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D. Foley

Proposal To  
UNION OIL COMPANY  
For  
SHORT COURSE ON VOLCANIC GEOLOGY AND  
HYDROTHERMAL SYSTEMS OF THE  
YELLOWSTONE CALDERA

## **Earth Science Laboratory**

---

**University of Utah Research Institute  
420 Chipeta Way, Suite 120  
Salt Lake City, Utah 84108  
(801) 581-5283**



December 2, 1983

UNIVERSITY OF UTAH RESEARCH INSTITUTE

# UURI

EARTH SCIENCE LABORATORY  
420 CHIPETA WAY, SUITE 120  
SALT LAKE CITY, UTAH 84108  
TELEPHONE 801-581-5283

December 2, 1982

Mr. John Bodell  
Union Oil Co.  
Geothermal Division  
1410 Guerneville Rd.  
Santa Rosa, CA 95406

Dear John:

The Earth Science Laboratory/University of Utah Research Institute is pleased to propose a short course in "Volcanic Geology and Hydrothermal Systems of the Yellowstone Caldera." This five day course would be offered to scientists of the geothermal staff of Union Oil Company. The course would be scheduled at your convenience in the late summer or early fall of 1983.

The course will convene in West Yellowstone, Montana, where motels and meeting facilities are available. Yellowstone National Park will be used as a field example illustrating ash flow tuff stratigraphy, caldera evolution and structure and systematics of hydrothermal systems in caldera environments.

Section A of the enclosed material is a proposed course schedule. This schedule recognizes the desire of Union professionals to be in the office in California on Mondays, and assumes their willingness to spend most of a weekend at the course. We have also assumed that the plane schedule into and out of West Yellowstone during 1983 will be similar to the past few summers.

The lectures (Section B) are designed to provide a broad introduction to the geology and hydrothermal systems of calderas, with emphasis on those topics of most interest to Union scientists. The budget (Section C) shows full time participation of myself and Dennis Nielson, with Regina Capuano.

joining the course in progress. Resumes (Section D) for all three are attached.

Participants in the course will be provided with a book containing course notes, hard copies of illustrative materials and reference lists. A list of suggested readings will be sent prior to convening of the course.

If you have any questions or wish to modify the course outline please do not hesitate to call either myself or Dennis Nielson.

Sincerely,

  
Duncan Foley

DF:jp

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TABLE OF CONTENTS

	<u>Page</u>
A. Proposed Course Schedule.....	1
B. Lecture Outline.....	3
C. Proposed Budget.....	5
D. Professional Resumes.....	6

A. PROPOSED COURSE SCHEDULE

Volcanic Geology and Hydrothermal Systems  
of the Yellowstone Caldera

Tuesday Assemble in West Yellowstone, Montana

afternoon Lectures  
I. Introduction  
II. Magmatism and petrology of volcanic systems  
III. Tectonic environments and physical spectrum of volcanism

evening Lectures  
I. Introduction to volcanic setting of Yellowstone area  
II. Volcanism of Central America  
III. Volcanism of Hawaii

Wednesday

morning Lectures  
I. Caldera cycles  
II. Ash flow tuffs  
III. Volcaniclastic deposits  
IV. Tertiary calderas of Nevada

afternoon Field Trip  
Volcanic rocks of northern Yellowstone  
Mt. Washburn - andesite vent facies  
Gardner River - ash flow tuff  
Sheepeater Cliffs - basalt  
optional stops - Tower Falls  
Overhanging Cliff  
Golden Gate  
Obsidian Cliff  
Madison Junction

evening Films and video tape on volcanic processes

Thursday

morning Lectures  
I. Geology of hydrothermal features  
II. Hydrothermal systems in calderas  
III. Geology of other volcanic geothermal systems

afternoon Field Trip  
Volcanic rocks of central Yellowstone  
Firehole River - rhyolites  
Mallard Lake dome overlook  
Bluff Point - ash flow tuffs

