SURVEY NOTES

VOL. 20 NO. 4 WINTER 1986
UTAH GEOLOGICAL AND MINERAL SURVEY

CUSMAP

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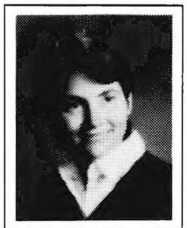


FROM THE DIRECTOR'S DESK

Two Utah Geologists

THIS issue of Survey Notes highlights CUSMAP, a U.S. Geological Survey program that includes state participants. The author of the lead article, Lehi Hintze, is familiar to most geologists working in Utah. Among his one hundred or so maps, articles, books, and contributions to guidebooks are the 1:500,000 scale Geologic Map of Utah and the handy reference Geologic History of Utah which he is in the process of revising. He retired from three decades of teaching at Brigham Young University and leading field geologic trips in western Utah, thus enabling him to join the UGMS. He is currently mapping Millard and Juab Counties as part of the UGMS county mapping program and as part of CUSMAP.

Another prolific worker in Utah's geology is William Lee Stokes. His book, *Geology of Utah,* has just been jointly published by the UGMS and the Utah Museum of Natural History. It is with pleasure that we offer it to all those interested in the man and his subject.

Geology of Utah

by Dr. William Lee Stokes

Jointly published by the Utah Museum of Natural History and the Utah Geological and Mineral Survey, 1986; 305 pages, 336 black and white photos, 182 drawings; price $12.00.

The Great Basin...The Colorado Plateau...The Middle Rocky Mountains... three areas as different from one another as any in the world. Yet they combine within the boundaries of one small state to make Utah a geologist's (and a sightseer's) dream come true. Possibly the only way to describe Utah in all its variety, whether the approach is geologic or any other, is through pictures. *Geology of Utah* will describe it to geologist, rockhound, and traveler equally well.

Until 1987 a large gap has existed in Utah's natural history literature. There has been no comprehensive, easy-to-read publication explaining the state's complicated and breathtaking geologic diversity. With the publication of Dr. William Lee Stokes' latest work, that gap has been filled.

Dr. Stokes has personally traversed most of Utah and knows it well. *Geology of Utah,* his interpretation of the events that have shaped the land, is assembled with care from half a century of involvement as teacher, archeologist, geologist, writer, and general man-about-Utah.

In laymen's terms, with the aid of 336 photographs and 182 drawings garnered from geologists, photographers, and land management professionals, Dr. Stokes tells the story with a clarity and insight that could only have been whispered by the rocks themselves.

Professional and amateur alike will find *Geology of Utah* to be one of the more useful reference books on the library shelf. The text is informative, the photographs intriguing—it makes you want to get out there and see the real thing. What more could one ask of a book?

"The rocks and scenery of Utah are my subject. They were a long time in the making and will endure a long time to come. To share the fascination of learning about them and understanding them to some degree is the purpose of this book."
... William Lee Stokes

CUSMAP MINERALS APPRAISAL

By Lehi F. Hintze

CUSMAP is one of those government acronyms that sounds worse than its good intentions merit. It derives from Conterminous United States Mineral Assessment Program, a program initiated in 1977 by the U.S. Geological Survey to provide an up-to-date assessment of the mineral resource potential of the lower 48 States. Under CUSMAP the geological, geochemical, geophysical, computerized data-bank, and satellite imagery expertise of the Geological Survey is focused on 2-degree quadrangle areas that have indications of economic resources, especially for strategic and critical minerals. Utah has already been the beneficiary of one such study, the 7,700 square-mile Richfield 2-degree quadrangle, now in the final stages of publication. And the Survey has just commenced comprehensive field study on a second 2-degree area, the Delta quadrangle. The two quadrangles include portions of nine counties in Utah as shown in Figure 1. Estimated date of completion of final reports for the Delta quadrangle is 1990, but interim reports on various aspects of the project will be made available meanwhile. At this stage of the federal CUSMAP program it is not common for a state to have been assigned more than one CUSMAP quadrangle. For Utah to have two is a recognition, not only of western Utah's mineral potential, but also of the very active role the Utah Geological and Mineral Survey plays in its own mineral appraisal program. (See UGMS Survey Notes, Fall, 1986: The Antelope Range Mining District Study—an integrated approach to mineral resource appraisal; also UGMS Survey Notes, Summer 1986: Kane County Geology.) UGMS geologists are cooperating fully with USGS specialists in order to bring about the greatest benefits, in terms of resource understanding, from the Delta 2-degree CUSMAP project. With the completion of both the Richfield and the Delta 2-degree areas, approximately one-sixth of the state of Utah will have received the scrutiny of the country's best experts on mineral potential. CUSMAP appraisals are not meant to be site specific, but the published results of the CUSMAP efforts will serve to focus private industry's exploration programs on target areas identified in the course of the survey.

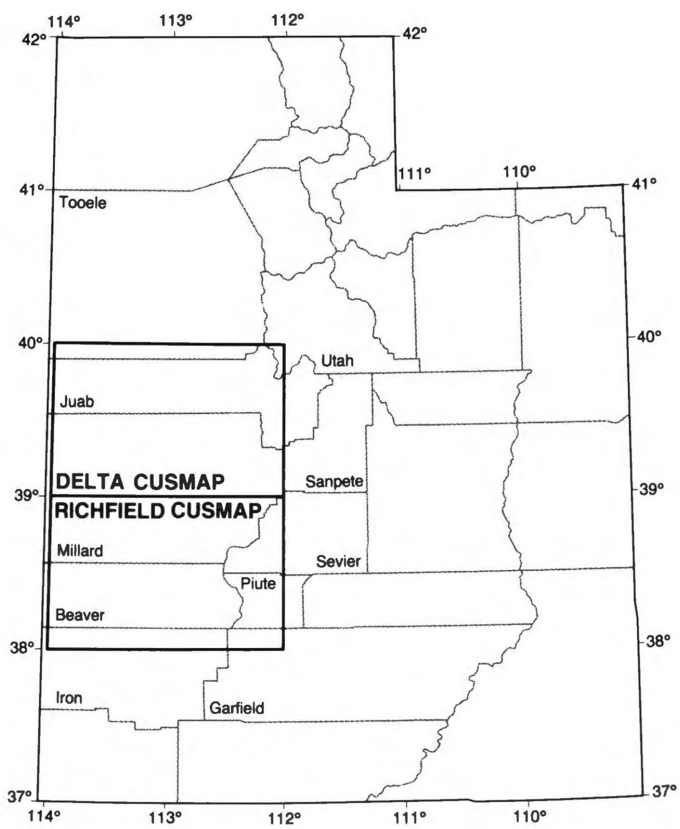


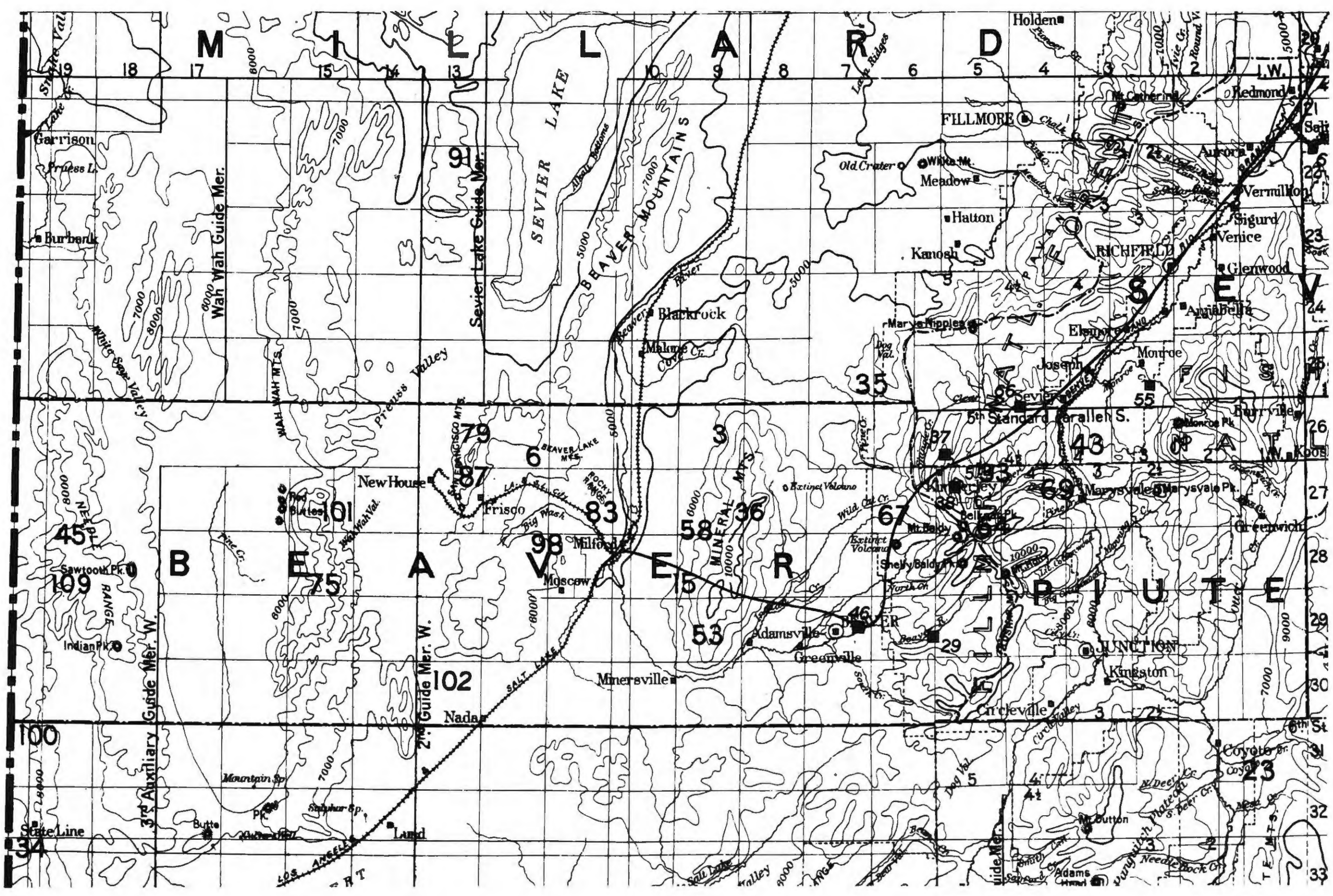
FIGURE 1. Map showing Delta and Richfield CUSMAP areas (bold outline) with respect to county boundaries.

