GL02773-4

Montana College of Mineral Science and Technology
Montana Bureau of Mines and Geology
Project Proposal

SUMMARY PAGE

Submitted To:

Dr. Clayton R. Nichols
Division of Geothermal Energy
U.S. Energy Research and Development Administration
Washington, D.C. 20545

Submitted By:

Marvin R. Miller, Chief, Hydrology Division
John L. Sonderegger, Hydrogeologist
Montana Bureau of Mines and Geology
Butte, Montana 59701

Project Title:

A reconnaissance study of geothermal potential in the upper parts of Red Rock Creek and Madison River valleys, southwestern Montana.

Project Director:

John L. Sonderegger

Investigators:

John L. Sonderegger
Wesley M. Bermel
Laurence A. Wegelin

Project Duration:

April 1, 1977, to March 31, 1979

Financial Agency for Grant:

Grants and Contracts Office
Montana College of Mineral Science and Technology
Butte, Montana 59701

Total Grant Requested:

$56,632

PROJECT PROPOSAL

Title: A reconnaissance study of geothermal potential in the upper parts of Red Rock Creek and Madison River valleys, southwestern Montana.

Preliminary Statement:

This application for a research project is intended to augment several related geothermal resource investigations in western Montana. Most Known Geothermal Resource Areas (KGRA's) were first identified by regional investigations of groundwater and surface-water resources or were previously known as hot-spring areas. The regional inventory of springs and wells as an initial field study method for the assessment of geothermal energy resource potential is a widely accepted approach (Coombs and Muffler, 1973, p. 99-101). The proposed investigation will augment studies concerning: (1) the geologic investigation of hot-spring occurrences by Professor R. A. Chadwick and students (M.S.U.); (2) the study of mine-water temperatures in hardrock mining districts (MBMG); (3) the evaluation of geothermal potential in western Montana by Robert Leonard (U.S. Geological Survey); and (4) the investigation of microseismic activity in the vicinity of Yellowstone National Park being conducted by Professor R. B. Smith and students (Univ. of Utah). The investigation will not, to the best of our knowledge, duplicate any work being performed by other investigators.

The Centennial (Red Rock Creek) Valley is west of Yellowstone National Park. The orientation of the valley is controlled by major deep-seated faults. Volcanic rocks are exposed on both sides of the valley and are believed to constitute a significant thickness of the fill within the valley. These rocks are of Pliocene age (Don Coffin, oral commun.), suggesting that considerable heat may still be retained within these rocks should they occur within the valley fill.

Investigation of the geothermal potential of this area has been almost nonexistent, and no additional research is known to be planned in this area, despite its classification as a prospectively valuable geothermal area (Bob Leonard, oral commun.).

Exhibit one shows the areas classified as a Known Geothermal Resource Area (KGRA) as of April 1, 1976, by the U.S. Geological Survey. Exhibit two, from the U.S. Geological Survey's Circular 647 (published in 1971), shows the areas then classified as KGRA's (black areas) and also shows the Potential Geothermal Resource

Areas (outline only). The proposed study area constitutes a logical area for extension of known geothermal energy related to the Yellowstone Park volcanic rocks.

Exhibit three is a geologic map of Montana. The proposed study area (red outline) occurs in the same geologic setting as the West Yellowstone KGRA (blue outline). This proposal is to conduct a reconnaissance study of the geothermal potential of this offset area along a recognized structural trend, where geologic conditions are similar. The geologic assumptions in support of this study are similar to the assumptions behind wildcat drilling along structural trends from known gas and oil producing fields.

Need for Study:

The State of Montana is currently attempting to formulate energy strategies and to project the rate of energy resource development within the state. Similarly, the federal government is attempting to evaluate the nations's energy resources in order to plan for the future. Of particular interest are nonfossil fuel energy sources. In view of these objectives it is necessary that Montana's geothermal resources be investigated and the Bureau Director has given a top priority to cooperative studies toward this goal.

Montana is believed to have several types of geologic heat sources capable of development for space heating and possibly for electrical generation. The occurrence of very young volcanic rocks (extension of the Yellowstone Park volcanic fields) within the two valleys to be studied and the possibility of a post-Eocene pluton at depth (Witkind, 1974) suggest that these sites should rank at the top of a list of areas within Montana with excellent geothermal energy potential. The results of this study will provide the State of Montana with an assessment of the energy potential in terms of water temperatures at depth and estimated annual water volumes and British Thermal Units of usable head content that can be developed within the boundaries of the study area.

Objectives:

Objectives of the proposed research are to provide an areal hydrochemical data base and to interpret the significance of these data with respect to geologic factors and the geothermal energy resource potential of the upper parts of Red Rock Creek and Madison River valleys. Particular emphasis will be placed upon:

1. Location and field sampling of all springs and wells within the project area.

2. Correlation of the most promising geothermal areas with the controlling geologic variables.

3. Modeling and characterization of the geothermal resources using U.S. Geological Survey research computer programs and facilities.

Methods of Investigation:

A. Field Procedures:

1. Locate springs and wells within the study area.

2. Determine in the field: temperature, flow (springs) or yield (wells), specific conductance, pH, and silica content for wells and springs.

