicholas Bugosh, Montana State University
187	Potential effects of coal mining on dissolved solids in Hanging Woman Creek basin, southeastern Montana. [May 1988]	Mike Cannon, USGS, Helena, Montana
	Hydrogeologic field reconnaissance for suitable hazardous-waste-disposal areas in Montana. [Summer 1986]	Stephan G. Custer, Montana State University
188	Hydrochemistry of coal-mining areas in west-central United States. Includes West Decker and Big Sky mines in Montana. [September 1986]	Robert Davis, USGS, Helena, Montana

Hydrogeology (*continued*)

189	Hydrology of shallow aquifers along the northern flank of Little Rocky Mountains, Fort Belknap Indian Reservation. [September 1988]	Robert Davis, USGS, Helena, Montana
190	Ground-water quality in the Corbin-Wickes area, south-central Montana. [September 1986]	Robert Davis, USGS, Helena, Montana
191	Use of geomorphology and geophysical methods to locate buried stream channels beneath the Bozeman fan in the southeastern part of the Gallatin Valley. [June 1986]	David Donohue, Montana State University
	Hydrogeology of northeastern Montana—emphasis on ground-water development and conservation.	Joseph Donovan, Robert N. Bergantino, Marvin R. Miller, Wayne A. Van Voast, Montana Bureau of Mines and Geology; Joe E. Moreland, USGS, Helena, Montana
*192	Water monitoring of the Colorado tailings, Butte, pre- and post-reclamation. [December 1986]	Terence E. Duaime, John L. Sonderegger, Herman R. Moore, Marek Zaluski, Montana Bureau of Mines and Geology
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219	Glacial geology of the Boulder River valley above McLeod, Park and Sweet Grass counties. Includes only the area north of the Beartooth front, where deposition representing three stages of two glaciations has been identified on the basis of relative dating techniques. [June 1986]	Vance Drain, William Locke, Montana State University
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