In setting up the CUSMAP program a decade ago, Congress recognized that a dependable supply of strategic and critical minerals is basic to the economic vitality of our industrial society and to our national security. Accordingly, it is projected that ultimately as much as one-fourth of the United States, including perhaps one-half of the state of Utah will receive this concentrated mineral assessment. The user base of the program's products is broad and diverse. An experimental public meeting was held in Salt Lake City in December 1979 to present the preliminary results of CUSMAP investigations in the Richfield 2-degree quadrangle. This meeting was so well received that similar meetings have been and are being held in other states as other CUSMAP programs are completed. The published information on mineral resource potential resulting from these CUSMAP projects will be used directly by decision makers for setting national policy and by Federal, State, and local governments for land-use planning, environmental impact analysis, and resource management activities. These data are also used by private industry in planning and developing their mineral exploration programs. The geological, geochemical, and geophysical data generated by CUSMAP become a part of the reservoir of basic geoscience information that gives us our perception of the earth on which we live.

In current mineral resource research, high emphasis is placed on development of exploration and assessment techniques for concealed mineral deposits. For example, at Rico, Colorado, a major molybdenum-porphyry deposit is located 3,700′ beneath the surface. Yet the deposit can be detected two miles away by observing faint thermal changes in the minerals of rocks that are not obviously altered. Similarly, subtle changes in the mineralogy of igneous rocks in the Wah Wah Mountains of western Utah led to the delineation of a buried disseminated molybdenum ore body. Perhaps a brief summary of some of the results of the Richfield 2-degree CUSMAP project will serve to show how our understanding of a mineral belt can change as a result of new techniques, new field work, and new viewpoints.

UTAH CUSMAP I - RICHFIELD 2°

The Richfield 2-degree map area was selected as Utah's first CUSMAP project because a mineralized belt extends east-west across the entire quadrangle. This is evident on the 1920 map by B.S. Butler, from which Figure 2 was taken, that was included in his USGS Professional Paper 111 on the "Ore Deposits of Utah". Butler was also the author of the first comprehensive geologic report on a mining district within the Richfield quadrangle. His "Geology and ore deposits of the San Francisco and adjacent districts, Utah", published as U.S. Geological Survey Professional Paper 80 in 1913, followed the pattern established a few years earlier by J.M. Boutwell in his reports on the Bingham and Park City mining districts. In the next six decades about 100 significant technical papers were published that dealt with various aspects of the geology within the Richfield 2-degree quadrangle area. Nearly half of these papers were concerned with geology and mineralization in and around Marysvale. Marysvale came to life in January 1865 when Jacob Hess of Manti found placer gold there. Mining activity near Marysvale provided the impetus for extension of the Denver and Rio Grande Railroad from Manti to Marysvale in 1890. Over the years the Marysvale district has produced a little bit of a lot of different metals: gold, silver, lead, copper, mercury, manganese, aluminum, and uranium. Yet with all this activity, Marysvale has never attained enough production to rank with Utah's other major mining districts. The San Francisco (Frisco) district



3 Antelope	34 Gold Springs	45 Indian Peak	67 Newton	83 Rocky	100 State line
6 Beaver Lake	35 Garden	53 Lincoln	69 Marysvale	87 Frisco	101 Sterling
15 Bradshaw	36 Granite	58 McBarry	75 Pine Grove	91 Saw Back	102 Sulphur
33 Kimberly	43 Henry	64 Baldy	79 Newhouse	98 Star	109 Washington

FIGURE 2. Mining district (bold numbers) in the Richfield 2-degree quadrangle as shown on B.S. Butler's U.S. Geological Survey Professional Paper on the Ore Deposits of Utah. The smaller numbers near squares show the location of water-powered electric plants.

was more productive. It, too, attracted a rail line from the north, the Los Angeles and Salt Lake City Railroad. In its heyday at the turn of the century, several thousand people lived in the town of Frisco. Their water was hauled in on the railroad. Later the town of Newhouse was built on the west flank of the San Francisco mountains. It derived its water from an eight-mile siphon from springs in the Wah Wah Mountains to the west. The Frisco-Newhouse district was mostly worked out by World War II, although smaller mining operations have continued until recently.

The Richfield CUSMAP project accomplished several goals. In the decade from its start-up in 1977 to its near-completion at present (just a few reports remain to be published in their final form; all the basic data has been released in open-file or other forms) the project more than doubled the mineral appraisal information available for the area. More than two dozen modern geologic maps of 7 1/2-minute quadrangles have been published, mostly covering the Marysvale area and also the area of the southern Wah Wah Mountains and Needle Range. In conjunction with the new mapping, numerous radiometric ages have been obtained for the intrusive and volcanic rocks in the area. This has enabled geologists to work out the sequence of events that produced the voluminous cover of igneous rock that extends from the Marysvale area into Nevada. Volcanic deposits mostly accumulate in the immediate vicinity of a source volcano and form as irregular streams or piles of volcanic material. But several of the eruptions in southwestern Utah consisted of huge clouds of ash and pumices that were dispersed over thousands of square miles. When these individual ash layers are fingerprinted by mineralogical, magnetic and radiometric techniques they become valuable key horizons that enable volcanic rocks over wide areas to be related to one another in their proper sequence. One of the fundamental accomplishments of the Richfield CUSMAP project has been the establishment of the volcanic stratigraphy for southwestern Utah. This has been accomplished by the cooperation of a number of geologists with various affiliations and interests working on different aspects of the volcanic rocks.

Team leader for the Richfield CUSMAP was Thomas A. Steven, veteran of many years of geological study in the San Juan volcanic mountains of southwestern Colorado. Steven was joined in the work in central Utah by John J. Anderson of Kent State University and by Peter D. Rowley and Charles G. Cunningham of the U.S. Geological Survey. Anderson and Rowley had previously completed Ph.D. studies in southwestern Utah under the late J. Hoover Mackin, and all were involved in trying a make sense out of the complex volcanic relationships in the areas. These men spent the bulk of their efforts in the Marysvale volcanic field (See Figure 3) and emphasized the importance of key volcanic ash horizons in unraveling the volcanic history. They identified the calderas that were the sources of volcanic ash and debris. This was no mean feat, because the original volcanic mountains, craters, and calderas had long since been so completely eroded away that the source area could be pin-pointed only by painstakingly tracing the thickness changes of volcanic rocks back to the source areas where they are the thickest. The main calderas that were identified are shown on Figure 3.

