



**STATE GEOLOGICAL SURVEY CONTRIBUTIONS TO THE
NATIONAL GEOTHERMAL DATA SYSTEM:
ACCOMPLISHMENTS FOR FEDERAL FISCAL YEAR 2012
OCTOBER 1, 2011 TO SEPTEMBER 30, 2012**

M. Lee Allison & Stephen M. Richard
Arizona Geological Survey



State geological survey employees collecting geothermal data.

OPEN-FILE REPORT OFR-13-11

August 2013

Arizona Geological Survey

www.azgs.az.gov | repository.azgs.az.gov



Arizona Geological Survey

M. Lee Allison, State Geologist and Director

Manuscript approved for publication in August 2013

Printed by the Arizona Geological Survey

All rights reserved

For an electronic copy of this publication: www.repository.azgs.az.gov

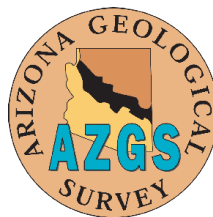
Printed copies are on sale at the Arizona Experience Store

416 W. Congress, Tucson, AZ 85701 (520.770.3500)

For information on the mission, objectives or geologic products of the
Arizona Geological Survey visit www.azgs.az.gov.

This publication was prepared by an agency of the State of Arizona. The State of Arizona, or any agency thereof, or any of their employees, makes no warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed in this report. Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the State of Arizona.

Recommended Citation: Allison, M.L. and Richard, S.M., 2013, State Geological Survey Contributions to the National Geothermal Data System: Accomplishments for Federal Fiscal Year 2012, October 1, 2011 to September 30, 2012. Arizona Geological Survey Open File Report, OFR-13-11, 38 p.



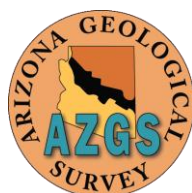
State Geological Survey Contributions to the National Geothermal Data System

Accomplishments through September 30, 2012



AASG
GEOTHERMAL DATA

Arizona Geological Survey



State Geological Survey Contributions to the National Geothermal Data System

Accomplishments for Federal Fiscal Year 2012
October 1, 2011 to September 30, 2012

Prepared by
Arizona Geological Survey
416 W. Congress Street, Suite 100
Tucson, AZ 85701

Under U.S. Department of Energy award DE-EE0002850

M. Lee Allison, Ph.D. & Stephen M. Richard, Ph.D.
Principal Investigators



This research was supported primarily by the U.S. Department of Energy's Geothermal Technologies Program and Office of Energy Efficiency & Renewable Energy program, under Award No. DE-E0002850.

Disclaimer: *"This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof."*

ANNUAL RESEARCH PERFORMANCE PROGRESS REPORT

Federal Agency and Organization: DOE EERE – Geothermal Technologies Program

Recipient Organization: Arizona Geological Survey on Behalf of the Association of American State Geologists

DUNS Number: 806758298

Recipient Address: 416 N. Congress Street, Suite 100 Tucson, AZ 85701

Award Number: DE-EE0002850

Project Title: State Geological Survey Contributions to the National Geothermal Data System

Project Period: 1/8/2010 to 4/30/2014

Principal Investigator: Lee Allison

State Geologist and Director, Arizona Geological Survey
Lee.allison@azgs.az.gov
520-209-4121

Report Submitted by: Kim Patten

(If other than PI)

Assoc. Dir. for Planning & Development
Kim.patten@azgs.az.gov
520-209-4125

Date of Report Submission: December 30, 2012

Reporting Period: October 1, 2011 through September 30, 2012

Report Frequency: Annual

Project Partners:

Alaska Division of Geological & Geophysical Surveys
Geological Survey of Alabama
Arkansas Geological Survey
Arizona Geological Survey
Colorado Geological Survey
Florida Geological Survey
University of Hawaii
Iowa Department of Natural Resources – Geological & Water Resources Survey
Idaho Geological Survey
The Board of Trustees of the University of Illinois, Illinois Geological Survey
Trustees of Indiana University, Indiana Geological Survey
University of Kansas Center for Research, Inc., Kansas Geological Survey
University of Kentucky Research Foundation, Kentucky Geological Survey
Board of Supervisors of Louisiana State University and A&M College, Louisiana Geological Survey
Massachusetts Geological Survey
Maine Geological Survey
Missouri Geological Survey, Department of Natural Resources, Division of Geology and Land Survey
Mississippi Department of Environmental Quality
Montana Bureau of Mines & Geology
North Carolina Geological Survey
University of North Dakota