Elephant Back Trail - rhyolites  
optional stop - Virginia Cascades

Friday

morning Lectures  
I. Hydrothermal fluids  
II. Hydrothermal alteration  
III. Isotopic dating

afternoon Field Trip  
Field mapping exercise - ash flow tuffs  
Mammoth Hot Springs  
optional stop - Roaring Mountain

Saturday

all day Field Trip  
Hydrothermal systems  
Norris Geyser Basin  
Grand Canyon  
Mud Volcano  
optional stops - West Thumb  
Upper Geyser Basin

Sunday

morning Field Trip  
Hydrothermal systems  
Pocket Basin  
Lower Geyser Basin  
Midway Geyser Basin

afternoon Depart West Yellowstone

## B. LECTURE OUTLINE

### TUESDAY afternoon

- I. INTRODUCTION
  1. Purpose of course
  2. Course logistics
- II. MAGMATISM AND PETROLOGY OF VOLCANIC SYSTEMS
  1. Mantle melts
  2. Lower crustal melts
  3. P-T conditions of magma
  4. Viscosity of magmas
  5. Chemical composition of magmas and volcanic rocks
  6. Magmatic evolution and volcanic suites
- III. TECTONIC ENVIRONMENTS AND PHYSICAL SPECTRUM OF VOLCANISM
  1. Volcanic activity and plate boundaries
  2. Intraplate volcanism
  3. Classification of eruptive types

### TUESDAY evening

- I. INTRODUCTION TO VOLCANIC SETTING OF YELLOWSTONE AREA
  1. Absaroka volcanic province and facies
  2. Fossil forest controversy
  3. Snake River Plain volcanic province
  4. Island Park and Yellowstone
- II. VOLCANISM OF CENTRAL AMERICA

Slides illustrating volcanism in a calc-alkaline province along a convergent plate margin
- III. VOLCANISM OF HAWAII

Slides illustrating basaltic shield volcanos; contrast with volcanism of Central America

### WEDNESDAY morning

- I. CALDERA CYCLES
  1. Six stages of Smith and Bailey, with revisions and examples
  2. Magmatic evolution of calderas
- II. ASH FLOW TUFFS
  1. Constituents
  2. Formation from clouds
  3. Mobility
  4. Thermal regime
  5. Welding zones



6. Secondary characteristics
7. Stratigraphy of ash flow tuffs

III. VOLCANICLASTICS

1. Air fall tuff characteristics
2. Distinguishing air falls from ash flows

IV. TERTIARY CALDERAS OF NEVADA

1. Volcanic province
2. Calderas of Nevada test site and vicinity
3. Stonewall Mountain

THURSDAY morning

I. GEOLOGY OF HYDROTHERMAL FEATURES

1. Surface characteristics of water- and vapor-dominated systems
2. Research drilling in Yellowstone
3. Geyser mechanisms

II. HYDROTHERMAL SYSTEMS IN CALDERAS

1. Physical parameters of water circulation
2. System models
3. Yellowstone
4. Long Valley
5. Paleo system examples

III. GEOLOGY OF OTHER VOLCANIC GEOTHERMAL SYSTEMS

1. Roosevelt Hot Springs, Utah
2. Cove Fort-Sulphurdale, Utah

FRIDAY morning

I. HYDROTHERMAL FLUIDS

1. Water classification
2. Water chemistry
3. Gas chemistry
4. Isotopes
5. Relations of fluid types in active volcanic systems
6. Water-rock interaction
7. Comparison of fluids in active and paleo systems

II. HYDROTHERMAL ALTERATION

1. Stability and solubility of minerals
2. Alteration environments
3. Alteration in Yellowstone
4. Comparison with other areas

III. ISOTOPIC AGE DATING

1. Goals of dating in volcanic and hydrothermal environments
2. K-Ar Dating
3. Fission-track dating

C. PROPOSED BUDGET

1. Salaries

Dennis Nielson	8 days
Duncan Foley	8 days
Regina Capuano	4 1/2 days
Drafting	2 days
Secretary	1 day