Meanwhile, in western Utah, Professor Myron G. Best of Brigham Young University was spearheading an effort to sort out the volcanic rocks that were derived from different source calderas near the Utah-Nevada line. Cooperative efforts of Best

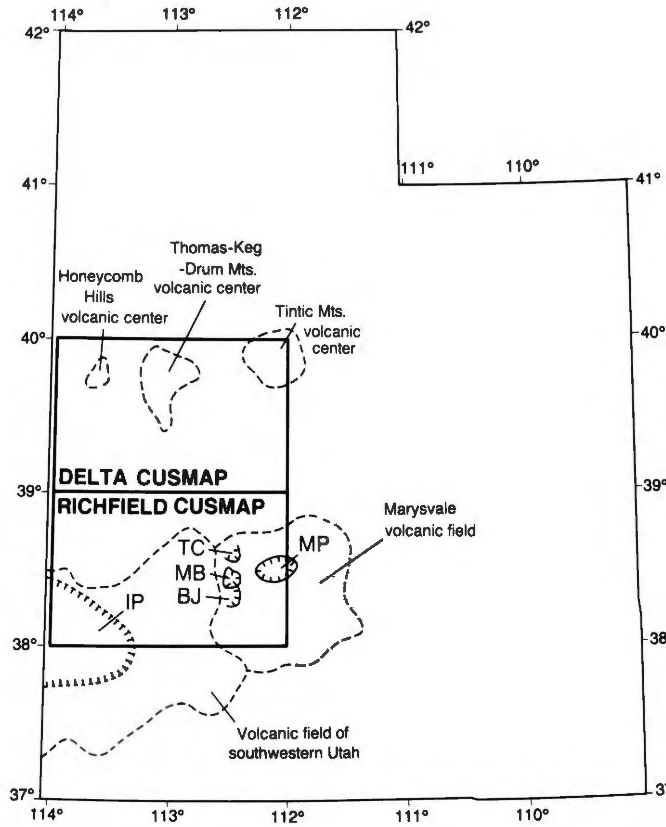


FIGURE 3. Volcanic fields of western Utah that are included in the Delta and Richfield CUSMAP areas. Calderas within the Marysvale volcanic field are:TC - Three Creeks caldera; MB - Mount Belknap caldera; BJ - Big John caldera; MP - Monroe Peak caldera; IP - Indian Peak caldera.

and Professor S. K. Grant of the University of Missouri at Rolla and members of the U.S. Geological Survey team resulted in the realization that the ash deposits from this western source (shown as the Indian Peak Caldera Complex on Figure 3) were among the most voluminous volcanic rocks of this type to have been erupted anywhere. From 33 to 26 million years ago the magma system astride the Utah-Nevada line broadcast 2,500 cubic miles of dacite and rhyolite ash flows over an area of 10,000 square miles, an area greater than the size of the Richfield 2-degree quadrangle.

Basic understanding of the volcanic processes that produced the igneous rocks in the Richfield CUSMAP area enabled reevaluation of the mineral potential of the Marysvale area. Exploration by Phelps-Dodge and Getty Oil in the Pine Grove area of the Wah Wah Mountains was done concurrently with the CUSMAP program. Getty geologists cooperated with Professor Best and the CUSMAP team in mapping of the geology in the vicinity of the prospect. Drilling by Getty outlined a large low-grade molybdenum body about 3,000' below the surface. Development of this ore body will await higher metal prices.

Persons interested in more detailed accounts of economic geology of the Richfield CUSMAP area might begin with the following articles which will lead to additional references if desired.

Selected Readings for the Richfield CUSMAP Area

Igneous Activity and Related Ore Deposits in the Western and Southern Tushar Mountains, Marysvale Volcanic Field, West-Central Utah, 1984, U.S. Geological Survey Professional Paper 1299, T.A. Steven, editor, 33 p.

Calderas of the Marysvale Volcanic Field, 1984, Journal of Geophysical Research, v. 89, p. 875-8764, by T.A. Steven and P.D. Rowley.

Tertiary Geology of the Area Between Milford, Utah and Pioche, Nevada, 1986, Utah Geological Association Publication 15, p.77-86, by M.G. Best.

Cenozoic Stratigraphic and Structural Framework of Southwestern Utah, 1979, U.S. Geological Survey Professional Paper 1149, by P.D. Rowley, T.A. Steven, J.J. Anderson, and C.G. Cunningham, 22 p.

Geology of the Milford Area, 1973, Utah Geological Association Publication 3, L.F. Hintze and J.A. Whelan, editors, 94 p.

UTAH CUSMAP II - DELTA 2°

Although the Delta 2-degree quadrangle adjoins the Richfield quadrangle and, like Richfield, consists mostly of basin-and-range country, there are some important differences from a minerals appraisal standpoint. As shown on Figure 4, a greater portion of the Delta quadrangle is covered by desert valleys; there is less bedrock exposed. But, a greater proportion of the exposed bedrock is sedimentary strata which may act as host rocks for metalliferous deposits, but which seldom act as primary generators for metals. Figure 3 shows that there are three volcanic centers that are aligned across the Delta quadrangle: the Tintic Mountains, Thomas-Keg-Drum, and Honeycomb Hills centers. These have been the primary centers for mineralization. Other igneous areas shown on Figure 4 include Mesozoic granitic bodies and Quaternary basaltic volcanos that have not produced significant ore mineralization. Perhaps the most significant aspect of the Delta 2-degree quadrangle is that it includes one of Utah's historic major mining districts, the East Tintic district, which has produced a quarter-billion dollars worth of lead, zinc, silver, gold, copper, cadmium, and manganese. In addition, the Delta quadrangle is host to the world's largest beryllium mine, presently producing ore from an open pit on the west side of the Thomas Range.

Present geologic relationships in western Utah are a product of a succession of sedimentary, volcanic, and structural events that have occurred over the last billion years. the generalized history of the area is as follows:

- ONE BILLION TO 200 MILLION YEARS AGO: The area that was to become western Utah was under shallow seas and resembled offshore Texas of today. Thousands of feet of marine limestone, dolomite and lesser amounts of shale and sandstone accumulated in shallow-water conditions as the sea floor subsided under the weight of the build-up of sediments.
- 200 MILLION TO 40 MILLION YEARS AGO: Marine deposition ceased and the sea floor was lifted up to form a broad north-south mountain chain something like the modern Andes. The eastern edge of this mountain chain was near the east edge of the Delta quadrangle; the western edge of the mountain chain was in central Nevada. During the creation of this new mountain chain, the marine sediments that had been deposited earlier were faulted, folded, and cut by a few granitic intrusions (for example, the granite in the House Range shown on Figure 4). River systems that eroded this mountain chain carried their debris mostly eastward and deposited it in eastern Utah, Wyoming and Colorado. Uplift of the mountains amounted to many thousands of feet.

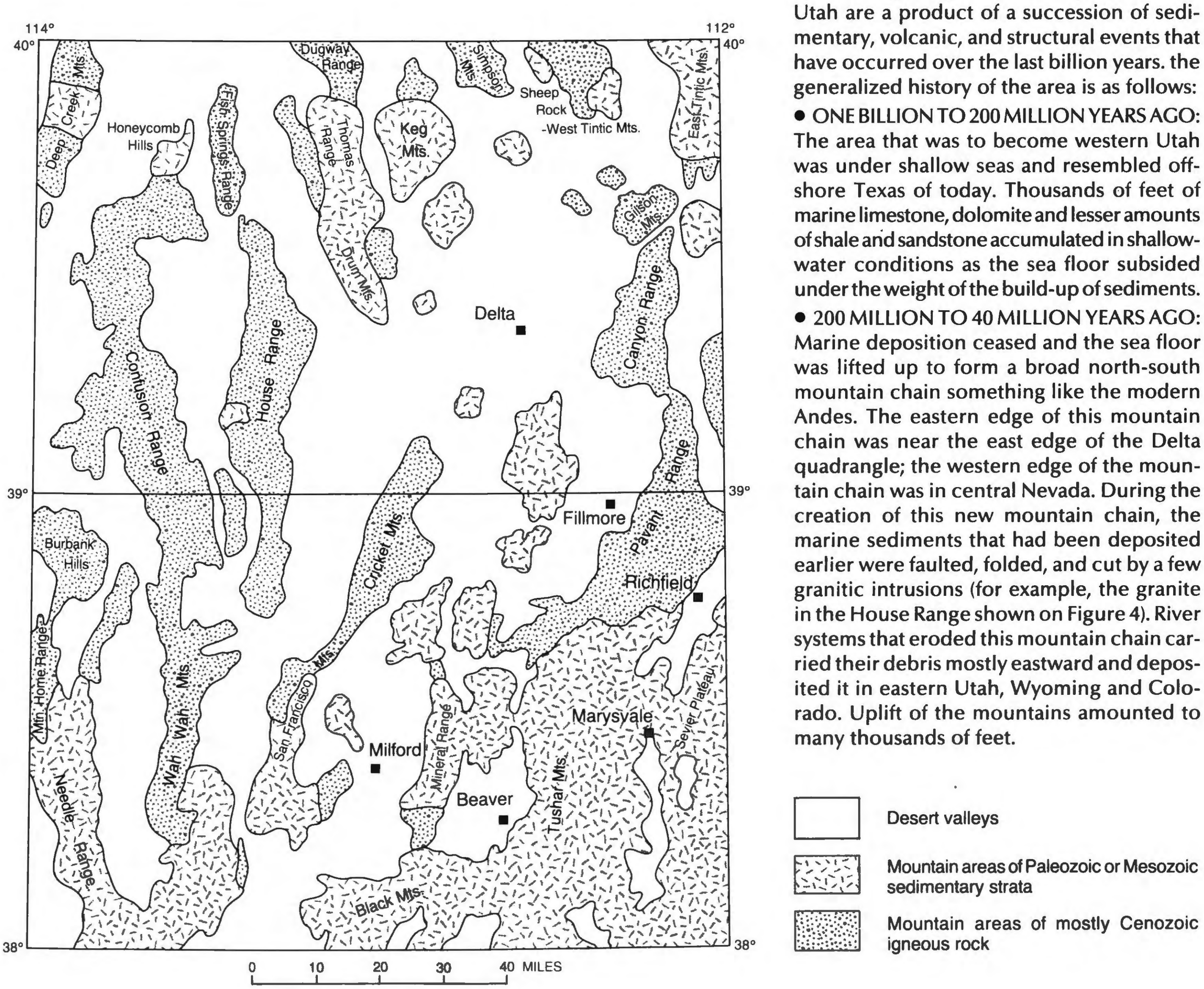


FIGURE 4. Generalized geologic map of the Delta and Richfield 2-degree quadrangles, 110 miles east-west by 140 miles north-south.