3. Measure stream flows and estimate the thermal and non-thermal contribution to base flow.

4. Study in detail the geology of areas suspected to contain geothermal cells.

5. Collect samples for standard chemical analysis.

6. Collect special samples for detailed chemical analysis.

B. Office and Laboratory Procedures:

1. Examine maps and aerial photographs to locate all identifiable wells and springs.

2. Determine the chemical quality of spring and well waters.

   a. Standard analyses include the determination of: Ca, Mg, Na, K, Fe, Mn, SiO_2, Al, HCO_3, CO_3, Cl, SO_4, F, pH, and specific conductance.

   b. Special analyses include all determinations in the standard analyses plus: NH_3, Sb, B, Li, Sr, As, Hg, U, Se, Br, I, and H_2S.

3. Plot well and spring locations on base maps. Contour overlay maps based upon water chemistry and geochemical calculations of equilibrium (at depth) water temperatures using silica and K-Na-Ca geothermometery models.

4. Code all data for input to state and federal data systems.

5. Compile and integrate data with related ongoing research projects.

6. Calculate the volume of thermal waters within each identified geothermal cell.

7. Develop initial models to describe the physical, thermal, chemical, and hydrologic conditions in the study area.

8. Write a final report on the study, which will include the following: the quantities of energy in each of the cells; the annual rate of natural dissipation of this energy; and a ranked list of high-potential sites within the study area, should the results indicate significant geothermal energy reserves.

Presentation of Results:

An annual progress report for limited distribution (ERDA and USGS) will be made available by March 31, 1978. The final report to ERDA will also be issued as a Montana Bureau of Mines and Geology Bulletin, with distribution to more than four hundred agencies and libraries throughout the United States. It is also expected that at least one paper resulting from the project will be submitted to an appropriate scientific journal.

Note on Personnel, Funding, Laboratory Facilities, and Work Schedule:

Professional resumes are presented in Appendix III. The Bureau is currently reviewing applications for a hydrologist position caused by resignation. Experience and interest in geothermal research will be one of the criteria in hiring this man.

Dr. Sonderegger is currently funded for one month's salary by ERDA as principal investigator on a geothermal research project entitled "A reconnaissance study of mine-water temperatures in hardrock mining districts of Montana" (Contract No. E(45-1) - 2426, TA2) which is scheduled to terminate May 15, 1977. There should be no conflict with time available or duties during the overlap period.

Laboratory instrumentation includes:

1 Model AA-4, Varian Techtion Atomic Absorption Spectrophotometer
1 Model 403, Perkin Elmer Atomic Absorption Spectrophotometer with background correction and auto-sample changer
1 Model 503, Perkin Elmer Atomic Abosrption Spectrophotometer with background correction and graphite furnace
1 Model S/N243, Spectrometrics Co. Plasma Source Echelle Spectrometer with qualitative comparator attachment

The laboratory has consistently done well on USGS interlaboratory standards for the last four years, since Laurence Wegelin became laboratory chief.

The project work plan and scheduling may be briefly summarized as follows: (a) spring of 1977, organize base maps, photos, etc., locate key points for stream flow gauging, review existing maps and data; (b) summer-fall 1977, reconnaissance field work and basic data collection; (c) winter-spring 1977-78, evaluate field data, work up preliminary models and locate key areas to test validity of models, write progress report; (d) summer-fall 1978, continue basic data collection for hydrologic budget, study key areas in detail to test models; (e) winter-spring 1978-79, refine models, input data to computer systems, write final report.

List of References and Persons Cited in Text

Coffin, Don, U.S. Geological Survey, Water Resources Division, Federal Building, Helena, Montana.

Coombs, Jim, and Muffler, L. J. P., 1973, Exploration for geothermal resources, in Kruger, P., and Otte, C., ed., Geothermal Energy, Stanford, California, Stanford Univ. Press, p. 95-128.

Godwin, L. H., Haigler, L. B., Rioux, R. L., White, D. E., Muffler, L. J. P., and Wayland, R. G., 1971, Classification of public lands valuable for geothermal steam and associated geothermal resources: U.S. Geol. Survey Circ. 647, 18 p.

Leonard, Robert, U.S. Geological Survey, Water Resources Division Federal Building, Helena, Montana.

Witkind, I. J., 1974, A possible concealed pluton in Beaverhead and Madison Counties, Montana, and Clark County, Idaho: U.S. Geol. Survey open-file report 74-312, 7 p.

