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## ROGER C. HENNEBERGER

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### **PRESENT POSITION**

Vice President, Earth Sciences

### **EXPERTISE**

- Technical and economic assessment of geothermal resources
- Design and implementation of geothermal exploration programs
- Planning and management of geothermal drilling and well testing programs
- Technical and financial control of geothermal development and operations
- Design, coordination and implementation of wellsite geology, well testing, instrumentation and downhole measurements in geothermal wells
- Well targeting and design of drilling programs
- Design and management of computerized data bases; development of analytical and financial software
- Assessment of geological hazards
- Permitting and regulatory compliance
- Detailed petrographic and petrologic analysis: transmitted and reflected light microscopy, X-ray diffraction, electron microscopy, clay mineralogy, chemical analysis, fluid inclusion studies
- Geochemical sampling

### **EDUCATION**

M.Sc. in Geology (First Class Honours), Univ. of Auckland (New Zealand), 1983

B.S. in Geology (Distinction), Stanford University, 1978

Fluent in Spanish; reads and speaks Portuguese and German

## EXPERIENCE

### *GeothermEx, Inc., 1984-present*

- Geologic modeling and resource assessment of geothermal fields at: The Geysers, California; Momotombo, Nicaragua; Wayang Windu, Indonesia; San Jacinto, Nicaragua; Miravalles, Costa Rica; Rincón de la Vieja, Costa Rica; Tenorio, Costa Rica; Karaha-Telaga Bodas, Indonesia; Bacon-Manito, Philippines; Lihir Island, Papua New Guinea; San Vicente, El Salvador; Meager Creek, Canada; Coso Hot Springs, California; Salton Sea, California; Cerro Prieto, Mexico; Zunil, Guatemala; Los Azufres, Mexico; Tres Vírgines, Mexico; Los Humeros, Mexico; Puna, Hawaii; Dixie Valley, Nevada; Steamboat Springs, Nevada; San Ignacio, Honduras; Takigami, Japan; São Miguel, Azores (Portugal); Desert Peak, Nevada; Beowawe, Nevada; Sierra Valley, California; Litchfield, California; Fish Lake Valley, Nevada; Ogden, Utah; Empire, Nevada; Vale, Oregon; Terceira, Azores Tauhara, New Zealand; 1984-present.
- Integration of technical data from deep exploratory wells, conceptual modeling of the geothermal resource, and preparation of feasibility report for the Las Pailas geothermal field, Costa Rica, 2002 - present.
- Managed the assessment of the geothermal resources of India and pre-feasibility studies of selected areas, 2001.
- Integrated resource review and assessment for planning a major expansion of the Pico Vermelho project on São Miguel, Azores (Portugal). Work includes selection of drilling sites and targets for new production and injection wells, and determination of overall drilling requirements for long-term field operations, 2001 - present.
- Design and implementation of geologic and geophysical investigations (including the drilling of deep temperature gradient wells) for the planned development of a new geothermal project on Ilha Terceira, Azores (Portugal), 1999 – present.
- Planning, coordination, geologic studies and environmental studies for the Master Plan study of the geothermal resources of Nicaragua, 1999 – 2001.
- Evaluations of field management and development options for geothermal projects on São Miguel Island (Azores), leading to successful expansion of capacity. Work included well design and wellsite geology for two successful production wells. 1996 – 2001.
- Economic valuation of geothermal wells at the Ahuachapán and Berlin fields, El Salvador, 2001.
- Planned and managed the drilling and workover of six deep (to 11,400 feet) steam wells in the Northwest Geysers geothermal field, California, for Geothermal Energy Partners, Ltd., 1992 - 1997.