• 40 MILLION TO 15 MILLION YEARS AGO: From the standpoint of mineral deposits, this was the most significant time in western Utah's history. Beginning in latest Eocene time, about 42 million years ago, volcanic activity dominated the geologic events in western Utah for the next 25 million years. These volcanic rocks rest everywhere across the eroded edges of deformed Paleozoic and Mesozoic strata. In the East Tintic mining district extensive igneous rocks were derived from an Oligocene composite volcano, active mostly between 32-33 million years ago. Although the volcano itself has been long since eroded away, its root system is exposed in the many dikes, plugs, and sills that cut the mining district area. The last volcanic activity in the East Tintic district was emplacement of a large dike and flow unit about 18 million years ago.

In the Thomas-Keg-Drum mountains area the volcanic rocks that erupted between 42-39 million years ago are rhyodacitic to quartz latitic in composition; those formed between 38-32 million years are rhyolitic; those dated at 21 million years are alkali rhyolites that bear beryllium; the volcanic rocks that range from 8 to 5 million years in age include basalts and the topaz-bearing rhyolites of Topaz Mountain. The magma chamber beneath this area yielded different products during its different eruptions and it is critical to mineral prospecting to understand which of the many events were productive of ore minerals. Mineralization associated with volcanism in this area has resulted in commercial production of fluorite, beryllium, uranium, manganese, and gold.

The Honeycomb Hills is the smallest of the volcanic centers in the Delta CUSMAP area. Its volcanic rocks range from 3 to 33 million years in age. The older rocks came as ashfalls from centers in Nevada and southwest Utah; the local center was active between 7 and 3 million years ago and produced topaz-bearing rhyolite. No commercial deposits have been produced from this center.

• 15 MILLION YEARS AGO TO THE PRESENT TIME: From its beginning 40 million years ago, volcanism has continued intermittently up until almost the present; basaltic lavas in the desert west of Fillmore range in age from about one million to about 1,000 years. Within the last 15 million years another process, faulting, has transformed the Delta and Richfield map areas into the basin-and-range topography that we see today. The mountains have moved upwards and the valley areas downward along fault zones similar to the Wasatch Fault. These trend generally north-south and the cumulative offset on each of them is several thousand feet. Erosional products from the mountains are deposited in the valleys. Anyone who drives through the area will spend much of the time driving over large alluvial fans that spread out from each canyon mouth along range fronts. The fill beneath the valley surface is made up of materials similar to those exposed on the surface: alluvial fan, playa lake, sand dune, and volcanic deposits interlayered, often to depths of several thousand feet, in major valleys. The basin-and-range faulting is produced by extension, or stretching, of the earth's crust. The enigma of exactly what lies beneath each valley floor is the challenge to the CUSMAP team. Understanding of subsurface relationships in the Delta 2-degree area has been enhanced by a deep seismic survey called COCORP that government-sponsored scientists ran recently across the entire Delta quadrangle. Interpretation of the seismic record is still under study. A few oil exploration wells have been drilled in the area, but not enough drilling has been done yet to yield unequivocal interpretations. Extending geologic relationships seen at the surface into the subsurface by means of geophysical, geochemical or any other rational means is the name of the game.

CUSMAP study of the Delta 2-degree quadrangle begins with a broader base of already published geologic data than did the Richfield study. a greater portion of the Delta area is now covered by published 7 1/2-minute geologic quadrangle maps, and there are numerous reports on the various economic mineral aspects of the area. Nonetheless, it is expected that the CUSMAP team effort will substantially improve our understanding of this area and will likely modify some of the ideas concerning this area that are currently held. The Utah Geological and Mineral Survey is contributing to the data base of the area by concurrently preparing comprehensive geologic reports on Millard and Juab counties. These will be accompanied by summary geologic maps on a scale of 1:100,000 that will show geologic features in these two counties more completely than ever before. Information generated during both studies will aid commercial explorationists in their site-specific studies by providing better understanding of the geologic history and better mineralization models of this interesting and complex area. For those who wish to pursue the economic possibilities of the Delta quadrangle further, the following list is provided:

Selected Reading for the Delta CUSMAP Area

General Geology and Mines of the East Tintic Mining District, Utah and Juab Counties, Utah, 1979, U.S. Geological Survey Professional Paper 1024, by H.T. Morris and T.S. Lovering, 203 p.

Geology and Mineral Deposits of the Thomas and Dugway Ranges, Juab and Tooele Counties, Utah, 1964, U.S. Geological Survey Professional Paper 415, by M.H. Staatz and W.J. Carr, 188 p.

Beryllium deposits in the Spor Mountain Area, Juab County, Utah, 1984, by L.J. Davis, Utah Geological Association Publication No. 13, p. 173-183.

Tertiary Volcanic Rocks and Uranium in the Thomas Range and Northern Drum Mountains, Juab County, Utah, 1982, U.S. Geological Professional Paper 1221, by D.A. Lindsey, 71 p.

Memorandum of Progress, Delta 2-Degree CUSMAP:Overview of Geologic Aspects of the Delta, Utah 2-degree Quadrangle Area, 1986, Utah Geological and Mineral Survey Open-File Report 96, by Lehi F. Hintze, 29 p. maps.

GREAT SALT LAKE LEVEL

Date (1987)	Boat Harbor South Arm (in feet)	Saline North Arm (in feet)
Jan 1	4211.20	4210.35
Jan 15	4211.35	4210.50
Feb 1	4211.40	4210.50
Feb 15	4211.55	4210.70
Mar 1	4211.65	4210.75
Mar 15	4211.75	4210.90
Apr 1	4211.85	4210.85
Apr 15	4211.85	4210.95
May 1	4211.70	4210.95
May 15	4211.65	4210.85

Source: USGS provisional records.

GEOLOGIC PROJECTS IN UTAH
Conducted in Summer/1987

In 1986 a request form was sent to each graduate school of geology in the United States, asking for the location and a brief description of geologic mapping projects and other types of geologic studies planned for the summer of 1987 in Utah. The responses were reported and computerized, and are listed below. Included in this information are: 1) geologist/ nvestigator; 2) school or organization; 3) county or counties in which work was done; 4) type of study; 5) specific geologic areas; and 5) map scale.

A new request form will appear in a later issue of Survey Notes for a description of projects planned for the summer of 1988. We would appreciate receiving your reply as soon as possible; this list will be printed in Survey Notes to provide information on geologic areas before the next field season starts. If you need more forms, please let us know.