APPENDIX I

Exhibits

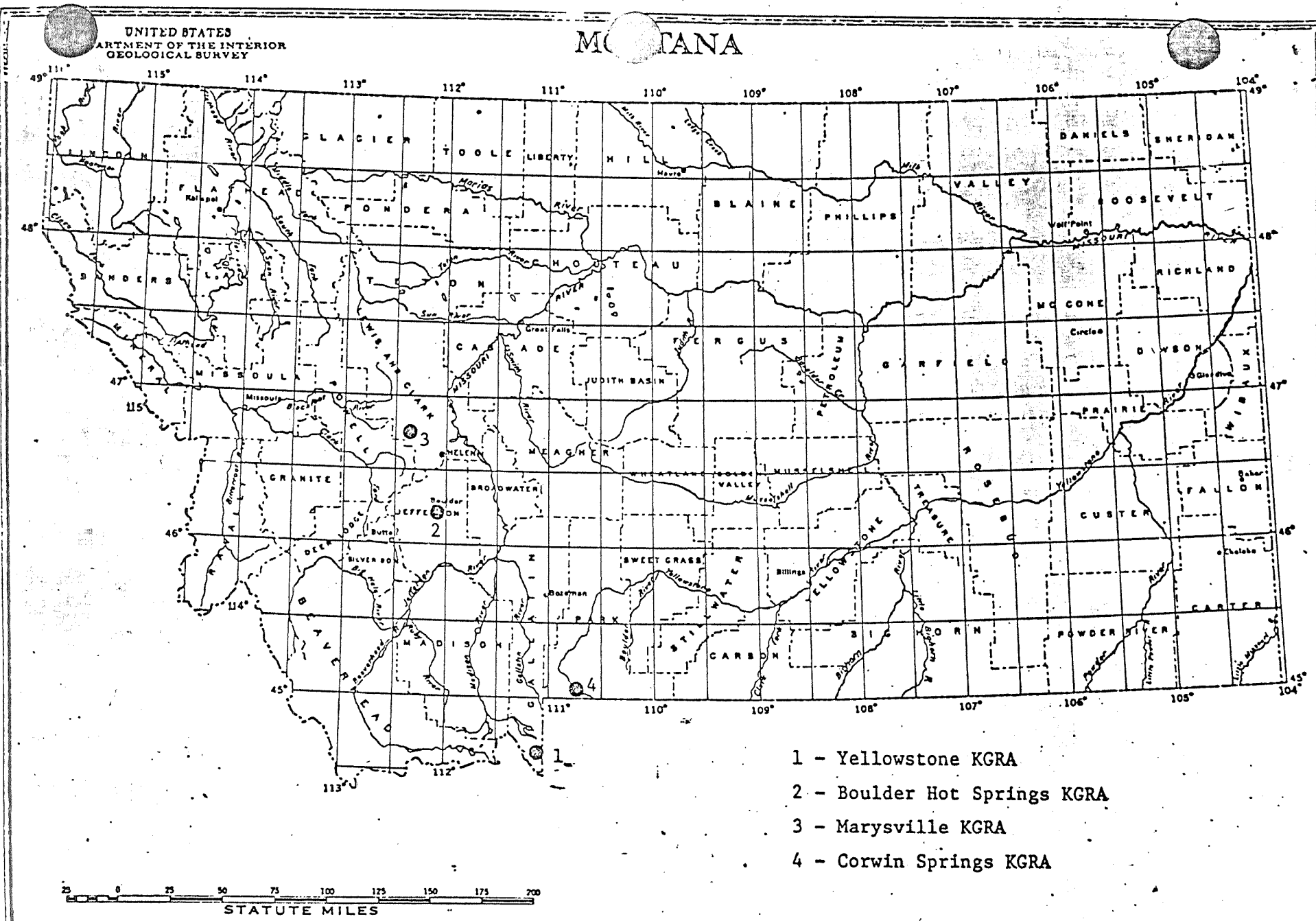


Exhibit 1. A map of Known Geothermal Resource Areas as of April 1, 1976.