2. Travel<sup>1</sup>

One-way flight SLC-WY<sup>2</sup>  
16 1/2 days per diem  
15 nites motel

3. Other Expenses

Meeting room  
Equipment rental  
Drafting supplies  
Course notes publication

4. Total \$10,630

<sup>1</sup> Transportation will be by van, rented by Union

<sup>2</sup> Regina Capuano joins course in progress

D. PROFESSIONAL RESUMES

RESUME

Regina M. Capuano

POSITION: Geochemist, Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah

EDUCATION: M.S., Geosciences (Economic Geology, Geochemistry), 1977, University of Arizona, Tucson, Arizona  
B.S. cum laude, Geology, minor: Math, 1974, State University of New York College at Brockport, New York

SOCIETY AFFILIATIONS: The Society of Economic Geologists  
The Geochemical Society  
The Society of Petroleum Engineers

PROFESSIONAL EXPERIENCE:

11/81-present Geochemist, Earth Science Laboratory, University of Utah Research Institute. Conduct and supervise programs directed toward the development and application of geochemical techniques for use in exploration, assessment and development of active hydrothermal systems.

2/78-10/81 Associate Geologist, Earth Science Laboratory, University of Utah Research Institute. Develop geochemical techniques to be used in the exploration and exploitation of low- to high-temperature geothermal systems.

4/80-11/80 Consultant, Resource Engineering Development Co., Midvale, Utah. Geochemistry of solution mining and restoration.

1/78-2/78 Consultant, Wyoming Mineral Corp., Lakewood, Colorado. Solved geochemical problems relevant to solution mining.

5/76-12/77 Research Assistant, Department of Geosciences, University of Arizona. Research on the geochemistry of uranium with applications to solution mining.

9/75-5/76 Teaching Assistant, Department of Geosciences, University of Arizona. Optical mineralogy and petrology.

1975 (summer) Cities Service Minerals Co., Tucson, Arizona. Geologic mapping, land status evaluation, and assisting in prospect appraisal for porphyry copper exploration.

PUBLICATIONS:

"Preliminary Analysis of the Formation of Uranium Roll Deposits as a Result of Reactions Between Circulating Fluids and an Arkose," Geological Society of America, Abstract with Programs, 9, 920 (1977).

"Chemical Mass Transfer and Solution Flow in Wyoming Roll-type Uranium Deposits," M. S. thesis, University of Arizona, 81 (1977).

"Initial Investigation of Soil Mercury Geochemistry as an Aid to Drill Site Selection in Geothermal Systems," Capuano, R. M. and Bamford, R. W., University of Utah Research Institute, Earth Science Laboratory, Report No. 13, 32 (1978).

"Multi-element Geochemistry of Solid Materials in Geothermal Systems and Its Application, Part I: The Hot-water System at the Roosevelt Hot Springs KGRA Utah," Bamford, R. W., Christensen, O. D. and Capuano, R. M., Earth Science Laboratory, University of Utah Research Institute, Report No. 30, 168 (1980).

"Hg and As Soil Geochemistry as a Technique for Mapping Permeable Structures Over a Hot-water Geothermal System," Capuano, R. M. and Moore, J. N., Abstract with Programs, Rocky Mountain Sec. meeting of Geological Society of America, 12, No. 5, 269 (1980).

"Trace Element Geochemical Zoning in the Roosevelt Hot Springs Thermal Area, Utah," Christensen, O. D., Moore, J. N. and Capuano, R. M., Geothermal Resources Council Trans., 4, 149-152 (1980).

"Multi-element Analysis of Geologic Materials by Inductively Coupled Plasma-Atomic Emission Spectroscopy," Christensen, O. D., Kroneman, R. L. and Capuano, R. M., Earth Science Laboratory, University of Utah Research Institute, Report No. 32, 33 (1980).