No	Geologist/Investigator	Organization	County(ies)	Type of Study	Location	Map Scale
1	Clayton, R.; Kowallis, B.J.; Best, M.J.	Brigham Young Univ	Beaver, Iron, Millard	structural geology; paleostress analysis of faults	Wah Wah Mtns, Star Range, Shauntie Hills	
2	Geissman, J.W.	Univ of New Mexico	Beaver, Millard, Utah	petrology; paleomagnetic/rock magnetic strikes	Mineral Mtns, Wasatch Mtns	
3	Nielson, R.L.	Stephen F. Austin State Univ	Beaver, Kane, Wasatch	stratigraphy; Lake Parowan pluvial lake	south-central Utah, central Utah, southwestern Utah	
4	Paull, R.K.; Paull, R.A.	Univ Wisconsin - Milwaukee	many counties	biostratigraphic study; detailed section analysis; paleontology; stratigraphy	southern, western, northern Utah	
5	Ren, X.; Kowallis, B.J.: Best M.J.	Brigham Young Univ	Beaver, Iron, Juab, Millard, Tooele	structural geology; microcrack orientations in intrusives	western Utah	
6	Robison, R.A.	Univ of Kansas	western and northern Utah	paleontology; stratigraphy		
7	Levy, M.	Lamont - Doherty Geol Observ of Columbia Univ	Box Elder, Juab, Millard, Tooele, Weber	rifting; sedimentology and mapping; geochemical analysis of volcanics; stratigraphy; structural geology; geologic mapping	Huntsville area, Promontory Range, Sheeprock Mtns, E Tintic Mtn, Dugway Range, Drum Mtns, San Francisco Range, Wah Wah Mtns, Canyon Range	30000
8	McCalpin, J.	Utah State Univ	Box Elder, Juab, Salt Lake, Utah, Weber	neotectonics; detailed dating of samples from Wasatch Fault trenches; structural geology; Quaternary soils	Wasatch Fault from Nephi to Brigham City	
9	McCalpin, J.	Utah State Univ	Box Elder, Juab, Salt Lake, Utah, Weber	neotectonics; detailed statistical analysis of past fault rupture patterns; setback recommendations; structural geology; engineering geology	Wasatch Fault from Nephi to Brigham City	
10	Miller, D.	USGS	Box Elder, Tooele	geologic mapping; tectonics of northwest Utah	Brigham City	100000
11	Rice, K.C.	Utah State Univ	Box Elder, Cache	hydrogeology; hydrochemistry; detailed fracture analysis and water quality data; reconnaissance; hydrogeologic mapping with field checking	Mantua Valley	24000
12	Bryant, B.	USGS	N central Utah	Wasatch-Uinta tectonics; geologic mapping	Uinta Mtns, Uinta Basin, Wasatch Mtns, Wasatch hinterland, Lake Mtns, Utah and Salt Lake Valleys	250000
13	McCalpin, J.	Utah State Univ	Cache	neotectonics; Late Quaternary tectonics and earthquake hazard; geologic mapping; environmental geology; structural geology; Quaternary soils	Cache Valley, Bear River Range	50000
14	Nelson, M.	Fort Hays State Univ	Cache, Davis, Salt Lake, Utah, Weber	Palentology; Lake Bonneville shoreline sediments	Wasatch Range west front	
15	Webster, G.D.	Washington State Univ	Cache, Morgan, Rich, Weber	paleontology; systematic biostrat - lower carboniferous crinoids	northern Wasatch Range, Bear Range, Wellsville Mtn	
16	Jepsen, K.; Nelson, M.E.	Fort Hays State Univ	Carbon	economic geology (coal); sedimentology; stratigraphy (Blackhawk, Star Point) Cretaceous	East Mtn, Wasatch Plateau	
17	Kowallis, B.J.	Brigham Young Univ	Carbon, Daggett, Emery, Grand, Sevier, Uintah, Wayne	geochronology; fission track dating		
18	Remy, R.R.	Louisiana State Univ	Carbon, Duchesne, Uintah	paleontology; sedimentology; mineralogy	south-central Uinta Basin (west of the Green River)	
19	Rienersma, P.E.	Univ of Utah	Carbon	sedimentology; stratigraphy	Castle Valley, north and east edge San Rafael Swell	

No	Geologist/Investigator	Organization	County(ies)	Type of Study	Location	Map Scale
20	Everitt, B.	Utah Div Water Resources	Daggett, Sanpete, Uintah	detailed logging; photo-logging; engineering geology	Calder Reservoir, Huntington Dam, Roftson Reservoir	
21	Ekdale, A.A.	Univ of Utah	Duchesne, Tooele, Utah	ichnology; paleontology; sedimentology	northern Utah	
22	Nelsen, M.E.; Madsen, J.H., Jr.	Fort Hays State Univ	Duchesne	paleontology	Uinta Basin	
23	Blakey, R.C.	Northern Arizona Univ	Emery, Grand, San Juan, Wayne	sedimentology; stratigraphy	southern Utah, northern Arizona	
24	Caputo, M.V.	Mississippi State Univ	Emery, Grand, Kane, San Juan, Wayne	sedimentology; stratigraphy; basin analysis	Table lands-Kane Co., San Rafael Swell, Green River Desert, Henry Mtns-Water Pocket Fold, Canyonlands	
25	Chan, M.A.	Univ of Utah	Emery, Grand	sedimentology; stratigraphy; petrology	Crescent Junction, Green River, Gunnison Butte	
26	Nelson, M.E.; Hunter, D.	Fort Hays State Univ	Emery	geologic mapping; paleontology; stratigraphy	San Rafael Swell	24500
27	Nelson, M.E.; Madsen, J.H., Jr.	Fort Hays State Univ	Emery	paleontology; biostratigraphy	San Rafael Swell	
28	Neuhauser, K.R.	Fort Hays State Univ	Emery	structural field mapping; stratigraphy	Cedar Mtn, northwestern San Rafael Swell	24000
29	Ochs, S.	Univ of Utah	Emery	sedimentology; depos. environ. interpretation	east-central San Rafael Swell	
30	Soulliere, S.J.	USGS	Emery, Grand	assessment of potential mineral resources	Horseshoe Canyon, Lost Spring Canyon	
31	Yingling, V.	Univ of Wyoming	Emery, Garfield, Juab, Sanpete, Sevier, Wayne	tectonics and sedimentation	San Rafael Swell, Waterpocket Fold, Gunnison Plateau, Kaiparowits Plateau	
32	Kamola, D.	Univ of Utah	Garfield, Wayne	sedimentology; stratigraphy	south-central Utah	
33	Lundin, E.R.	Univ of Arizona	Garfield	geologic mapping; structural geology	Bryce Canyon National Park region	24000
34	Walton, A.W.	Univ of Kansas	Garfield, Piute	sedimentology; paleovolcanology	Sevier Plateau	
35	Bartsch-Winkler, S.; field party	USGS	Garfield, Kane	geologic reconnaissance for Wilderness report	Escalante River area	
36	Gernant, R.E.; Schlipp, W.	Univ of Wisconsin - Milwaukee	Grand, Wayne	paleoenvironments; paleontology; stratigraphy	canyons of the Colorado and Green	
37	Langford	Univ of Utah	Grand, San Juan	sedimentology		
38	Grant, S.K.	Univ of Missouri - Rolla	Iron	detailed mapping; general geology; geology mapping	near Cedar City	24000
39	Sable, E.; field party	USGS	Iron	general geology	Cedar City, Escalante, Page areas	
40	Sable, E.; Sanchez, J.D.	USGS	Iron	geologic mapping; sedimentary environment studies	Cedar City area; Kaiparowits Plateau	250000
41	Connor, J.	USGS	Juab, Millard	reconnaissance examination and sampling of Precambrian rocks	Canyon Range, East Tintic Mtns, Simpson Mtns, Deep Creek Range	
42	de Vries, R.	Northern Illinois Univ	Juab, Sanpete, Utah	petrology; geochemistry; petrology; volcanology	Wasatch Plateau	
43	Morrow, J.R.	Washington State Univ	Juab, Millard	paleontology; petrology; biostratigraphic sampling	Granite Mountain and the northern Confusion Range	
44	Sorensen, M.	USGS	Juab, Utah	geologic mapping	southern Wasatch Range, central Utah	24000
45	Webster, G.D.	Washington State Univ	Juab	paleontology	Confusion Range	
46	Weiss, M.P.	Northern Illinois Univ	Juab, Sanpete	geologic mapping; stratigraphy; structure	Juab-Sanpete area, SW Uinta Basin	24000
47	Ekstrand, E.J.; Butler, R.F.	Univ of Arizona	Kane	paleomagnetic	Vermillion Cliffs east of Kanab	
48	Oviatt, C.G.	Kansas State Univ	Millard	Quaternary geology	Black Rock Desert	100000
49	Sack, D.	Univ of Utah	Millard, Juab	Quaternary geology	Tule Valley	100000
50	Davis, F.D.	Utah Geological and Mineral Survey	Millard	Quaternary geology	Whirlwind Valley - Red Knolls area, Ferguson Desert	100000
51	Hintze, L.	Utah Geological and Mineral Survey	Millard	stratigraphy; structure	Burbank Hills	100000
52	Lindsey, D.A.; field party	USGS	Millard	geological field checking; geophysical mapping; sampling for geochemical alteration, petrologic, and isotopic studies	Delta, Utah	250000
53	Nelson, M.E.; Fuchs, W.	Fort Hays State Univ	Millard	paleontology		