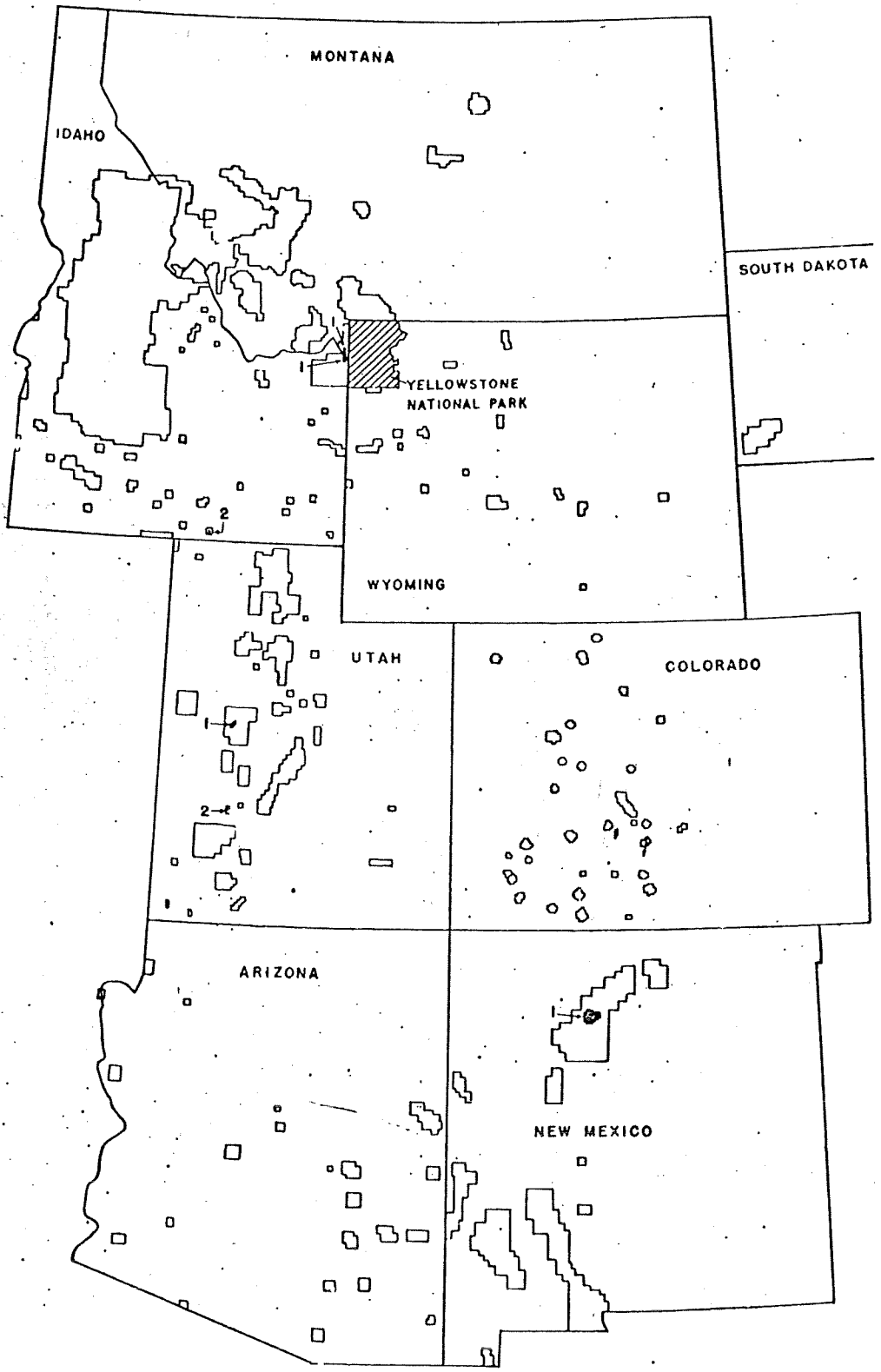
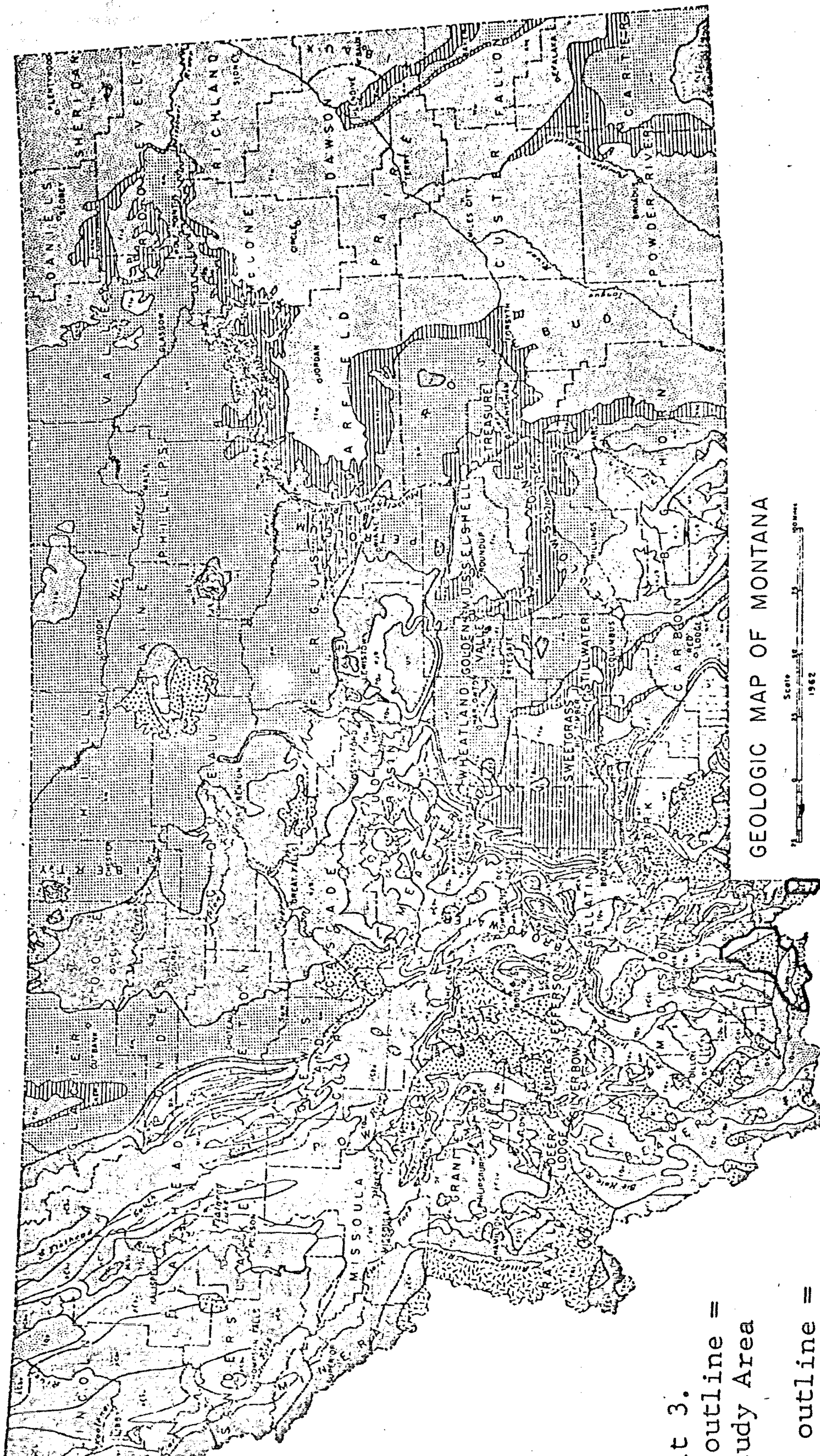


