FINAL REPORT

PROJECT TITLE: Accelerated Geothermal Resource Development in the Great Basin Through Enhanced Public Awareness and Outreach to Stakeholders

COVERING PERIOD: August 1, 2001 through August 30, 2002

DATE OF REPORT: November 1, 2002

RECIPIENT: University of Nevada, Reno,
MS 172, Reno, NV 89557-0088

AWARD NUMBER: Award Number: 2010467
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OTHER PARTNERS: Sub-awardees.
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PROJECT OBJECTIVE: The Great Basin Center for Geothermal Energy conducted work encompassing two main tasks. We (1) produced a web-based, stakeholder geothermal information system for Nevada geothermal data relevant to assessing and developing geothermal resources, and (2) we held informational stakeholder workshops (both as part of GeoPowering the West Initiative).

The objective of this grant was to conduct workshops and fund database and web development activities. This grant funds salaries for web and database developers and part of the administrative assistant who helps to coordinate and organize workshops, and maintain selected databases.

BACKGROUND:

The Great Basin Center for Geothermal Energy was established at the University of Nevada, Reno in May 2000 to promote research on and utilization of geothermal resources in the Great Basin of the Western United States. The Center received funding through this grant to promote increased geothermal development in the Great Basin.

This grant was used to support public outreach activities including web page and database development, and conducting informational workshops for stakeholders. Web page development and organization of workshops is an on-going activity through additional funding to the Center through DOE-ID. Several workshops were organized and executed during the funding cycle under this grant, and these are reported below.

RESULTS:

Workshops

Workshops that were conducted as part of the GPW activities include the following:

1. In May 2001 the Center organized a *Joint UNR/USGS Geothermal Science Workshop* on the UNR campus to define areas of common interest in geothermal research and facilitate collaboration.
2. A second workshop, *Geothermal Opportunities in Nevada*, involved representatives from Nevada's geothermal industry, academia, and state and federal government agencies, and was organized by the Center and held on January 11, 2002. Over 200 people attended the highly successful workshop that identified barriers to geothermal development. The workshop focused on the many geothermal resources located throughout Nevada, as well as exploration, assessment and development of these resources. (Please check our website <http://www.unr.edu/geothermal/> for presentations given at the January 11, 2002 meeting.)
3. A third workshop was held January 17, 2002 at UNR to discuss and initiate Center collaboration with researchers from Lawrence Berkeley National Laboratory and Lawrence Livermore National Laboratory. On January 17, 2002, several of those in attendance at the January 11 meeting convened at the UNR campus to further discuss ideas for developing Nevada's geothermal sites. Both meetings were very successful with several collaborations being initiated between UNR, LLNL and LBL researchers.
4. A fourth workshop was held on April 18 and 19 at the Desert Research Institute in Reno. The title of this workshop was *Introduction to Geothermal Energy* and it was cosponsored with the Geothermal Resources Council (GRC) and the U.S. Department of Energy GeoPowering the West Program. Included in the workshop was a field trip to the Steamboat Hills geothermal area, followed by a tour of the Moana Geothermal District Heating System in south Reno.
5. A fifth workshop was organized and held in Reno June 12 and 13, 2002 to highlight *DOE sponsored research at the Dixie Valley Geothermal Area*. Principal investigators funded by the DOE to conduct research on the Dixie Valley Geothermal System met and presented preliminary and final results of their work. Following the formal presentations, working groups were assembled for the purpose of producing a document summarizing the results of DOE sponsored research at the site. A subset of participants met on June 14 to discuss preparation of a document from the workshop. The Center, in cooperation with DOE and INEEL, is currently assembling a document summarizing the results of the workshop that will include recommendations for future work in Dixie Valley and the Great Basin in general. The working groups were arranged by four topics: Geotectonics, Exploration, Geochemistry, and Reservoir Geology. A combined report of the four working groups will be drafted that summarizes the workshop's results and addresses the central question: Is Dixie Valley a good analog for other Basin and Range geothermal systems? The goal is for the summary to be used as a guide to future investigations of hydrothermal systems in the Great Basin. This document and the presentations will be published on the web and appropriate portions will be published in cooperation with GRC.

The Center, in cooperation with DOE and INEEL, assembled a document that summarizes the results of the Dixie Valley workshop and includes recommendations for future work in Dixie Valley and the Great Basin in general. The working groups, upon which the summaries are based, were arranged by four topics: Geotectonics/Geologic Setting, Exploration Technology Applications, Geochemical Studies, and Reservoir Geology, Structure and Analysis. Each working group prepared a report, and Shevenell (with input from selected workshop participants) led the preparation of an executive summary of the workshop and working group conclusions. The combined report of the four working groups summarizes the workshop's results and addresses the central question: Is Dixie Valley a good analog for other Basin and Range geothermal systems? The goal is for the summary to be used as a guide to future investigations of hydrothermal systems in the Great Basin. This document and the presentations are published on the Center's web site

(http://www.unr.edu/geothermal/meetingsandpresentations/meetings_pres.html)

and on a CD distributed by INEEL (Joel Renner) at the annual GRC Meeting. Appropriate portions of the workshop results will be published in cooperation with GRC.