No	Geologist/Investigator	Organization	County(ies)	Type of Study	Location	Map Scale
54	Dunlap, W.J.	Univ of Minnesota Duluth	Morgan	detailed structure/microstructure	Francis Peak	
55	Bowman, J.R.	Univ of Utah	Salt Lake	geologic mapping; economic geology; geochemistry; mineralogy; hard-rock geology; petrology	Alta	2400
56	Jackson, A.L.	BLM-Moab	San Juan	geologic mapping; economic geology; detailed sub-surface facies analysis	Blanding basin	24000
57	Aubrey, W.; field party	USGS	SE Utah	stratigraphic and sedimentologic studies	NW New Mexico, SW Colorado, SE Utah	
58	Dubiel, R.; field assistant	USGS	SE Utah	sedimentology		
59	Fred Peterson; field party	USGS	SE Utah	stratigraphic, sedimentologic, and paleotectonic studies		
60	Bossart, K.	Univ of Utah	Tooele	paleontology, sedimentology, stratigraphy	Stansbury Island, Stansbury Mtns, southern Lakeside Mtns	
61	Davis, L.E.	Washington State Univ	Tooele	paleontology; sedimentology; stratigraphy	Oquirrh Mtns	
62	Harlick, A.J.	Univ of Utah	Tooele	sedimentology; paleoecology; ichnology depositional environment	Lakeside Mtns	
63	Connor, J.; field party	USGS	Uintah	mineral appraisal	Diamond Peaks west of Dinosaur National Monument	
64	Scott, R.W., Jr.; Pantea, M.	USGS	Uintah	geologic mapping; sedimentologic studies	Douglas Creek area and adjacent areas	
65	Benson, A.K.	Brigham Young Univ	Utah	engineering geology; geophysics; structural geology; fault detection; close-order gravity surveys	Wasatch Mtns, Utah Valley, West Mtns	
66	Nelson, M.E.	Fort Hays State Univ	Wasatch	paleontology	Wasatch Range	
67	Bowling, D.L.	Univ of Utah	Washington	economic geology; geochemistry		
68	Nielson, D.R.	Brigham Young Univ	Washington	economic geology; geochemistry; paleontology; stratigraphy; paleoenvironmental	Basin-Plateau transition	
69	Van Loenen, R.; field party	USGS	Washington	BLM Wilderness Mineral Resource evaluations	vicinity of Zion National Park	
70	Schlinger, C.M.	Univ of Utah	Wayne	geophysics; gravity and magnetic surveys of dikes and sills	Willow Wash	
71	Dott, R.H.	Univ of Wisconsin Madison		sedimentology of the lower Oquirrh Formation		
72	Peterson, M.S.	Brigham Young Univ		paleontology; stratigraphy; biostratigraphy		
73	Beget, J.E.	Univ of Alaska		Quaternary soils; sedimentology; hydrology; paleohydrology; Quaternary stratigraphy		
74	Jensen, M.E.	UGMS	Box Elder	geologic mapping		24000
75	Lowe, M.V.	Davis/Weber county geologist	Cache	geologic mapping	Smithfield quad	24000
76	Mork, A.	Eastern Washington Univ	Cache	geologic mapping	Boulder Mtn quad	24000
77	Berry, L.	Brigham Young Univ	Cache	geologic mapping	Porcupine Reservoir quad	24000
78	Robinson, J.	Cornell Univ	Tooele	geologic mapping	Gold Hill quad	24000
79	Proctor, P.D.	Brigham Young Univ	Iron	geologic mapping	Antelope Peak quad	24000
80	Klauk, R.H.	UGMS	Sevier	environmental geology; engineering geology	county-wide	
81	Fong, A.W.	Northern Illinois Univ	Sanpete	geologic mapping	Fountain Green South	24000
82	Mattox, S.R.	Northern Illinois Univ	Sanpete	geologic mapping	Gunnison	24000
83	Willis, G.	UGMS	Sanpete, Sevier	geologic mapping	Redmond Canyon, Aurora, Sigurd, Richfield	24000
84	Chitwood, J.P.	Kansas State Univ	Grand	geologic mapping	Hatch Mesa	24000
85	Goydas, M.J.	Kansas State Univ	Grand	geologic mapping	Fisher Valley	24000
86	Jackson, M.	Hawaii Volcano Observatory	Garfield	geologic mapping	Copper Creek Benches	24000
87	Nelson, S.	Brigham Young Univ	Sevier	geologic mapping	Geyser Peak	24000
88	Doelling, H.H.	UGMS	Kane	geologic mapping	Rainbow Point, Calico Peak, Elephant Butte	24000
89	Harty, K.M.	UGMS	all counties	environmental geology; engineering geology; landslide inventory		500000

No	Geologist/Investigator	Organization	County(ies)	Type of Study	Location	Map Scale
90	Harty, K.M.	UGMS	all counties	environmental geology; engineering geology; surface hydrology		750000
91	Hecker, S.	UGMS	all counties	shallow ground water hydrology; structural geology; Quaternary fault map		500000
92	Christenson, G.E.	UGMS	all counties	enginnering geology; seismic hazards		750000
93	Tripp, B.; Mayes, B.	UGMS	all counties	economic geology (zeolites)		
94	Clark, D.L.	Northern Illinois Univ	Juab	geologic mapping	Juab quad	24000
95	Biek, R.F.	Northern Illinois Univ	Juab	geologic mapping	Nephi quad	24000
96	McDermott, J.G.	Northern Illinois Univ	Juab	geologic mapping	Levan	24000
97	Auby, W.	Northern Illinois Univ	Juab	geologic mapping	Chriss Canyon	24000
98	Banks, R.L.	Northern Illinois Univ	Sanpete	geologic mapping	Fountain Green North	24000
99	Mulvey, W.	UGMS	Davis, Wasatch, Washington	environmental geology; engineering geology	statewide studies	
100	Sprinkel, D.	UGMS	central Utah	stratigraphy; paleontology	central Utah	
101	Lund, W.R.	UGMS	Salt Lake	engineering geology	Salt Lake Valley	
102	Lund, W.R.	UGMS	Duchesne	engineering geology	SW Uinta Basin region	

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GREAT SALT LAKE TIDES

By Don R. Mabey

SIGNIFICANT diurnal tides do not occur on Great Salt Lake, but wind tides and seiches (oscillating waves) are common. Lin and Wang in "Wind Tides of the Great Salt Lake" (1978) report that winds from the south or west in excess of 10 knots lasting for more than 12 hours are required to excite major seiching when the wind declines. The records of lake level in the Black Rock area at the south end of the lake and at Promontory Point at the east end of the Southern Pacific causeway, and the wind velocity at Salt Lake City airport for late January 1969 show a seiching event. For about 12 hours the wind blew from the south with an average velocity of 25 knots. The lake level at the south end of the lake declined about 1.0 foot while at Promontory Point the level rose about 0.8 foot. When the wind velocity decreased to less than 10 knots, seiching started.

On the first cycle, the lake level at the south end of the lake rose about 2.5 feet to a level about 1.5 feet above the static level. At Promontory Point the level dropped about 1.8 feet to about 1.0 foot below the static level. Oscillations continued with decreasing amplitude for 8 cycles with a period of approximately 6 hours.

The period of the oscillations is dependent upon the configuration of the lake. It increases or decreases as the lake level rises and falls and as structures are built that restrict the movement of lake water. When the Southern Pacific causeway was built, it reduced the seiching period from 9 hours to 6 hours. The amplitude of the seiche is a maximum at the margins of the lake where the wind tides that produced the seiche are greatest and near zero at a nodal area between.

Seiching can also be initiated by a lake surge caused by an earthquake. Such a surge was produced by an earthquake at the north end of Great Salt Lake in 1909. Newspaper reports indicate that water washed over the Southern Pacific Railroad tracks on the Lucin Cutoff and over the bath house pier at Saltair. There are no records to indicate the amplitude of the surge or the resulting seiching.

N·E·W P·U·B·L·I·C·A·T·I·O·N·S

Maps

Map 87, *Geologic map of Capitol Reef National Park and vicinity, Utah*, by G. Billingsley, P.W. Huntoon, and W.J. Breed, 1987, scale 1:62,500, full color, four map sheets and one explanation sheet, 130" x 30". Price $8.00.

A production number. This is a beautiful wall map (nearly 7 feet high for the map alone) covering a structurally and geologically complex part of Utah. It affords insight into the development of the features that made the area a logical choice for a national park. Two cross sections, 11 photographs, and an explanation sheet supplement the map.

Map 98, *Provisional geologic map of the Hells Kitchen Canyon SE quadrangle, Sanpete County, Utah*, by S.R. Mattox, 1987, 2 plates, color, 1:24,000, 17 page booklet. Price $4.00.

A thesis map in the UGMS quadrangle series, this study covers an area with some of the most complex structures in the Gunnison Plateau and outcropping rocks ranging from Late Cretaceous to Tertiary.

Map 100, *Geologic map of Grand County, Utah* postcard, by H.H. Doelling, color, 4 x 5, 1987. Price $0.25.

Map 101, *Geologic map of Kane County, Utah* postcard, by H.H. Doelling, color, 5 x 7, 1987. Price $0.25.

Map 102, *Geologic map of Arches National Park* postcard, by H.H. Doelling, color, 5 x 7, 1987. Price $0.25.

Open-File Reports

Open-File Report 104, *Geology and mineral potential of the Antelope Range Mining District, Iron County, Utah*, by M.A. Shubat and W.S. McIntosh.

Special Studies

Special Study 69, *Contributions to economic geology in Utah - 1986*, with two articles: *Roof geology and coal seam characteristics of the No. 3 Mine, Hardscrabble Canyon, Carbon County, Utah*, by M.D. Bunnell, and *Petrology and geochemistry of the O.K. copper-molybdenum deposit, Beaver County, Utah*, by T.W. Taylor, 1987, 39 pages. Price $4.00.

Two shorter papers concerned with mining economics. The first is Mark Bunnell's study of the No. 3 Mine's geology and structure to understand roof and seam conditions. He concludes that the findings can be used to anticipate unstable areas, thereby resulting in improved production and mine safety. Ted Taylor's study of the O.K. deposit concentrates on understanding the genetics of the deposit in relation to other known moly and copper deposits.

Reports of Investigation

Report of Investigation 213, *Investigation of potential geologic hazards near the Thistle landslide, Utah County, Utah*, by G.C. Willis, 24 pages. Price $2.00.