New Hampshire Geological Survey
New Jersey Geological Survey
New Mexico Institute of Mining & Technology
Board of Regents, NSHE, obo University of Nevada, Reno, Nevada Bureau of Mines and
Geology
New York State Geological Survey
Ohio Department of Natural Resources, Division of Geological Survey
The Board of Regents of the University of Oklahoma, Oklahoma Geological Survey
Oregon Department of Geology and Mineral Industries
Pennsylvania Geological Survey
Rhode Island Geological Survey
South Carolina Geological Survey
Sinte Gleska University, South Dakota
Tennessee Division of Geology
Texas Bureau of Economic Geology
Utah Geological Survey
Virginia Division of Geology and Mineral Resources
Vermont Office of Department of Environmental Conservation
Washington State Department of Natural Resources
Wisconsin Geological and Natural History Survey
West Virginia Geological and Economic Survey
Wyoming State Geological Survey

In-Kind Partners:

Connecticut Geological Survey (through Massachusetts Geological Survey)
Delaware, Georgia, and Maryland Geological Surveys (through the Virginia Division of Geology
and Mineral Resources)
Nebraska Geological Survey (through the University of North Dakota)
North Dakota Geological Survey (through the University of North Dakota)
South Dakota Geological Survey

Cost Share Partners:

Alabama Geological Survey
Illinois Geological Survey
Minnesota Geological Survey
Oklahoma Geological Survey

DOE Project Team: DOE Contracting Officer – Genevieve Wozniak
DOE Project Officer – Arlene Anderson
Project Monitor – Grant Logsdon (for FY11)
Technical Lead – David Cuyler

CONTENTS

Annual Research Performance Progress Report.....	4
Executive Summary	7
Technical Accomplishments.....	9
Data Delivery	9
Data Interoperability & Content Models.....	10
Metadata.....	12
Repositories.....	12
AASG Repository.....	13
Source Code Repository.....	13
Applications	14
Management and Operations Accomplishments	16
Project Meetings.....	16
Science Advisory Board	16
Management Advisory Board	17
Collaboration	18
Staffing.....	19
Communications, Outreach, Technology Transfer.....	19
Publications.....	20
Presentations.....	20
News interviews and Other General Interest articles	23
Schedule, Milestones, and Status	25
Plans for FY 2013	25
Cost Status	26
ARRA Jobs Reporting.....	26
Actual or Anticipated Problems or Delays	27
Statement of Project Objectives Status of Tasks and Milestones	28

EXECUTIVE SUMMARY

For the second year in a row, the project has received “good” or “outstanding” review comments during the annual sponsor peer review. Each reviewer scored the project as “outstanding” the highest possible mark for relevance and impact of research. Comments include “*the project is collecting a treasure trove of data assets from all of the state geological surveys*” and “*state level data discovery, access, and cataloging/tagging are crucial to the larger NGDS goals.*” Also scored were the Scientific and Technical Approach; Project Management/Coordination; Accomplishments, Results, and Progress; Strengths; Weaknesses; and Suggested Improvements.

All 50 states are represented in the project and subcontractors been actively participating in data digitization, collection, and distribution. Unfortunately North Carolina was unable to accept the funding as originally intended and thus, the Virginia Division of Geology and Mineral Resources in collaboration with Dr. John Costain of Virginia Tech will assume the North Carolina data collection efforts. Both surveys worked together in order to achieve this compromise.

New data collection tasks have begun that were awarded under this project to Arizona, Colorado, Idaho, Indiana, Massachusetts, Maine, New Jersey, New Mexico, Nevada, Oklahoma, Oregon, Pennsylvania, Utah, Vermont, Washington, and West Virginia. All non-drill projects and all but one drill project have received National Environmental Policy Act (NEPA) clearance for the new data collection. Initial results are already showing positive contributions to the geothermal industry, including the discovery of a new geothermal resource in Utah’s Black Rock Desert (ranked #7 of the top 12 Geothermal Discoveries of 2012).

The efforts of the NGDS Architecture, Design, Testing, and Maintenance project at Boise State University under the new PI have greatly increased over the last quarter of FY12 and overall results have been positive. The System Vision, Software Requirements, Data Assessment and Inventory, and new Web site, Geothermaldata.org, have all been initiated or deployed with significant contributions from the AZGS staff. This coupled with the end user interaction bode well for effective collaboration over the next year. The project Web site (www.stategeothermaldata.org) and the BSU NGDS Web site now both point to the same data search and user interface tools.