Web Pages and Databases

In establishing an interactive, web based database, Oracle8i, ARCSDE, and ARCIMS software were installed on the server housing the Center's web pages in April 2002. Early attempts to install remote sensing data and other raster-type data have been slowed with problems related to the Oracle8i and ARCSDE interface. The UNR campus Oracle team is now in the process of resolving these Oracle problems, and Center personnel (Don Sawatzky) is working on the ARCSDE problems. It is anticipated that we should be able to generate geodatabases in the next quarter. ARCIMS, for viewing and delivery of maps and layers via standard web browsers, has been satisfactorily tested.

The Great Basin Geothermal data service has improved greatly in the last quarter of this grant with installation of a now operational relational database. Oracle8i was installed on the ALE data server in the Mackay School of Mines, UNR. An additional 40 Gbytes of disk storage was also installed.

ESRI ArcSDE was also installed and became operational. ArcSDE is an Oracle application that serves ESRI shape files and coverages and raster files of many formats. Test geodatabases were created and are available on the web. ArcSDE has the highly desirable advantage that its geodatabases can be composed of georeferenced files of different projections.

The data service is provided by ESRI ArcIMS. This package offers serving feature files or image files available from geodatabases on a data server. Importantly, maps composed of several geodatabase layers can be viewed, composed, and printed with a web browser, and are available to any personal computer connected to the web.

PLANS FOR THE FUTURE (WITH DOE-ID FUNDING):

Development of geodatabases and management of the Geothermal database now will be undertaken. Relevant geodata files available from several databases must now be considered for

addition to the Geothermal database. These will include base maps of cartographic and topographic information; geologic, geophysical, economic, and geothermal scientific data in vector format; and an abundance of satellite and aircraft images and thematic maps; and tabular data. These data layers will be added to the web page, as will results and data sets from on-going research projects being conducted by the Center's researchers. Additional workshops will be held in cooperation with the Center's DOI, Idaho Operations Office program manager Jay Nathwani, and with Joel Renner (INEEL) under continuing funding to the Great Basin Center for Geothermal Energy, through the cooperative grant DE-FG07-02ID14311 administered by DOE, Idaho Operations Office and the Idaho National Engineering and Environmental Laboratory.

PATENTS:

None.

RELATED ACCOMPLISHMENTS

Publications/Presentations:

Publications

- Arehart, G., M. Coolbaugh and S.R. Poulson. 2002. Geochemical Characterization of Geothermal Systems in the Great Basin: Implications for Exploration, Exploitation and Environmental Issues. Transactions Geothermal Resources Council 26: 479-482.
- Blewitt, G., M. Coolbaugh, W. Holt, C. Kreemer, J. Davis and R. Bennett. 2002. Targeting of Potential Geothermal Resources in The Great Basin from Regional Relationships Between Geodetic Strain and Geological Structures. Transactions Geothermal Resources Council 26: 523-526.
- Calvin, W., M. Coolbaugh and R.G. Vaughan. 2002. Geothermal Site Characterization Using Multi- and Hyperspectral Imagery. Transactions Geothermal Resources Council 26: 483-484.
- Coolbaugh, M., and R. Bedell, 2003, A Simplification of weights of evidence using a density function and fuzzy distributions: a comparison of probability modeling techniques in the designation of geothermal systems in Nevada; Geological Association Canada Special Volume "GIS applications in the Earth Sciences", *in press*.
- Coolbaugh, M., J. Taranik, G. Raines, L. Shevenell, D. Sawatzky T. Minor, and R. Bedell. 2002. A Geothermal GIS for Nevada: Defining Regional Controls and Favorable Exploration Terrains for Extensional Geothermal Systems. Transactions Geothermal Resources Council 26: 485-490.
- Faulds, J., L. Garside, G. Johnson, J. Muehlberg and G. Oppliger. 2002. Geologic Setting and Preliminary Analysis of the Desert Peak-Brady Geothermal Field, Western Nevada. Transactions Geothermal Resources Council 26: 491-494.
- Garside, L., L. Shevenell, J. Snow and R. Hess. 2002. Status of Nevada Geothermal Resource Development Spring 2002. Transactions Geothermal Resources Council 26: 527-532.
- Louie, J.N. 2002. Assembly of a crustal seismic velocity database for the western Great Basin. Transactions Geothermal Resources Council 26: 495-500.

- Skalbeck, J.D., R. Karlin, L. Shevenell, and M. Widmer, M. 2002. Geothermal reservoir volume estimation from gravity and aeromagnetic modeling of the Steamboat Hills geothermal area, Reno, Nevada. Transactions Geothermal Resources Council 26: 443-448.
- Shevenell, L. and J. Taranik. 2002. Overview of Activities of the Great Basin Center for Geothermal Energy. Transactions Geothermal Resources Council 26: 507-510.
- Shevenell, L., L. Garside, G. Arehart, M. van Soest, and B.M. Kennedy. 2002. Geochemical Sampling of Thermal and Nonthermal Waters in Nevada to Evaluate the Potential for Resource Utilization. Transactions Geothermal Resources Council 26: 501-506.
- Shevenell, L., and J.V. Taranik, 2002. Summary of Activities of the Great Basin Center for Geothermal Energy - Bulletin Geothermal Resources Council 31(5): 179-182.