Exhibit 2. Outlined areas denote Potential Geothermal Resource Areas as of December 24, 1970 (from U.S. Geol. Survey Circular 647).



EXPLANATION

SEDIMENTARY ROCKS

CENOZOIC

TQu, Tertiary sediments, Willow Cr. fm, glacial deposits, and alluvium in western Montana.
Tfw, Fort Union, Flaxville, Wasatch, and White River fms in central and eastern Montana.

TKl, Livingston fm of Crazy Mts area; includes Montana group above Eagle ss, Hell Cr., and Fort Union fms

MESOZOIC

Ksm, St Mary River formation of north-central Montana
Khc, Hell Cr fm, central and eastern Montana.

Km, Montana group: Telegraph Creek, Eagle, Claggett, Judith River, and Bearpaw fms over most of state; Fox Hills ss and Pierre sh in extreme east

Kc, Colorado group: Thermopolis, Mowry, Belle Fourche, Greenhorn, Carlile, and Niobrara formations in south-central and eastern Montana, and the Blackleaf fm and Marias River shale of north-central Montana

KJTR, Lower Mesozoic Ellis group, Morrison formation, and Kootenai fm. Includes Triassic Dinwoody where present.

PALEOZOIC

MP, Mississippian, Pennsylvanian, and Permian fms: Madison group, Big Snowy group, Amsden, Quadrant-Tensleep, and Phosphoria formations.

DC, Devonian and Cambrian formations: Flathead, Wolsey, Meagher, Park, Pilgrim, Red Lion, Maywood, Grove Cr., Jefferson, and Three Forks formations

PRECAMBRIAN

pCb, Belt formations undifferentiated.
pCbu, Upper Belt formations of the Piegan and Missoula groups.
pCbl, Lower Belt formations of the Ravalli group and the Prichard formation

pCgs, Pre-Belt gneisses, schists, marbles, and associated rocks of the Cherry Creek series, pre-Cherry Cr fms, and the Stillwater igneous complex.

IGNEOUS ROCKS

TKv, Volcanic Rocks

TKi, Intrusive Rocks

Exhibit 3.
Red outline =
Study Area

Blue outline =
West Yellowstone KGRA

APPENDIX II
Project Budget
April 1, 1977 - March 31, 1979

	Federal	State
Salaries and Wages		
Hydrogeologist 9 mo. 4.5/yr	$13,860 14,742	$4,620 3 mo
Secretary 1 mo.	655	
Draftsman ½ mo.	550	
Hydrotechnician 6 mo.	6,600	
Subtotal	21,665	4,620
Benefits (13.5% of salaries)	2,925	624
TOTAL SALARIES AND BENEFITS	24,590	5,244
Capital Equipment		
One Marsh-McBirney Model 201 portable water current meter with case and wading rod.	1,365	
Expendable Equipment and Supplies		
Field supplies--maps, aerial photos, field chemical testing materials, etc.	750	
Office and drafting supplies	300	
Miscellaneous equipment rental and repair	250	
Reference materials and copying	450	
	1,750	
Travel and Per Diem		
State vehicle (4-wheel drive) 7,500 miles @ $.20	1,500	
Per Diem 120 days @ $20/day	2,400	
Professional Meetings	1,250	
	5,150	
Other		
Computer application	1,000	
Contingencies	765	
Publication of final report	1,500	
	3,265	
Analytical Costs		
125 standard water analyses @ $42	5,250	
25 special water analyses @ $159	3,975	
	9,225	
TOTAL less indirect costs	45,345	5,244
Indirect costs (45.9% of wages and benefits as determined by HEW standard accounting procedures)	11,287	2,407
TOTAL COSTS	$56,632	$7,651

All items purchased for this study shall become the property of the Montana Bureau of Mines and Geology upon completion of the project.

APPENDIX III

Professional Resumes

RESUME

Name and Position:

Marvin R. Miller
Born May 9, 1941, Laramie, Wyoming
Married: 1968, one child
Chief, Hydrology Division, Montana Bureau of Mines and Geology
Research Associate Professor, Montana College of Mineral Science and Technology

Education:

A.B. in Geology, University of Montana, Missoula, Montana, June 1963
A.M. in Geology, Indiana University, Bloomington, Indiana, June 1965
Ph.D. in Hydrogeology, minors in Civil Engineering and Geomorphology, Indiana University, Bloomington, Indiana (currently completing work on dissertation).