Initial feedback from the user community at industry tradeshow and technical conferences has been incredibly positive and provided valuable feedback. With the increased end user engagement through the NGDS Architecture, Design, Testing, and Maintenance project at BSU, comments and feedback are provided directly to the PI and User Experience Contractors.

Milestones:

- Finalized Year 1 and 2 deliverables schedule
- Finalizing Year 3 statements of work with State Geological Survey subrecipients; some subrecipients required a mid-year review, which will occur in FY13.
- Achieved access to more than 2 million data points provided using Web services via the network
- Hosted meetings of the project Management and Scientific Advisory Boards; Management Advisory Board meeting was a webinar in July of 2012 and the Science Advisory Board meeting was hosting in coordination with the Association of American State Geologists Annual Meeting in Austin, TX in June of 2012.
- Hosted the annual regional Hub workshop in September 2012 in Tucson, AZ.
- Re-launched the AASG Contributions repository site and catalog for easier search and metadata contributions
- Released a new data search application for improved access to data

(search.geothermaldatasystem.org)

- Released data extraction application built for NGDS services (data.geothermaldatasystem.org)
- Released new and revised tutorials to assist in technology transfer (usgin.org and accessible through stategeothermaldata.org and geothermaldata.org)
- Continued improvements on internal workflows and deliverables tracking; including adding a new geoinformatics content specialist to assist with data QA/QC and web service deployment
- National Environmental Policy Act clearance completed on all non-drilling projects and all but one drill project under the supplemental funding for new data collection
- New data collection, including new drilling and discovery, commenced
- Active community engagement and outreach both nationally and internationally including participation at Geothermal Energy Association events, Geothermal Resources Council Annual Meeting, Stanford Geothermal Workshop, American Geophysical Union Fall Meeting, Geological Society of America Annual Meeting, International Geological Congress, European Geological Union Annual Meeting, and many more at the state and national levels.
- Participated in the National Geothermal Data System (NGDS) Architecture, Design, Testing, and Maintenance reboot in June 2012 at Boise State University
- Developed, updated, or approved nearly all content models in conjunction with the DOE-chaired Geothermal Data System Design and Population Working Group (GDSDPWG), including
- Redesigned and released geothermaldata.org representing a cumulative information site for all NGDS related projects
- Continued developing external partnerships including partnerships with Microsoft Research, Energistics, Western Regional Partnership, Esri, Open Geospatial Consortium (OGC), International GeoSample Number Implementation Organization, National Data Repositories, DataONE, and conversations with the U.S. State Department in deploying NGDS across the globe, including across Latin America through the 60-member GeoSur collaborative, based in Venezuela.
- The AZGS talk on NGDS at the GRC annual meeting received a Best Presentation award.

TECHNICAL ACCOMPLISHMENTS

DATA DELIVERY

The following represents a summary of the data sets submitted by participants to AZGS for QA/QC over the year:

Table 1: Data sets submitted for QA/QC

Month	Number of Data Sets	Number of States Represented
October 2011	62	24
November 2011	46	18
December 2011	29	13
January 2012	26	16
February 2012	44	11
March 2012	18	9
April 2012	41	13
May 2012	82	22
June 2012	67	26
July 2012	34	15
August 2012	39	18
September 2012	48	19
TOTAL	536	

The following represents a summary of the data sets approved by AZGS as meeting project standards, placed online as a Web service, and added to the online project catalog over the year. If a dataset is incomplete the set is returned to the subrecipient with requests for additional information or clarification. Also note that some datasets submitted, when deployed, are added to an existing service. For example, if a state submits 500 well logs the first year and 500 well logs the second year, it is counted as two datasets but deployed as one contiguous service.

Table 2: Data sets approved for service deployment

Month	Number of Data Sets	Number of States Represented
October 2011	58	23
November 2011	24	20
December 2011	23	16
January 2012	70	22
February 2012	8	7
March 2012	2	2
April 2012	4	4
May 2012	64	19
June 2012	30	18
July 2012	70	21
August 2012	18	10
September 2012	28	16
TOTAL	399	

DATA INTEROPERABILITY & CONTENT MODELS

In order to clarify understanding of data submissions to the NGDS we have identified and expanded upon three tiers of data interoperability. These include:

1. Tier 1 -- Serving arbitrary data files via Web-services annotated with metadata in the NGDS catalog;
2. Tier 2 -- Serving structured data in files or via (geospatial) web services annotated with metadata in the NGDS catalog;
3. Tier 3 -- Serving structured tabular data via geospatial web services according to NGDS-adopted community content models annotated with metadata in the NGDS catalog.