Questions concerning the Thistle Landslide of 1983 keep recurring due to the unanswered problem of "what to do with it." Willis considers one of those questions in this report: a USGS geologist, Irving Witkind, expressed concern about geologic problems if a dam and reservoir were to be constructed upstream from the slide area. Willis has evaluated this concern.

Report of Investigation 214, *Study of landslides west of the K & J Subdivision in Snake Creek Canyon, Wasatch County, Utah*, by R.H. Klauk and W. Mulvey, 28 pages. Price $3.50.

In response to a request about past and future landslides in an area being considered for development, Klauk and Mulvey of the Site Investigation Section have assessed and summarized the geologic potential.

Report of Investigation 215, *Technical reports for 1986, Site Investigation Section*, compiled by W. Mulvey, 158 pages. Price $5.50.

This collection of technical reports represents a large part of the work done by UGMS Site Investigation personnel to help the citizens and decision makers of Utah to understand geologic hazards and to avoid them.

Bulletins

Bulletin 123, *High-temperature geothermal resources of Utah,* by D.R. Mabey and K.E. Budding, 1987, 64 pages. Price $7.00.

This study updates previous work on high-temperature resources in Utah in defining the area, evaluating the resources, determining which exploration techniques are useful in Utah, and suggesting further exploration. A companion report is the "Annotated Geothermal Bibliography of Utah" compiled by K.E. Budding and M.H. Bugden as Bulletin 121, 1986, 82 pages, $5.00.

Circulars

Circular 79, *Suggested approach to geologic hazards ordinances in Utah,* by G.C. Christenson, 1987, 16 pages. Free while supply lasts.

Hazards ordinances in Utah, like much of the rest of the U.S., are often lacking or minimally addressed in codes used by governing bodies to protect the health, safety and property of Utah citizens. This document outlines a series of steps (generic but directly useable) which can be followed by local government to consider geologic hazards.

Miscellaneous Publications

Miscellaneous Publication M, *Guidelines for preparing engineering geologic reports in Utah,* by the Utah Section of the Association of Engineering Geologists, 2 pages. Free.

Miscellaneous Publication N, *Guidelines for evaluating surface fault rupture hazards in Utah,* by the Utah Section of the Association of Engineering Geologists, 2 pages. Free.

Miscellaneous Publication O, *Geology and Grand County,* by H.H. Doelling and others, 16 page color brochure. Price $1.50.

A color brochure describing the principal geologic and mineral features of the county in capsule form. Easy to read, it contains 20 full-color photographs, 9 diagrams, and a map that will be as useful to non-professionals as to geologists who plan to work in Grand County. The brochure was artistically designed and was distributed at a UGMS geologic conference held in Moab on May 14 and 15, 1987. It should be of special interest to schools and earth science teachers.

Books

Geology of Utah, by William Lee Stokes, 1986, 305 pages, 336 black and white photographs, 182 illustrations. Price $12.00.

All prices quoted are over-the-counter prices. For prices plus mailing costs, please call the UGMS at 581-6831.

UTAH EARTHQUAKE ACTIVITY

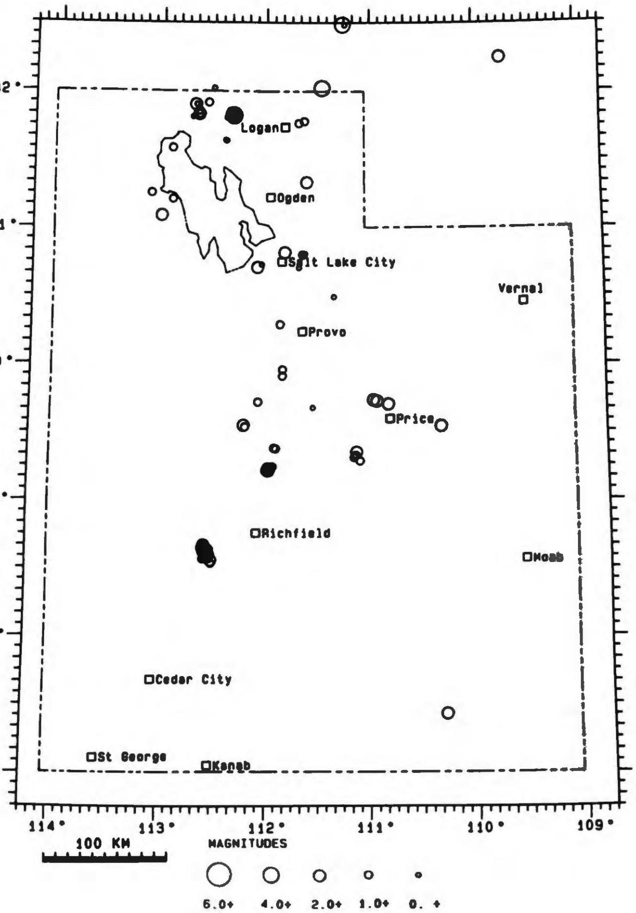
October through December 1986

By Ethan D. Brown

UNIVERSITY OF UTAH SEISMOGRAPH STATIONS
DEPARTMENT OF GEOLOGY AND GEOPHYSICS

THE University of Utah Seismograph Stations records an 81-station seismic network designed for local earthquake monitoring within Utah, southeast Idaho, and western Wyoming. During October 1 to December 31, 1986, 121 earthquakes were located within the Utah region, including 43 greater than magnitude 2.0. The epicenters in the accompanying figure show earthquake activity scattered throughout Utah's main seismic region with significant localized clustering. The largest earthquake during this time period, M_L 3.6, occurred on October 29, and was located 32 km WNW of Logan in northern Utah. This earthquake was reported felt in Tremonton, Utah, and other areas of Box Elder county. Felt earthquakes in the same epicentral area also occurred on October 31 (M_L 3.5) and December 31 (M_L 3.3). On October 1, a small earthquake of M_L 2.7 occurred 8 km northeast of Salt Lake City and was felt in the northeastern Salt Lake valley. An earthquake on November 13 (M_L 2.6), located under Magna, Utah was also felt in the Salt Lake valley. An earthquake of M_L 3.4 on October 5, located 50 km WSW of Richfield, Utah, was reported felt by a plant operator near Beaver, Utah.

Over half (73 out of 121) of the earthquakes recorded during the study period occur in three spatial clusters. The largest is one WNW of Logan and includes 35 earthquakes ($M_L \leq 3.6$) that occurred chiefly during October and early November. A smaller cluster of 12 events ($M_L \leq 2.4$) occurred at the end of October in the area of the March 24 M_L 4.4 Japanese Valley earthquake, about 55 km north of Richfield. A cluster of 26 events ($M_L \leq 3.4$) 50 km SW of Richfield includes the felt earthquake of October 5. This cluster occurs through the first week in October and is a continuation of activity which began in the last report period of July 24.



Additional information on earthquakes within Utah is available from the University of Utah Seismograph Stations, Salt Lake City, Utah 84112; telephone (801) 581-6274.

UTAH QUADRANGLE MAPPING

By Hellmut H. Doelling

THE Utah Geological and Mineral Survey (UGMS) has a program by which qualified graduate degree candidates interested in mapping geologic quadrangles in Utah can obtain up to $1,500 of assistance. The quadrangles can be mapped as part of thesis requirements and will be published under our "provisional" series in full color. Interested individuals should write a letter proposal to Dr. Hellmut H. Doelling, Senior Mapping Geologist, Utah Geological and Mineral Survey; 606 Black Hawk Way, Salt Lake City, Utah 84108. The proposal should identify the 7.5 minute quadrangle in Utah to be mapped (all mapping must be done at the 1:24,000 scale), the name of his/her thesis adivisor, a time table defining starting and completion dates, the expected list of deliverables, and a statement defining the goals of the thesis research. A letter of recommendation and support from the thesis advisor should accompany the proposal.

Qualified geologic mappers other than degree candidates can also participate. The requirements and assistance will essentially be the same. This might include professors, postgraduates, and other workers who have a strong interest in Utah geology. Minimum requirements in terms of deliverables can be obtained from the UGMS. The UGMS map series is designed for multi-purpose use, hopefully to be used by nonprofessionals as well as those in the geologic profession. The work should not only map the stratigraphy and structure but also provide data on geologic hazards, economic geology, historical geology, and materials characteristics. Quaternary geology, the geology of unconsolidated deposits, is considered as important as the geology of the older consolidated deposits.

UGMS geologic maps are published in two plates and an accompanying booklet. Plate 1 is the 7.5 minute quadrangle, and plate 2 contains cross sections, legend, explanations, lithologic column, correlation of rock units, and whatever other data the author might deem important (and whatever space permits). The accompanying booklet is designed to enlarge upon the geologic information printed on the plates. The booklet can range in length from 8 to 24 pages; photographs, figures, and diagrams included. The booklet can be a condensed version of the student's thesis or, if the advisor agrees, can be the thesis document itself.