"Geothermal Exploration at Hill Air Force Base, Ogden, Utah," Glenn, W. E., Chapman, D. S., Foley, D., Capuano, R. M., Sibbett, B. S., Cole, D. and Ward, S. H., Earth Science Laboratory, University of Utah Research Institute, Report No. 34, 77 (1980).

"Geothermal Exploration at Hill Air Force Base, Ogden, Utah," Glenn, W. E., Chapman, D. S., Foley, D., Capuano, R. M., Sibbett, B. S., Cole, D. and Ward, S. H., Abstract with Programs, Rocky Mountain Sec. Geological Society of America, 12, No. 5, 274 (1980).

"An Evaluation of Exploration Methods for Low-temperature Geothermal Systems in the Artesian City Area, Twin Falls and Cassia Counties, Idaho," Struhsacker, E. M., Smith, C. and Capuano, R. M., Geol. Soc. Am. Bull., in press.

"Analysis of Ground Water Criteria and Recent Restoration Attempts After In-situ Uranium Leaching," Buma, G., Johnson, P., Bienek, G., Watson, G., Noyes, H. and Capuano, R., Prepared for the U.S. Bureau of Mines by Resources Engineering Development, Contract No. JO 295019 (1980).

"Fluid-mineral Equilibria in a Hydrothermal System, Roosevelt Hot Springs, Utah," Capuano, R. M. and Cole, D. R., Geochim. et Cosmochim. Acta, 46, 1353-1364 (1982).

"Water Chemistry as an Aid in Reconnaissance Exploration for a Low-Temperature Geothermal System, Artesian City Area, Idaho," Capuano, R. M., Geothermal Resources Council Transactions, 5, p. 59-62 (1981).

"Trace Element Zoning in the Roosevelt Hot Springs Thermal Area, Utah," Christensen, O. D., Capuano, R. M., and Moore, J. N., J. Volcanology and Geothermal Research, in press.

"Geochemical Indicators of a High-Temperature Geothermal System," Moore, J. N., Capuano, R. M., and Christensen, O. D., 9th International Geochemical Exploration Symposium, Saskatoon, Canada, May 12-14, (1982).

"An Overview of the Chemical Aspects of Mineral-Solution Interaction in Leach Systems," Cole, D. R., Apps, J., Capuano, R. M., Kusik, C. L., Langmuir, D., and Wadsworth, M. E., 183rd Am. Chem. Soc. Nat. Meeting, Las Vegas, Nev., Geochemistry GEOC 87 (1982).

"Evaluation of the Geothermal Reservoir Associated with Auburn and Johnson Hot Springs, Upper Star Valley, Wyoming", Adams, M. C., and Capuano, R. M., Geothermal Resources Council Transactions, 6, p. 73-76 (1982).

"Depositional Environments of Trace Elements in Soils Over an Active Hydrothermal System, Roosevelt Hot Springs, Utah," Capuano, R. M., Geol. Soc. Am. Annual Meeting, Abstract with Programs, 14, no. 7, p. 459 (1982).

"Numerical Modeling of the Chemical Processes of Solution Mining," Capuano, R. M., Am. Chem. Soc., Southwest and Rocky Mountain Combined Regional Meeting, Dec. 1-3, 1982, El Paso, Texas, Abs. No. 106 (1982).

## RESUME

Duncan Foley

BIRTHPLACE AND DATE: Appleton, Wisconsin, December 17, 1947

POSITION: Geologist, Project Manager, Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah

EDUCATION: B.A., Geology, 1971, Antioch College, Yellow Springs, Ohio  
M.Sc., Geology, 1973, Ohio State University; emphasis on environmental geology  
Ph.D., Geology, 1978, Ohio State University; emphasis on volcanic geology

PROFESSIONAL AFFILIATIONS: 1982, American Association of Petroleum Geologists  
1980, Utah Geological Association  
1979, American Geophysical Union  
1978, Geothermal Resources Council  
1976, Society of Sigma-Xi  
1972, Geological Society of America