Tier 1 data allows discovery and access since a simple metadata record is produced. Thus you ensure discoverability but have no interoperability. Tier 2 data allows discoverability through a USGIN-style metadata format and basic interoperability since the data is provided in a tabular format and most software can be written to ingest this data directly. Tier 3 allows data discovery, software ingestion of data through a standard OGC service where the software knows and understands what the data means, and you can directly compare that data to other datasets in the same format; hence true interoperability and analysis of integrated data sets.

Table 1 provides additional detail on the data tier, type of data, and input/output requirements of each tier.

Table 3: Additional detail on the three tiers of data interoperability

Data Tier	Type of Data	Input Requirements	Output Requirements
Tier 1	Scanned Documents	Upload the file to a web accessible location; Create metadata for record	Accessible via HTTP GET; Metadata points to the URL accessible via CSW
Tier 2	Structured (tabular) data not conforming to an NGDS content model. Examples include Excel/csv tables, Microsoft Access databases)	Upload files to a web accessible location; Create metadata for record. Metadata should include descriptive information about the column headers and data types that the documents contain.	Accessible via HTTP GET; Metadata points to them via CSW. Optional – data may be exposed as a WFS/WMS.
Tier 3	Structured data conforming to an NGDS content model	Upload files to a web accessible location; WFS and WMS services are deployed to serve data; Create metadata pointing at all endpoints (because the content model defines entity/attribute information the creation of metadata is less cumbersome).	Accessible via HTTP GET; Data exposed as WFS/WMS services; Metadata points to all endpoints accessible via CSW.

We have developed a software application that validates metadata in the tabular template format using a collection of user defined rules. This validation framework is useful for validation of content for geothermal data services as well.

To promote interoperability a number of data content models (or templates or interchange formats) have been adopted, or where inadequate or none exist, developed and reviewed in coordination with the system-wide GDSDPWG. The content model defines the information that will be associated with a feature or observation type; the content model may be implemented in a variety of ways, but USGIN is currently implementing these interchange formats as GML Simple Features to be served by an OGC WFS. If data to be served are not accounted for by an existing content model, network participants are invited to propose new models. A document with guidelines for construction of a content model workbook is available online at http://repository.usgin.org/uri_gin/usgin/dlio/340.

The following is a list of available content models:

- Active Fault/Quaternary Fault
- Aqueous Chemistry
- Borehole Temperature Observation Feature
- Data Interchange Content Models
- Direct Use Feature
- Drill Stem Test Observations
- Fault Feature
- Fluid Flux Injection and Disposal
- Geologic Contact Feature
- Geologic Unit Feature
- Geothermal Area
- Geothermal Fluid Production
- Geothermal Power Plant
- Heat Flow
- Heat Pump Facility
- Lithology Interval Log Feature
- Metadata
- Physical Sample
- Powell Cummings Geothermometry
- Power Plant Production
- Radiogenic Heat Production
- Seismic Event Hypocenter
- Thermal Conductivity

- Thermal/Hot Spring Feature
- Volcanic Vents
- Well Fluid Production
- Well Header
- Well Log Data Compilation Workbook
- Well Log Observation

These content models are currently stored in the USGIN and AASG repositories; however, as they are system wide, we are working on establishing a Python based application that can be used to manage content models and placing them at geothermaldata.org (NGDS main site) directly. We will then redirect the links from stategeothermaldata.org to the new location. This is expected to be completed prior by mid-January 2013.

Since the content models evolved rapidly during production scale data compilation over the first year of the project; WFS services have been deployed as the models evolve, and iteration of model versions and XML schema for corresponding WFS features has resulted in some discrepancies between the Excel Workbooks and corresponding XML documents. During early September 2011, the AZGS team reviewed and synchronized the deployed services and XML schema to produce a collection of schema that will validate the deployed services. XML schema for NGDS data interchange WFS features are being placed in a USGIN repository (<http://schemas.usgin.org/schemas/>).

XML schemas are versioned, and the namespace for the schema elements is unique to that schema version. Thus namespace-aware client applications can determine if an instance document is using a known schema version.