Academic Honors:

Outstanding senior in geology at University of Montana 1963
National Defense Education Act (NDEA) 3-year fellowship in hydrogeology at Indiana University 1963-1966.
National Aeronautics and Space Administration fellowship in hydrogeology at Indiana University 1967.

Work Experience:

1965 Geologist, Humble Oil & Refining Co., Summer job
1966 Instructor, Indiana University, Summer job
1967 Instructor, Indiana University, Summer job
1967-1969 Instructor, Montana Tech, and Hydrogeologist, Montana Bureau of Mines and Geology
1969-1971 Assistant Professor, Montana Tech, and Hydrogeologist, Montana Bureau of Mines and Geology
1971-present Research Associate Professor, Montana Tech, and Chief, Hydrology Division, Montana Bureau of Mines and Geology. The position involves supervising, conducting, and directing technical ground-water, surface-water, and quality of water investigations. Additional duties include hydrogeologic research, teaching courses in ground-water geology, and assisting federal, state, and local organizations and individuals in developing and utilizing Montana's water resources. The hydrology division currently has a full-time staff of 14 in offices in Butte and Billings.

Current Research Interests:

Ground-water flow systems, water-quality changes within hydrologic systems, and ground-water exploration and development. Current research emphasis has been placed on the hydrogeologic aspects of the origin and development of dryland salinity problems throughout the Northern Great Plains.

Publications:

Miller, M. R., 1969, Water Resources of Eastern Montana, *in* Montana Geological Society Guidebook, 20th Ann. Field Conf., p. 239-243.

_____1971, Hydrogeology of saline-seep spots in dryland farm areas—a preliminary evaluation, *in* Proceedings of Saline Seep - Fallow Workshop, Great Falls, Montana, Feb. 22-23, 1971, 12 p.

_____and Juvan, Eddie, 1971, Possibilities of developing potable water supplies, north-central Montana, *in* Proceedings of Saline Seep - Fallow Workshop, Great Falls, Montana, Feb. 22-23, 1971, 9 p.

_____and Bond, E. W., 1972, an evaluation of weather modification in the Great Plains of Montana—Part 1 (ground water), *in* Impacts of Induced Rainfall on the Great Plains of Montana - An Interim Report: Montana Agricultural Experiment Station Research Report 26, p. 41-73.

Ferguson, Hayden, Brown, P. L., and Miller, M. R., 1972, Saline seeps on non-irrigated lands of the northern plains, *in* Proceedings on Control of Agriculture Related Pollution in the Great Plains, Lincoln, Nebraska: Great Plains Agricultural Council Publication No. 60, p. 169-191.

Miller, M. R., and Bond, E. W., 1973, Impacts of induced rainfall on the Great Plains Montana - Section 8 (ground-water hydrology) Final Report: Montana Agricultural Experiment Station Research Report 42, 74 p.

_____1973, Saline-seep development in Montana and adjacent areas—hydrogeological aspects, *in* Proceedings of Governor's Saline Seep Emergency Meeting, Helena, Montana, April 25, 1973, p. 23-28.

Bahls, Loren L., and Miller, M. R., 1973, Saline seep in Montana, *in* Second Annual Report, Montana Environmental Quality Council, p. 35-44.

Miller, M. R., 1974, Hydrogeochemical investigation of selected water sheds in southwestern Montana: Montana Univ. Joint Water Resources Research Center Report No. 60, 27 p.

_____and Bahls, L. L., 1975, Ground-water seepage and its effects on native soils: Montana Univ. Joint Water Resources Research Center Report No. 66, 56 p.

Brown, P. L., and Miller, M. R., 1975, Perennial cropping for saline seep control: American Soc. Agronomy Jour. (in press).

Miller, M. R., and others, 1976, An overview of saline-seep programs in the states and provinces of the Great Plains, *in* Regional Saline-seep Control Symposium, Bozeman, Montana: Montana Agricultural Experiment Station Research Report No. ____ (in press).

Brown, P. L., Cleary, E. C., and Miller, M. R., 1976, Water use and root depths of crops for saline seep control, *in* Regional Saline-seep Control Symposium, Bozeman, Montana: Montana Agricultural Experiment Station Research Report No. ____ (in press).

RESUME

Name: John Lawrence Sonderegger II
Born January 14, 1942, Madison, Wisconsin
Married, two children

Education:

B.S.I. - Geology, 1962-1966, University of Wisconsin
M.S. - Geology, Fall 1966, University of Tennessee[1], 1967-1969, University of Alabama
Ph.D. - Geochemistry, 1969-1970, Northwestern University[2], 1970-1973, New Mexico Tech[3]

Academic Honors:

University of Wisconsin - Instate Tuition Scholarship 1963-1966
Northwestern - N.D.E.A. Fellowship

Work Experience:

Montana Bureau of Mines and Geology - Research Assistant Professor and Hydrogeologist-December 1974 to present.
Georgia Earth & Water Division - Geologist II - 1973-1974; Geologist III - 1974 to December 1974.
Geological Survey of Alabama - ¾ time as Geologist I - 1967-1969.