### PROFESSIONAL EXPERIENCE:

- 6/79-present Geologist, Project Manager, Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah. Project Manager for programs of low- and moderate-temperature geothermal resource assessment in western and Great Plains states, including coordination with two U. S. Geological Survey resource assessment efforts, evaluation of geothermal resources at federal facilities, transfer of resource assessment technology to private sector explorationists, and evaluation of geothermal resources in proposed wilderness areas. Participated in project to estimate national geothermal market potential. Ongoing study of central Idaho geothermal systems.
- 1979-present Instructor, Yellowstone Institute, for "Calderas and Hydrothermal Systems," a week long lecture and field course that emphasizes interpretation of ash-flow tuff stratigraphy, caldera evolution, and the geological nature of hydrothermal systems in calderas; taught in Yellowstone National Park.
- 1/78-6/79 Associate Geologist, Earth Science Laboratory. Assisted in management of U. S. Department of Energy funded program of low-temperature geothermal resource assessment in western U. S. Environmental geologist for overview of southern Utah Known Geothermal Resource Areas.
- 9/73-1/78 Teaching Associate, Department of Geology and Mineralogy, Ohio State University. Environmental geology, historical geology, introductory geology, oceanography, field methods, and for three summers at central Utah field camp. Taught "Geology and the Environment." Also held research position in K-Ar Isotope Geochronology Lab.

- 7/73-8/73 Dr. Wayne A. Pettyjohn, Ohio State University. Water sampling and observing detailed reclamation progress for ground control for remote sensing of strip-mined lands.
- 6/72-9/72 Field Assistant, Dr. James W. Collinson, Ohio State University, N.S.F. Grant. Regional Upper Paleozoic stratigraphy of east-central Nevada.
- 6/71-9/71 and 9/72 Field Assistant, U.S. Geological Survey, Western Mineral Resources Branch, Menlo Park, California. Geologic mapping near Goldfield, Nevada, with emphasis on volcanic stratigraphy.
- 9/69-12/69 Assistant Community Manager, Community Government, Antioch College, Yellow Springs, Ohio. Management of diverse student programs, involving financial, personnel, and extensive college and community contact.
- 4/69-8/69 Physical Science Aide, U.S. Geological Survey, Pacific Mineral Resources Branch, Menlo Park, California. Mineral separations lab; geochemical sampling of alteration assemblages and detailed geologic mine mapping in Goldfield and Silver Peak, Nevada.
- 9/66-12/66 Assistant, Geology Department, Field Museum of Natural History, Chicago, Illinois. Fossil Invertebrates; curating trilobite collection.

PROFESSIONAL ACTIVITIES:

Presented talks on geologic parameters of geothermal energy to American Association for the Advancement of Science (1980), Industrial Development Research Council (1980), National Rural Electric Cooperative Association (1980), National Water Well Association (1979), U.S. Department of Energy Contractors (1978, 1979, 1980), Intermountain Institute of Food Technologists (1982), and Snake River Section of American Institute of Mining Engineers (1982).

Coleader of Geothermal Systems of the Yellowstone Caldera fieldtrip, Geothermal Resources Council (1980), leader of Wyoming Geological Association field trip to hydrothermal systems of northern Yellowstone National Park (1982).

President, Basin and Range Section, Geothermal Resources Council (1980-82).

Secretary, Utah Geological Association (1981-1982)

Courses and workshops attended: Geothermal energy in the Cascades (1981); Geochemical fundamentals for geothermal exploration and reservoir evaluation (1980); Fission-track age dating (1979), "Direct Utilization of Geothermal Energy: Development of Four Educational Reports" (1979), Geothermal Geology of Yellowstone (1978); Volcanic rocks and their vent areas (1978); Direct utilization of geothermal energy (1978).



PUBLICATIONS:

"Geology and Land-Use Planning on the Big Darby Creek, Ohio, Watershed," Foley, D. and McKenzie, G. D., Geol. Soc. of Am., Abstracts with Programs, 6, No. 6, 508 (1974).