METADATA

Metadata for the NGDS should be provided using USGIN metadata recommendations (<http://lab.usgin.org/profiles/doc/metadata-content-recommendations>). These requirements proscribe the content of the metadata, but not the delivery format. ISO19139 XML is the preferred encoding based on its expanding adoption in the national and international community. USGIN guidelines for implementing the content recommendations in ISO19139 XML are available as part of the AASG State Geothermal Data Repository (<http://repository.stategeothermaldata.org/repository/resource/98ddf901b9782a25982e01af3b0ec3ea/>), as well as a detailed USGIN profile for interoperable metadata using ISO19139 (<http://repository.stategeothermaldata.org/repository/resource/98ddf901b9782a25982e01af3b0bda50/>). Both individual metadata records for simple (single-distribution) and those requiring file uploads can be created using the new AASG State Geothermal Data Repository (<http://repository.stategeothermaldata.org/repository/>). AASG participants can provide metadata in multiple formats: by building a CSW with USGIN style metadata available for harvest, by completing the metadata content model, or by entering a repository submission at the AASG repository.

To bulk load metadata records in the metadata content model we have developed a software application to read the metadata from an Excel table and serialize as XML that can be imported to the AASG catalog.

REPOSITORIES

In addition to the resources available at the USGIN developer's site, <http://lab.usgin.org>, we have created an AASG repository separate from the USGIN repository. The USGIN repository and catalog will thus act as a harvesting catalog and repository for documents that have no other "collection" based repository home. The AASG repository was created to provide AASG data participants an individual collection level repository for the NGDS contributions.

AASG REPOSITORY

The AASG Repository (<http://repository.stategeothermaldata.org/repository/>) was created this year and included a metadata scrub of the USGIN repository and metadata catalog to help clean up the existing records produced during the initial phase of project work and provide a collection level repository for the AASG records. The repository is used for maintenance of metadata which describe resources contributed to the AASG State Geothermal Data Project. The repository also provides an archive for files that are not hosted by the agency contributing the resource. The application was implemented using open-source software Django, Node.js, and CouchDB by AZGS Developer, Ryan Clark. The code is available at <https://github.com/usgin/metadata-repository>.

The repository allows users to “Browse the Collections,” “Manage Resources,” or “Register for an Account.” When browsing the repository for data there are three ways in which to do so, by data theme and state, resource accessibility, or by source organization. The datasets by data theme and state are probably the most applicable for the domain scientists and engineers (public), the datasets by resource accessibility is probably most applicable to information technology specialists interested in the implementation of the NGDS, the datasets by source organization includes the organization that created the metadata. The source organization is probably only useful for those interested in a particular agency’s contributions since a number of entities are collection data for a different state, for example, the Arizona Geological Survey is collecting the data for the California Geological Survey.

SOURCE CODE REPOSITORY

Since the NGDS is built using open-source standards and protocols, a GitHub repository was created to help facilitate the sharing and development of code developed for USGIN systems. This repository is available at <https://github.com/usgin>. Examples of available code in the repository include:

- Content Model Manager
- WFS Search Client
- URI Redirect
- Metadata Repository
- Metadata Server
- USGIN Geoportal Addon
- AASG Tracking Site
- ArcMap Client
- XML Validation Tool
- CSW Search Client

APPLICATIONS

The concept behind NGDS is to encourage third-party development or adaption of software applications, emulating the World Wide Web paradigm. However, one new application was developed by the project team this year (NGDS Feature Search & Map Viewer) and two applications were upgraded (Catalog Search Client and ArcMap Client). The ArcMap Client was updated to comply with updates to ArcMap v10.0 and to include the modified AASG catalog. The ArcMap client currently searches four catalogs: USGIN Catalog, OneGeology Portal, GeoData Government Catalog, and AASG Geothermal Data Catalog. See Figure 1 for an example of the ArcMap Client in use.