Presentations

Presentations by Center personnel at the *Geothermal Opportunities in Nevada*, January 11, 2002, meeting:

Greg Arehart - Geochemical Techniques for Exploration and Assessment

Mark Coolbaugh - Regional Controls on the Distribution of Geothermal Systems in Nevada

Lisa Shevenell - Updated Database and Assessment of Nevada Geothermal Resources

James V. Taranik - Moderator of the session: Databases and Technology for Geothermal Assessment and Exploration in the Great Basin

Presentations by Center personnel at the Department of Energy's *Workshop on Dixie Valley Geothermal Research*, June 12-14, 2002:

James V. Taranik – Introductory remarks on the Center and the workshop

Lisa Shevenell – Session moderator of the Geochemical Studies session

Presentations by Center personnel at the *Annual Geothermal Resources Council Meeting*, Reno, NV, September 23-5:

Arehart, G. Geochemical Characterization of Geothermal Systems in the Great Basin: Implications for Exploration, Exploitation and Environmental.

Blewitt, G. Targeting of Potential Geothermal Resources in The Great Basin from Regional Relationships Between Geodetic Strain and Geological Structures, (Poster Only).

Calvin, W. Geothermal Site Characterization Using Multi- and Hyperspectral Imagery.

Coolbaugh, M. A Geothermal GIS for Nevada: Defining Regional Controls and Favorable Exploration Terrains for Extensional Geothermal Systems.

Oppliger, G. Geologic Setting and Preliminary Analysis of the Desert Peak-Brady Geothermal Field, Western Nevada

Garside, L. Status of Nevada Geothermal Resource Development Spring 2002.

Louie, J.N. Assembly of a crustal seismic velocity database for the western Great Basin (oral and poster presentations).

Shevenell, L. Overview of Activities of the Great Basin Center for Geothermal Energy.

Shevenell, L. Geochemical Sampling of Thermal and Nonthermal Waters in Nevada to Evaluate the Potential for Resource Utilization.

Lisa Shevenell Co-chair and session moderator of the Great Basin Studies session, with Colin Williams (USGS).

Lisa Shevenell Co-chair and session moderator of the Great Basin Center I and II sessions, with Jay Nathwani (DOE-ID).

Shevenell, L., P. Kasameyer, C. Bruton, J.L. Renner, and B.M. Kennedy, 2002. Executive Summary of the Workshop on DOE Sponsored Research at Dixie Valley, Nevada (June 12-14, 2002). Published on CD and at the following web site:
http://www.unr.edu/geothermal/meetingsandpresentations/intro_summarydv.pdf

MILESTONE STATUS TABLE:

ID Number	Task/Milestone Description	Planned Completion	Actual Completion	Comments
2	Shevenell & Taranik - GeoPowering the West			
2.01	Stakeholder Workshop Advisory Committee organized	07/2001	7/01	
2.02	Topics and agenda developed for Workshop 1	8/2001	9/01	
2.03	Initial design of web pages implemented	9/2001	9/01	
2.04	Workshop 1 is held in October 01	10/2001	1/02	
2.05	Initial input of Remote Sensing data on web pages.	10/2001	12/01	
2.06	Initial input of Geophysical data on web pages.	12/2001	3/02	
2.07	Second Workshop advertised	3/2002	4/02	
2.08	1/11/02 workshop proceedings on Web	3/15/2002	3/15/2002	
2.09	Develop Web; advertise for future workshops	3/15/2002	ongoing	
2.11	Assist GRC with 4/18/02 and 1/03 workshop	4/20/2002	4/20/2002	
2.11	Topics and agenda developed for Workshop 2	5/1/2002	4/30/2002	
2.12	Web based announcement of workshop	5/1/2002	5/1/2002	
2.13	Begin input of geophysical data	5/15/2002	in progress	
2.14	Create index map of known magnetotelluric surveys	6/1/2002	in progress	
2.15	Develop links to other geothermal data sites	6/1/2002	in progress	
2.16	Organize Dixie Valley workshop for DOE	6/15/2002	6/12/2002	

BUDGET DATA (as of August 30, 2002):

		Approved Spending Plan			Actual Spent to Date		
Phase/Budget Period		DOE	Cost	Total	DOE	Cost	Total
From	To	Amount	Share		Amount	Share	
7/01/2001	6/30/2002						
	UNR - Acct #						
GeoPowering the West	1330-114-0072	\$32,288		\$32,288	\$32,288		\$32,288
	Totals	\$32,288	\$0	\$32,288	\$32,288	\$0	\$32,288