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- Nationwide assessment to characterize and rank the geothermal resources and assess the feasibility of various utilization projects, Republic of Armenia, 1998.
- Coordinated and led seminar in geothermal exploration (seminar conducted entirely in Spanish), Costa Rica, 1993.
- Monitoring of drilling operations, assessment of the technical and financial status of drilling and development the Cerro Prieto geothermal field, Mexico, 1991 - 1995.
- Wellsite geology and technical monitoring of drilling operations at: The Geysers, California; Bradys Hot Springs, Nevada; Empire, Nevada; Zunil, Guatemala; Coso Hot Springs, California; Meager Creek, British Columbia; Gerlach, Nevada; and São Miguel, Azores (Portugal); 1985 - 2000.
- Well testing, downhole measurements and geochemical sampling at: Brady's Hot Springs, Nevada; Coso Hot Springs, California; Amatitlán, Guatemala; The Geysers, California; Gerlach, Nevada; Dieng, Indonesia; Lihir Island, Papua New Guinea; East Mesa, California; Wayang Windu, Indonesia; Fish Lake Valley, Nevada; São Miguel, Azores (Portugal); Steamboat Springs, Nevada; Cibuni, Indonesia; and Empire, Nevada; 1985 - 1997.
- Design and supervision of well workover, repair or abandonment programs at Cerro Prieto, Mexico; The Geysers, California; and Casa Diablo (Mammoth), California; 1993 - 1998.
- Design and supervision of temperature gradient and slim hole drilling programs at: Sierra Valley, California; Vale, Oregon; Gerlach, Nevada; Litchfield, California; Brady's Hot Springs, Nevada; and Terceira, Azores; 1984 - 2001.
- Economic evaluation and cash flow analysis of existing and proposed geothermal operations at: The Geysers, California; Imperial Valley, California; Momotombo, Nicaragua; Mt. St. Helens, Washington; Puna, Hawaii; and Meager Creek, Canada 1986 - 1995.
- Comprehensive assessment of geothermal resource potential throughout The Geysers geothermal field and surrounding areas, 1986.
- Geological analysis for selection of well targets and well designs at: The Geysers, California; São Miguel, Azores (Portugal); Zunil, Guatemala; Meager Creek, Canada; Bradys Hot Springs, Nevada; Empire, Nevada; Rincón de la Vieja, Costa Rica; 1987 - 2000.
- Developed software for probabilistic assessment and economic evaluation of geothermal projects, 1991 - 1992.
- Instrumentation of wells and coreholes at Puna, Hawaii; Bingham, Utah; and Litchfield, California.

- Computerized mathematical modeling of heat flow at Kocani Valley, Yugoslavia, 1984.
- Statistical study of flow characteristics of more than 500 geothermal wells in the United States, 1986.

### *Field Geologist, Noranda Exploration, Reno, Nevada, 1980*

- Geologic mapping and core logging at a molybdenum prospect in northeastern Nevada.

### *Associate Geologist, Fluor Mining and Metals, Redwood City, California, 1979 - 1980*

- Executed ore reserve estimation studies and developed computer-based systems for ore deposit simulation using modern geostatistical techniques. Projects included assessments of major copper, uranium, precious metals and coal deposits in the U. S., Canada, Australia, and China.

### *Geologist, U.S. Geological Survey, Menlo Park, California, 1977 - 1978*

- Developed a comprehensive computer package for storing, manipulating and interpreting data from geodetic leveling surveys.

## **MEMBERSHIPS**

Geothermal Resources Council

International Geothermal Association

## **SELECTED PUBLICATIONS**

National Assessment of U.S. Geothermal Resources – A Perspective. Transactions, Geothermal Resources Council, Vol. 28, 2004 (with Subir K. Sanyal, Christopher W. Klein, and James W. Lovekin).

Pico Alto, Terceira: A New Geothermal Field in the Azores. Transactions, Geothermal Resources Council, Vol. 28, 2004 (with Rui Cabeças, Rita Martins, and Eduardo Granados).

Status of the South Meager Geothermal Project British Columbia, Canada: Resource Evaluation and Plans for Development. Transactions, Geothermal Resources Council, Vol. 28, 2004 (with M. Ghomshei, K. MacLeod, S. Sanyal, A. Ryder, J. Meech, and B. Fairbank).

Injection Testing for an Enhanced Geothermal System Project at Desert Peak, Nevada. Transactions, Geothermal Resources Council, Vol. 27, 2003.

Dealing with Uncertainties in Drilling Geothermal Wells: A Case History from The Azores. Transactions, Geothermal Resources Council, Vol. 25, 2001.

Geothermal resources of Armenia. Proceedings, World Geothermal Congress, 2000.

Development of a geothermal Master Plan for Nicaragua. Proceedings, World Geothermal Congress, 2000.

Numerical modeling of the Cerro Prieto geothermal field, Mexico. Proceedings, World Geothermal Congress, 2000.

Development of injection capacity for the expansion of the Ribeira Grande geothermal projects, São Miguel, Açores, Portugal. Proceedings, World Geothermal Congress, 2000.

Advances in multiple-legged well completion methodology at The Geysers geothermal field, California. Proceedings, World Geothermal Congress, 1995.

Drilling and completion of multiple legs in the northwest Geysers. Transactions, Geothermal Resources Council, Vol. 17, 1993.

A new discovery well in the upper Agua de Pau geothermal system, São Miguel Island, Azores: results of drilling and testing. Transactions, Geothermal Resources Council., Vol. 14, 1990.

Economic analysis of steam production from The Geysers geothermal field, California. Transactions, Geothermal Resources Council, Vol. 13, 1989.

Stratigraphic and structural controls of the occurrence of steam at The Geysers. Transactions, Geothermal Resources Council, Vol. 13, 1989.

Statistical analysis of geothermal wells in the western United States. Report EPRI AP-5310, Project 2195-8, Electric Power Research Institute, 1987.

Hydrothermal alteration and evolution of the Ohakuri geothermal system, Taupo volcanic zone, New Zealand. Journal of Volcanology and Geothermal Research, Vol. 34, 1988.

## **CITIZENSHIP**

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