M.S. Thesis:

A photogeologic and structural study of a limestone terrane with emphasis on fractures affecting ground-water occurrence.

Ph.D. Dissertation:

A preliminary investigation of the dissolution kinetics of strontianite and witherite.

Publications:

Sonderegger, J. L., 1968, Geology of the Athens quadrangle, Alabama (abs): Jour. Alabama Acad. Sci., v. 39, no. 3, p. 211.

_____1969, Calculation of carbon dioxide partial pressure from chemical analyses of limestone ground water: Jour. Alabama Acad. Sci., v. 40, no. 4, p. 227-231.

_____1970, Hydrology of limestone terranes-photogeologic investigations: Geol. Survey Alabama Bull. 94-C, 27 p.

_____1974, Effect of Chattanooga shale facies distribution on the in situ formation of negative structures by ground-water solution (abs): Geol. Soc. America Abs. with Programs, v. 6, no. 4, p. 399.

_____1974, A preliminary investigation of strontianite dissolution kinetics (abs): Geol. Soc. America Abs. with Programs, v. 6, no. 7, p. 961.

_____1976, Hydrologic and geochemical controls on tailings pond drainage affecting Soda Butte Creek, Cooke City, Montana (abs): Geol. Soc. America Abs. with Programs, v. 8, no. 5 p. 634.

_____A tentative exploration model for the location of oxidized uranium deposits in fluvial sandstone: submitted to Econ. Geology.

_____and Billings, G. K., 1971, the geochemical cycle of molybdenum (abs): Geol. Soc. America Abs. with Programs, v. 3, no. 7, p. 712-713.

_____Brower, K. R., and LeFebre, V. G., 1976, A preliminary investigation of strontianite dissolution: Am. Jour. Sci., in press.

_____and Kelly, J. C., 1970, Hydrology of limestone terranes-geologic investigations: Geol. Survey Alabama Bull. 94-B, 146 p.

_____and Wallace, J. J., Jr., 1976, Final report: Acid mine drainage control-feasibility study, Cooke City, Montana: Report to Montana Department of Natural Resources for E. P. A. Grant No. S-802671, 197 p.

Billings, G. K., and Sonderegger, J. L., 1971, The geochemical cycle of molybdenum in our environment (abs): Am. Chem. Soc., Div. Water, Air and Waste Chem., Ann. Mtg., Washington, D. C.

Billings, G. K., Beane, R. E., Sonderegger, J. L., and Hayslip, D. L., 1972, Phase I: Qualitative mineralogical analysis and quantitative chemical analysis of selected shale samples from the Lyons, Kansas, nuclear-waste burial site: Oak Ridge Nat. Lab. Contract Research Report for Subcontract No. 3673, 22 p.

Wallace, J. J., Jr., Sonderegger, J. L., and Higgins, G. L., Jr., 1975, Annual report: Acid mine drainage control-feasibility study, Cooke City, Montana: Report to Montana Department of Natural Resources for E. P. A. Grant No. S-802671, 39 p.

Work in Progress:

An Atlas of Georgia's Ground-Water Quality by Sonderegger, Pollard, and Cressler, in final review for publication by the Georgia Department of Natural Resources, Earth and Water Division.

A reconnaissance study of mine-water temperatures in hardrock mining districts of Montana (with Don Lawson, MBMG).

Research Interests:

1. Field and laboratory studies of mineral-aqueous interactions which effect ground-water composition.

2. The use of ground-water chemistry in the evaluation of geothermal and uranium resource potential.

[1] Left for financial reasons.
[2] Left because of faculty changes in geochemistry.
[3] Degree granted in 1974.

PROFESSIONAL RESUME

Name: Laurence A. Wegelin
1021 West Diamond Street
Butte, Montana 59701
Telephone: (406) 792-8321 ext. 274 (work)
(406) 792-7213 (home)

Personal:
Birth date: 8/13/40 Married, four children 5'6" 156 lbs.
U.S. Citizen

Professional Experience: 11 years

Field: Analytical Chemistry - Inorganic

Education:

University of Wyoming, Laramie, Wyoming
Electrical Engineering, 7 semesters - 117 credit hours
GPA: 3.67/4.0 from 1959 to 1962

Professional Experience:

3/70 to present — Montana College of Mineral Science and Technology
Montana Bureau of Mines and Geology
Butte, Montana 59701

Present Position: Chief Chemist, Analytical Division

Immediate Supervisor: Dr. S. L. Groff, Director and State Geologist

Responsible for all chemical analyses required by the Bureau's Geology Division, Hydrology Division, and Energy Division as well as for chemical analyses requested by other State or Federal cooperating agencies, such as the U.S. Geological Survey, U.S.D.A. Forest Service, Environmental Protection Agency, the Bureau of Land Management, the Montana Department of Fish and Game, Montana Department of Agriculture, the Montana Department of Health and Environmental Sciences, and Montana Department of State Lands. This includes; chemical analyses of geological materials, surface and groundwater and coal; purchasing equipment and instrumentation; budgeting and staffing; and overall supervision of laboratory staff. Also responsible for: evaluating new analytical methods and improving existing ones; has maintained and demonstrated a high degree of analytical quality control for the last several years through a reference-sample exchange program with the U.S. Geological Survey and the Environmental Protection Agency as well as maintaining good internal control measures.