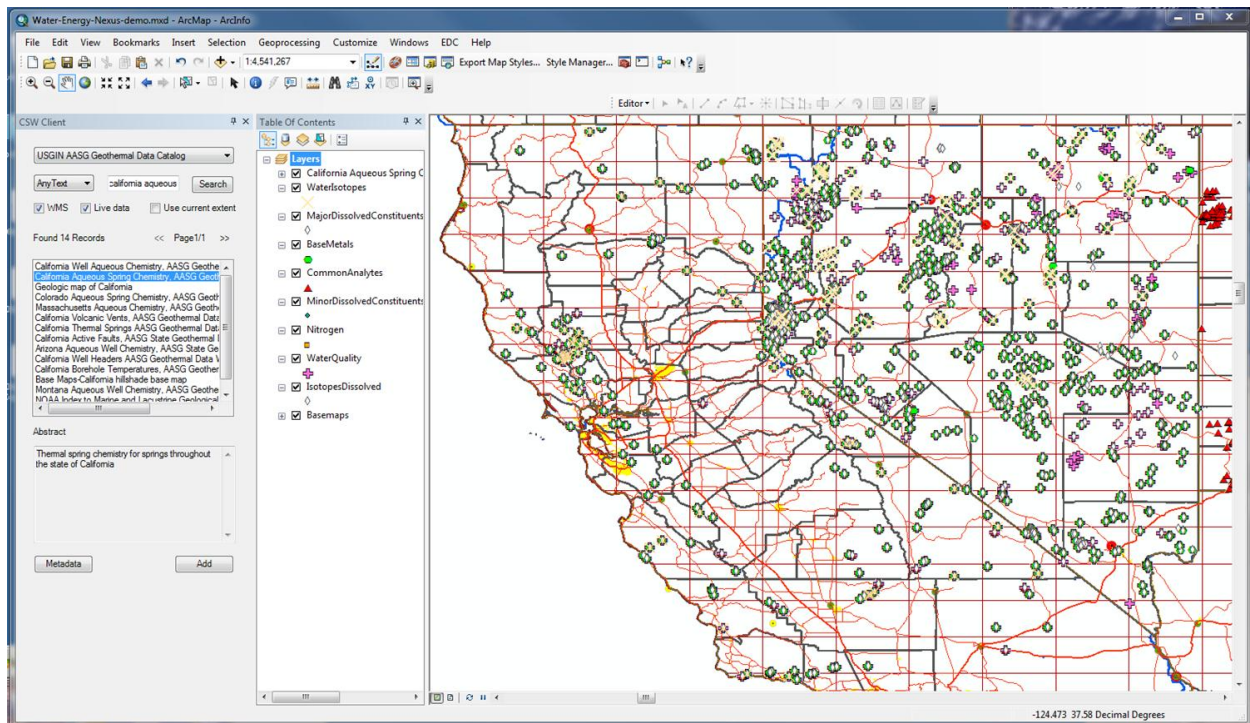


Figure 1: Esri ArcMap Catalog Search Client displayed to the left side of the image. The data mashup to the right side of the image displays datasets discovered through the catalog search

The Catalog Search Client also received an update, providing a more “search engine” type look and feel. Much of the same functionality is present as in the previous version, including the ability to preview the dataset on a map and download directly into ArcMap. New features include the ability to review the full metadata record, view full XML metadata, preview a sample of the attribute table, and a variety of access options including Get Capabilities for WMS/WFS. The access options vary depending on the type of data and permissions associated with the data. See Figure 2 for an example of the new search client.