"Geology of the Stonewall Mountain Volcanic Center, Nye County, Nevada," Foley, D. and Sutter, J. F., Geol. Soc. of Am., Abstracts with Programs, 10, No. 3, 105 (1978).

"The Essence of Urban Environmental Geology," McKenzie, G. D., Utgard, R. O., Foley, D. and McKenzie, D. I., Journal of Geological Education, 26, 32-37 (1978).

"Geology in the Urban Environment," Utgard, R. O., McKenzie, G. D. and Foley, D., eds., Burgess Pub. Co., Minneapolis, Minn., 355 p., (1978).

"Western States Cooperative Direct Heat Geothermal Program of DOE," Wright, P. M., Foley, D., Nichols, C. R. and Grim, P. J., Geothermal Resources Council, 2, Section 2, 739-741 (1978).

"Geology Effects," Environmental Overview Report on Utah Geothermal Resource Areas, Foley, D., in White, K. L., Hill, A. C. and Ursenbach, W. O., eds., Lawrence Livermore Lab UCRL-13955, 1, 6.1-6.13 (1978).

"State Coupled Resource Assessment Program - An Update," Foley, D., Wright, P. M., Struhsacker, D. W., Nichols, C. R., Mink, L. L., Brophy, G. P., Grim, P. J. and Berry, G. Geothermal Resources Council Transactions, 3, 217-219 (1979).

"Nature and Distribution of Geothermal Energy," Muffler, L. J. P., Costain, J. K., Foley, D., Sammel, E. A. and Youngquist, W., Direct Utilization of Geothermal Energy: A Technical Handbook, D. H., Anderson and J. W. Lund, eds., Geothermal Resources Council Special Report No. 7, 1-1 to 1-15 (1979).

"The State Coupled Program - A New Emphasis," Foley, D., Brophy, G. P., Mink, L. L. and Blackett, R. E., Geothermal Resources Council Transactions, 4, 779-781 (1980).

"Geothermal Exploration Program Hill Air Force Base, Davis and Weber Counties, Utah," Glenn, W. E., Chapman, D. S., Foley, D., Capuano, R. M., Cole, D., Sibbett, B. S., Ward, S. H., University of Utah Research Institute, Earth Science Laboratory, Rept. 34, 77 p. (1980).

"Exploration Strategies for Regional Assessment of Hydrothermal Resources," Ward, S. H., Foley, D., Moore, J. N., Nielson, D. L., Ross, H. P., Wright, P. J., in Witherspoon, P., Bresee, J., eds., in preparation.

"Low-temperature Geothermal Resources in the Central and Eastern United States," Sorey, M. L., Reed, M. J., Foley, D., Renner, J. L., in Reed, M. J., ed., Assessment of low-temperature geothermal resources of the United States-1981: U. S. Geological Survey Circular, in press (1982).

"Hydrothermal Systems of Central Utah - A Regional Perspective," (abs.), Foley, D., in Britt, T. L., ed., Program and abstracts for the Utah Geological Association 1982 symposium on the overthrust belt of Utah; Utah Geological Assoc. Pub. 11, p. 18.

Field Trip Road Logs for 6 Highway Routes in Yellowstone National Park, Foley, D., Nielson, D. L., Nichols, C. R., in Reid, S. G., Foote, D. J., Geology of Yellowstone Park Area: Wyoming Geological Association 33rd Annual Field Conference Guidebook, pgs. 343-352, 356-363 (1982).

"Road Log, Field Trip #3 Emphasizing Geothermal Phenomena," Foley, D., in Goolsby, J. E., ed., Field Trip Road Logs: Wyoming Geological Association 33rd Annual Field Conference, p. 22-24, (1982).

"Tables of Co-located Geothermal Sites and BLM Wilderness Study Areas," Foley, D., Dorscher, M., Earth Science Lab Open File Report 107, DOE/ID/12079-88.