1/69 to 6/69 — Minerals Engineering Company, Lamps Division, General Electric Company
P.O. Box 431
Dillon, Montana 59725

Position: Chief Chemist

Immediate supervisor: Blair T. Burwell Jr., General Manager

Was responsible for analytical quality control and the supervision of laboratory staff to furnish chemical analyses for three divisions of the operation. 1. Mining Division - to assure the removal of a specified grade of ore. 2. Mineral Dressing Division - to assure a specified concentrate was being produced. 3. Chemical Extraction Division - to assure a pure tungsten product was being produced. Also was responsible for the purchasing of laboratory equipment, instrumentation, and budgeting to operate the laboratory.

9/66 to 1/69 — Molybdenum Corporation of America - Research Center
P.O. Box 607
Louviers, Colorado 80131

Position: Chemist

Immediate supervisor: Edwin Tomasi, Chief Chemist

Performed chemical analyses for; 1. Production - trace metal analyses for quality control of six rare earth products. 2. Research and Development - chemical and trace metal analyses needed for engineering and process development. 3. Exploration and Geology - chemical analyses of geological material and ore.

8/65 to 9/66 — Colorado School of Mines Research Foundation, Inc.
Golden, Colorado 80401

Position: Technician

Immediate supervisor: James Drobnick, Manager, Chemical Extraction and Hydro-Metallurgical Division

Performed chemical analyses needed for various process design or process control projects undertaken by the administration. Also assisted in pilot-plant operations by monitoring or controlling one or more stages of several different test plants.

RESUME'

Personal:

Wesley Martin Bermel
Born April 8, 1952, Williston, North Dakota
Married, one child

Education:

B.S. - Geological Engineering (June, 1976), Montana College of Mineral Science and Technology

Professional Organizations:

Junior Member, American Association of Petroleum Geologists

Work Experience:

Currently employed by the Montana Bureau of Mines and Geology, Hydrology Division, as a Hydrotechnician (classified in June, 1975).

My present work assignments include: 1. To review subdivision environmental impact statements and make comments on the subdivision with respect to its effects on ground and surface water as well as potential flood danger. 2. To supervise six (6) student assistants which are presently collating all existing water quality information in the Fort Union Coal Region. 3. To supervise one (1) student who is presently doing some of Hydrology Division's computer programming and to control system design, computer programming and system analysis. 4. To construct plane table maps of hydrologic test areas. 5. To produce photographic materials such as black-and-white prints and color slides for Division use. 6. To perform routine technical work in collecting and processing geological data and materials: a. Specific conductivity surveys of ground and surface water; b. Well inventorying and monitoring; c. Aquifer testing.

Presently, I am one of several whom are supervising the collating of all ground-water information for the Fort Union Coal Region in Montana.

Preceding June, 1975, I was also employed by the Montana Bureau of Mines and Geology, Hydrology Division, as a student assistant; my responsibilities were centered around the supervision of coding Water Quality Data. However my main job was to write, revise, and update the Hydrology Division's programs. Associated with the programming, I was also involved in the developing of several Data Systems. Along with these responsibilities I also monitored our test wells throughout the state.

Other work done with the Bureau also includes two (2) years of work assiciated with the Silver Bow Creek drainage study. This involved water quality sampling, measuring field parameters such as pH, specific conductivity, EH, turbidity, and stream flow measurements.

During the summer of 1973, I was employed by the Anaconda Copper Mines Company where my job consisted of taking drill rig samples and splitting core when necessary.

Major Accomplishments Included:

Water Quality Data System
Printer Plot Routine
Water Level Program and Data Base
Well Appropriation Data Base and Associated Programs

Open File Reports:

Bermel, W.M., 1974, Conversion of Section-Township-Range to Latitude-Longitude.

_____, 1973, Mineral Identification, Question Answer Documentation.

_____, 1974, Recording on the IBM 1311 Disk System.

_____, 1974, Storage Data Preparation for Lat-long.

Bergantino, Robert, Bermel, W.M., 1975, Montana Geological Maps of Southeastern Montana at 1:250,000 scale.

Method of Payment

Payment in full will be $56,632, which may be made according to standard ERDA accounting procedures.

Approval Signatures

Submitted by:

Mr. Marvin R. Miller
Chief, Hydrology Division
Montana Bureau of Mines and Geology

Dr. John L. Sonderegger
Hydrogeologist
Montana Bureau of Mines and Geology

Approved by:

Dr. S. L. Groff
Director and State Geologist
Montana Bureau of Mines and Geology

Dr. Vernon Griffiths
Director of Research
Montana College of Mineral Science and Technology

Dr. Clayton R. Nichols
Division of Geothermal Energy
U.S. Energy Research and Development Administration