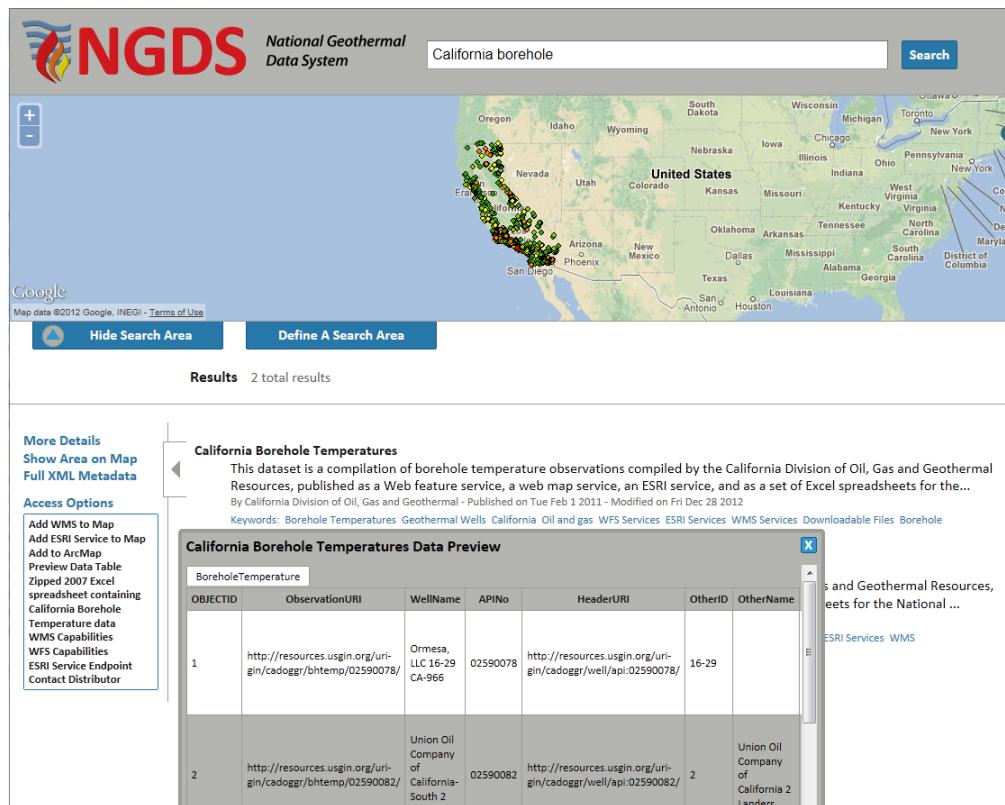


Figure 2: The new search-engine style catalog search displaying the map service and a sample of the dataset

Newly created in 2012 is the NGDS Feature Search & Map Viewer extraction tool built using OpenLayers. The application allows the user to search, preview, and extract data from WFS in a tabular form. An online tutorial on the development of such an application is scheduled for release in 2013. Figure 3 provides an example of the NGDS Feature Search & Map Viewer.

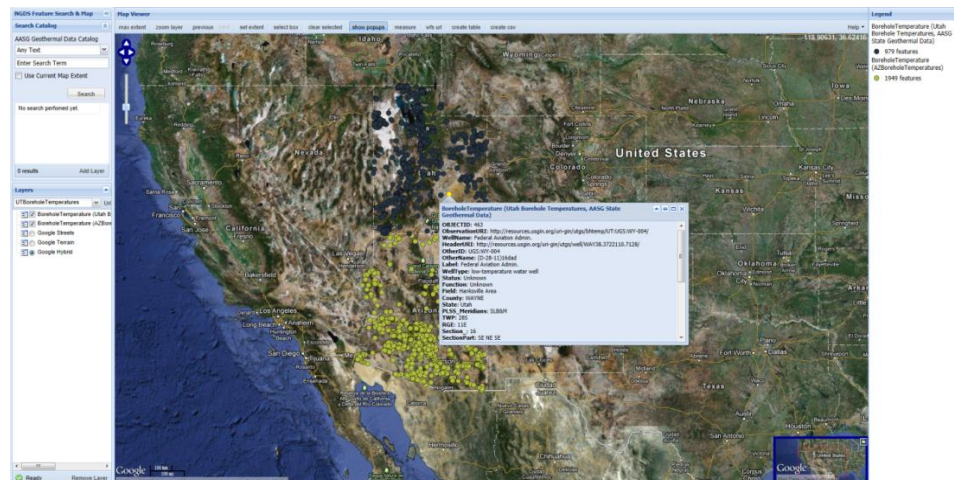


Figure 3: The new Feature Search & Map Viewer tool showing Arizona and Utah borehole temperature data with pop-ups enabled

MANAGEMENT AND OPERATIONS ACCOMPLISHMENTS

For the second year in a row, the project has received “good” or “outstanding” review comments in all categories during the annual sponsor peer review. Each reviewer scored the project as “outstanding” the highest possible mark for relevance and impact of research. Also scored during the review were the Scientific and Technical Approach; Project Management/Coordination; Accomplishments, Results, and Progress; Strengths; Weaknesses; and Suggested Improvements.

Select comments from the review include:

- *“The approach for acquiring data appears to be exemplary. A huge amount of work has gone into developing procedures for data acquisition and formats for data submission.”*
- *“There is a large and growing collection of information assets acquired from participating states; the incoming assets are being assessed and incorporated via a quality process; the assets, once acquired, are being managed and visualized via a capable information system.”*
- *“The project has uploaded an impressive amount of data that has been submitted by a large number of team members representing all 50 states.”*
- *“Project has a strong management component and outward facing exposition and consultation effort associated with it.”*

The project management tools developed for tracking deliverables and tasks are still in use. The in-house task tracking site allows technical reviewers the ability to track progress through the QA/QC process while the publicly accessible site available from the project website at stategeothermaldata.org allows project participants to track their progress as well as their data's progress through the QA/QC process.