RESUME

Dennis L. Nielson

POSITION: Section Manager - Geology, Earth Science Laboratory, University of Utah Research Institute, Salt Lake City, Utah

EDUCATION: B.A., Geology, 1970, Beloit College, Beloit, Wisconsin  
M.A., Geology, 1972, Dartmouth College, Hanover, New Hampshire  
Ph.D., Geology, 1974, Dartmouth College, Hanover, New Hampshire

SHORT COURSES: Volcanic Rocks and Their Vent Areas, University of Nevada, Reno, 1977  
Engineering Management by Objectives for Improving Productivity, University of Utah, 1978  
Geothermal and Hydrothermal Systems, Yellowstone Institute, 1978  
Economics of Minerals and Energy Projects, AIME, 1981

SOCIETY AFFILIATIONS: American Geophysical Union  
Geological Society of America  
Geothermal Resources Council  
Utah Geological Association

HONORS AND AWARDS: Haven Science Prize, Beloit College (1970)  
NDEA Title IV Fellowship - Dartmouth College (1971-1974)  
American Men and Women of Science  
President, Basin and Range Section, Geothermal Resources Council (1979)

PROFESSIONAL EXPERIENCE:

7/80-present Section Manager - Geology. Earth Science Laboratory, University of Utah Research Institute. Responsible for overall technical quality of geologic work and management of the geologic staff.

7/79-present Geologist/Project Manager, Earth Science Laboratory, University of Utah Research Institute. Project manager for the following programs under Department of Energy contracts: Geothermal Exploration and Assessment Technology Program, Industry Coupled Program, M-X/Renewable Energy Systems Program. Responsible for coordinating technical work at Roosevelt Hot Springs KGRA, Utah; and Beowawe; Tuscarora; Colado; McCoy; Soda Lake-Stillwater KGRAs, NV. Formulation and technical review of procurements, contract monitoring, and program design. Also manager of numerous proprietary geothermal exploration programs. Participated in a program to assess the state-of-the-art and recommend needed research in an industry sponsored program in solution mining and hydrometallurgy.

- 1979-present      Instructor, Yellowstone Institute, for a course on Calderas and Hydrothermal Systems which concentrates on the formation of calderas, ash-flow tuff stratigraphy, and the geology of hydrothermal systems in the caldera environment.
- 4/78-7/79        Geologist, Earth Science Laboratory, University of Utah Research Institute. Develop case studies for geothermal resource areas in western U.S. Responsibilities include supervision of geologic programs, geologic mapping, synthesis and publication of exploration data, and formation of exploration criteria.
- 6/74-4/78        Staff Geologist, The Anaconda, Co., Salt Lake City, Utah. Uranium exploration in frontier project areas in the United States. Responsible for generating and supervising projects through the initial drilling stages. Experience in Precambrian plutonic and metasedimentary environments and Tertiary volcanic and sedimentary environments. Activities included detailed mapping, quadrangle mapping, regional reconnaissance, interpreting geophysical and geochemical data, supervising rotary and diamond drilling, and land acquisition through leasing and claim staking.
- 1971 summer     Field Geologist, Great Lakes Exploration Co. (subsidiary of Bear Creek Mining Co.). Reconnaissance mapping in the Precambrian Shield of the Upper Peninsula of Michigan and northern Wisconsin. The mapping was designed to locate areas having potential for massive sulfide deposits.
- 1970 summer     Field Geologist, Great Lakes Exploration Co. (subsidiary of Bear Creek Mining Co.). Quadrangle mapping and geochemical surveys of water wells and soils in conjunction with a massive sulfide exploration program in northern Wisconsin.
- 1968 fall        Field Assistant, Bear Creek Mining Co. Base metal exploration in the Upper Peninsula of Michigan and northern Wisconsin. Duties included drafting, supervising diamond drilling, and assisting with field mapping.