The UGMS budget is limited and thesis contracts issued thus far have been on a first come, first served basis. In the case of heavy response, contracts will be awarded (1) on the strength of the proposal, and (2) on the priority needs of the UGMS. Our past contracts have not only been with students from Utah universities, but from universities all over the United States. Our program is open to all who agree that some of the best geology is available in Utah. ▪

EXTRA, EXTRA

NEWS RELEASES...

DENVER, COLORADO—The Society of Mining Engineers (SME) will repeat the short course, *Evaluation, Design, and Operation of Precious Metal Heap Leaching Projects,* September 11-13, 1987 in San Francisco prior to the American Mining Congress meeting. For information, contact Meetings Department, Society of Mining Engineers, P.O. Box 625002, Littleton, CO 80162, (303) 973-9550, or telex 881988.

RENO, NEVADA—A conference on *Small Mines Development in Precious Metals,* sponsored by the Society of Mining Engineers is scheduled for August 30 through September 2, 1987. For more information contact Meetings Department, SME, P. O. Box 625002, Littleton, CO 80162-5002, (303) 973-9550, or telex 881988.

BOISE, IDAHO—*The annual Rocky Mountain Section joint meeting of AAPG-SEPM-EMD* will be held on September 13-16. Contact David Small C&EH, Boise-State University, 1910 University Drive, Boise, ID 83725, (208)385-3303 if you are interested or need more information.

CALL FOR PAPERS...

APCOM 89 21st International Symposium on the Application of Computers and Operations Research in the Mineral Industry will be held in conjunction with the Society of Mining Engineers - TMS Annual Meeting on February 28 through March 3, 1989 in Las Vegas, Nevada. The theme will be "Mineral Industry Computing—A Look into the Future" and you are being requested to *submit your papers* now.

The technical sessions of this conference will consist of a mix of papers discussing: 1) currently established utilization of software and hardware applicable in the decade of the '90s and beyond; 2) new applications, many made possible by the technology of personal computers; and 3) those systems in development today with the potential for future use within the mineral industry. Papers that are commensurate with any of these three categories are solicited. Long-term reference value will be used as a criterion in the selection.

The deadline for submittal is AUGUST 3, 1987. Be sure not to miss out!

THE MINERAL INDUSTRY OF UTAH IN 1986

The value of nonfuel mineral production in Utah in 1986 was an estimated $285 million, nearly a 9% decline from 1985, according to the Bureau of Mines, U.S. Department of the Interior. Metals output continued its decline from more than half of the total value of nonfuel minerals produced in 1984 to about one-fifth in 1986.

The major factor in the drop of value of Utah's nonfuel mineral output was the shutdown of Kennecott's Utah Copper Division operations from March 31, 1985 to October, 1986. The Bingham Canyon Mine had been the state's principal producer of copper, gold, molybdenum, and silver and, with the exception of gold, these commodities declined in quantity and value in 1986. As part of a mid-year labor contract settlement, Kennecott agreed to proceed with its $400 million modernization plan and resumed mining operations in October. About 1,500 workers were recalled by year end and ore was stockpiled until the concentrators could be restarted in early January. Changing its modernization program, Kennecott planned to construct a flotation mill east of Copperton adjacent to the new grinding mill; concentrates would be slurried to its Garfield smelter and tailings to ponds near Magna.

Another downturn for Utah's economy and mineral industry occurred as USX Corporation's USS Inc. Geneva Works were idled in July, after bargaining between United Steelworkers of America and the company failed. In November, the Utah Industrial Commission ruled that the 1,900 employees of the steel plant and Keigley limestone quarry were locked out of their jobs and eligible for unemployment benefits.

The total value of industrial minerals production fell as declines were posted for portland cement, clays, gilsonite, gypsum, lime, phosphate, industrial sand and gravel, and crushed stone. Commodities rising in value included masonry cement, magnesium compounds, potassium salts, salt, construction sand and gravel, and sodium sulfate.

Industries on the shores of Great Salt Lake continued to be affected by persistent high lake levels. AMAX Magnesium Corporation lost its 40,000-acre solor ponds near Rowley when they were flooded after high winds breached a 13-mile dike protecting the area. However, the plant and decantation pond were undamaged and production of magnesium metal continued using unaffected inventories and alternate sources. AMAX was evaluating the feasibility of developing solar evaporation ponds on the west desert of Great Salt Lake where the state was preparing to pump excess lake waters to alleviate flooding and damage around the shores. AMAX reached a tentative agreement to sell its Sol-Aire Salt and Chemical Company byproduct salt marketing outlet to Diamond Crystal Salt Company.

Table 1. Nonfuel mineral production in Utah[1]

Minerals	1985 Quantity	1985 Value (thousands)	1986[p] Quantity	1986[p] Value (thousands)
Beryllium concentrate------short tons--	5,738	$6	6,000	$6
Cement:				
Masonry------thousand short tons--	W	W	2	150
Portland------do--	W	W	1,100	63,400
Clays[2]------do--	332	2,509	237	$1,585
Gem stones------	NA	80	NA	W
Gold (recoverable content of ores, etc.)------troy ounces--	135,489	43,039	W	W
Gypsum------thousand short tons--	413	4,033	457	3,566
Lime------do--	225	11,912	213	11,253
Salt------do--	1,189	28,468	1,038	31,262
Sand and gravel (construction)------do--	[3]14,000	[3]36,400	15,900	36,900
Stone (crushed)------do--	4,657	14,180	4,500	14,100
Combined value of asphalt (native), copper, magnesite (1986), magnesium compounds, molybdenum, phosphate rock, potassium salts, sand and gravel (industrial), silver, sodium sulfate (natural), stone (dimension), and values indicated by symbol W------	XX	171,732	XX	123,127
Total------	XX	312,359	XX	285,349

[3] Estimated. NA Not Available. [p] Preliminary. W=Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX=Not applicable.

[1] Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2] Excludes fuller's earth, values included with "Combined value."

Prepared January 15, 1987, by the Bureau of Mines in the Denver Regional Office of State Activities in cooperation with the Utah Geological and Mineral Survey.

REPRINT THE GEOLOGIC MAP OF UTAH??

The UGMS is interested in determining the response from public and private sectors for a reprint of the Geologic Map of Utah. Scale 1:250,000, Army Map Series base; four color; designed to be spliced together into a 71½"w x 89"h wall map or as separate quadrants with accompanying explanation:

- NEQ by W.L. Stokes and J.H. Madsen, Jr., 1961, 49" x 48".
- NWQ by W.L. Stokes, 1962, 48" x 59½".
- SWQ by L.F. Hintze, 1963, 50½" x 59½".
- SEQ by L.F. Hintze and W.L. Stokes, 1963, 48" x 59½".

If you would possibly buy a set if they were reprinted, please indicate the price you would be willing to pay and send a reply to:

Editor
Utah Geological and Mineral Survey
606 Blackhawk Way
Salt Lake City, Utah 84108

We would appreciate your help in distributing this memo to people who might be interested.

Phoenix, Arizona—the 117th AIME Annual Meeting will be held in the Hyatt Regency Hotel on January 25, 1988 in conjunction the Society of Mining Engineers Annual Meeting and Exhibit. For further information, contact: Meetings Department, Society of Mining Engineers, P.O. Box 625002, Littleton, CO 80162-5002, (303) 973-9550, telefax 1-303-973-3845, telex 881988.

UGMS Staff Changes

Staff changes since last issue include:

Robert E. Blackett, recently with Meridian Corporation, has joined the Economic section while *Hal Gill* has left the Site Investigation section to work for Environmental Science Engineering.

Steve Kerr, geotech with the Coal group is now with Barrick Mercur Gold Mines, Inc.

After 3 1/2 months in Australia, *Bea Mayes* is back with the Minerals group.

POTENTIAL OPENINGS AT UGMS

The Utah Geological and Mineral Survey may fill two career positions this summer.

DEPUTY DIRECTOR: The position of Deputy Director will become vacant when Don Mabey leaves UGMS this summer. The Deputy Director assists the Director in the management of the UGMS, manages the UGMS Support Program and conducts geologic research. Minimum requirements for the position are a college degree in geology or a closely related field and four years of professional experience including experience in managing earth science programs.

EARTHQUAKE SCIENTIST: The last session of the Utah State Legislature authorized a new position of earthquake scientist in the UGMS to direct a UGMS program providing earthquake hazard information to all potential users in Utah. The minimum requirements for this position are a college degree in geology or a closely related field and four years of professional experience including significant experience in earthquake hazard investigations. This senior-level scientist will be assisted by a working-level geologist and will work with several other state and federal agencies to identify and provide information about Utah's earthquake hazards.

These positions have not yet been authorized to be advertised, however, UGMS is optimistic. For information on the status of these positions, contact Gary Arndt, Department of Natural Resources, 1636 W. North Temple, Salt Lake City, UT 84116, (801) 533-6015.

UTAH NATURAL RESOURCES
Utah Geological and Mineral Survey
606 Black Hawk Way
Salt Lake City, Utah 84108-1280

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