#### PUBLICATIONS:

##### PAPERS AND TECHNICAL REPORTS

- Nielson, D. L., 1973, Silica diffusion at Ascutney Mountain, Vermont: Contributions to Mineralogy and Petrology, v. 40, p. 141-148.
- Nielson, D. L., Clark, R. G., Lyons, J. B., Englund, E. J., and Borns, D. J., 1976, Gravity models and mode of emplacement of the New Hampshire Plutonic Series, in Lyons, P. C., and Brownlow, A. H. (eds.) Studies in New England Geology: Geological Society of America Memoir 146, 301-318.

- Nielson, D. L., Sibbett, B. S., McKinney, D. B., Hulen, J. B., Moore, J. N., and Samberg, S. M., 1978, Geology of Roosevelt Hot Springs KGRA, Beaver County, Utah: University of Utah Research Institute, Earth Science Laboratory, Rept. No. 12, 121 p.
- Nielson, D. L., 1978, Radon in geothermal exploration, theory and an example from Roosevelt Hot Springs KGRA, Utah: University of Utah Research Institute, Earth Science Laboratory, Rept. No. 14, 31 p.
- Nielson, D. L., and Moore, J. N., 1979, The exploration significance of low-angle faults in the Roosevelt Hot Springs and Cove Fort-Sulphurdale Geothermal Systems, Utah: Geothermal Resources Council Transactions, v. 3, p.503-506.
- Nielson, D. L. (ed.) 1979, Program Review: Geothermal Exploration and Assessment Technology Program including a report of the Reservoir Engineering Technical Advisory Group: University of Utah Research Institute, Earth Science Laboratory, Rept. No. 29, 128 p.
- Foley, D., Nielson, D. L., and Nichols, C. R., 1980, Geothermal systems of the Yellowstone Caldera: Geothermal Resources Council Field Trip No. 1, 69 p.
- Glenn, W. E., Hulen, J. B., and Nielson, D. L., 1980, A comprehensive study of LASL Well C/T-2 Roosevelt Hot Springs KGRA, Utah and application to geothermal well logging: Los Alamos Scientific Laboratory, Rept. LA-8686-MS, 175 p.
- Nielson, D. L. (ed.) 1980, Geothermal Systems in Central Utah: Geothermal Resources Council Guidebook to Field Trip No. 7, 54 p.
- Nielson, D. L., 1980, Summary of the geology of the Roosevelt Hot Springs Geothermal System, Utah: in Nielson, D. L. (ed.), Geothermal Systems in Central Utah, Geothermal Resources Council Guidebook to Field Trip No. 7, p.25-29.
- Nielson, D. L., Moore, J. N., and Forrest, R. J., 1980, Road log to geothermal systems in central Utah: in Nielson, D. L. (ed.), Geothermal Systems in Central Utah, Geothermal Resources Guidebook to Field Trip No. 7, p.44-54.
- Sibbett, B. S., and Nielson, D. L., 1980, Geology of the central Mineral Mountains, Beaver County, Utah: University of Utah Research Institute, Earth Science Laboratory, Rept. No. 33, 42 p.
- Ward, S. H., Ross, H. P., and Nielson, D. L., 1981, Exploration strategy for high-temperature hydrothermal systems in the Basin and Range Province: Am. Assoc. Petroleum Geologists Bull., 65/1 p.86-102. Reprinted in Energy Minerals, AAPG reprint Series No. 25, p. 232-248.
- Nielson, D. L., 1981, The bedrock geology of the Hillsboro quadrangle, New Hampshire: N. H. Dept. of Resources and Economic Development Bull. No. 8, 76 p.

- Ross, H. P., Nielson, D. L., and Moore, J. N., 1982, Roosevelt Hot Springs geothermal system, Utah-Case Study: Am. Assoc. Petroleum Geologists Bull., v. 66, no. 7, p. 879-902.
- Nielson, D. L., (ed.), 1982, Overthrust belt of Utah: Utah Geological Association Publication 10, 335 p.
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