PROJECT MEETINGS

Project members met at the Association of American State Geologist's (AASG) Annual Conference in Austin, TX in June of 2012. DOE Program Officer, Arlene Anderson, and AZGS Project Manager, Kim Patten, presented an update on the project to attendees. After the AASG meeting the project's Science Advisory Board met (additional information in the next section). The project PI, Lee Allison, met with the AASG Executive Committee to brief them on project progress and review plans and recommendations.

Leveraging funds from the USGIN project, AZGS and USGS were able to host a meeting on creating and deploying geologic map services using GeoSciML, an international mark-up language that underlies USGIN. Representatives from more than two dozen states attended this event.

Technical leads were encouraged to attend a workshop on data integration and data delivery at the Earth Science Information Partners (ESIP) Federation and DataONE meeting in Madison, WI in July of 2012. Collaboration with ESIP and DataONE are encouraged to provide a community of practice regarding distributed data networks.

SCIENCE ADVISORY BOARD

The SAB was called upon to review the subrecipients Year 1 and 2 progress and the Year 3 proposed statements of work. By collocating the meeting with the AASG Annual Meeting in Austin, TX we were able to maximize travel for those SAB participants who are also AASG members. In addition to the core SAB members, a number of external reviewers were also invited. These reviewers included geothermal experts from DOE and Principal Investigators of other NGDS projects. This ensured de-duplication of

effort and consistency between projects.

Each statement of work was reviewed using the following criteria:

1. The relevance and significance of the proposed deliverables for development of geothermal resources
2. The appropriateness and utility of the proposed delivery mechanism
3. Whether the quantity of delivered data is consistent with the funding level and reasonable estimation of the effort required to produce the proposed deliverable.

Each member of the SAB was assigned as lead for a subset of states for review; however they were all provided with the Year 3 proposals and updated information on the amount of funds expended and requested amount for each subrecipient. In addition, they were provided with links to and detailed instructions for use of the stategeothermaldata.org tracking site. SAB members associated with a particular state were asked to recuse themselves during the review of that state. By splitting the subrecipients among the core membership of the SAB, we were able to maximize the review time by allowing each member to focus on approximately 8 states each, rather than all 50. This methodology was based on a similar well-established and successful process used by the USGS and AASG in reviews of proposals for the STATEMAP component of the National Cooperative Geologic Mapping Program.

In addition, SAB members provided recommendations on quality assurance plans, duplication of efforts, and other factors as they saw fit. The SAB is guided by the “Science Advisory Board Plan” dated July 6, 2010 and included in the FY2010 annual report.

Membership:

Chair- Rick Allis, Utah Geological Survey
John Costain, Virginia Tech University
Dave Norman, Washington Geological Survey
Arlene Anderson, Department of Energy
Lisa Shevenell, Nevada Bureau of Mines and Geology
Ed Deal, Montana Bureau of Mines and Geology
Chacko John, Louisiana Geological Survey

Invited Guests:

Dave Blackwell, Southern Methodist University
John Ziagos, Lawrence Livermore National Lab
Colin Williams, U.S. Geological Survey

Conclusions of the event were that:

1. Overall the project is progressing well
2. All Year 1 and Year 2 deliverables are due by mid-December 2012, unless there are extenuating circumstances
3. The SAB will meet again in December 2012 or January 2013 to review progress of all 50 states and host a mid-year review of those states flagged for such review
4. Depending on progress determined during the mid-year review, the SAB will consider reallocation of resources from subrecipients determined to be unable to meet timely completion of deliverables.

MANAGEMENT ADVISORY BOARD

The MAB met by webinar July of 2012 to discuss and approve the recommendations of the Science Advisory Board and to receive a project update. In addition, the AASG Executive Committee and other attendees were briefed on the project status at the AASG annual meeting in June, 2012 and Liaison Committee meeting in September of 2012. The MAB agreed to all of the SAB recommendations and the

suggestion that sustainability of the network should be top priority for AASG.

Membership (effective June 2012):

AASG Past-President, Vicki McConnell, Oregon
AASG President, Harvey Thorleifson, Minnesota
AASG Vice President, Jonathan Arthur, Florida
DOE-GTP, Melissa Jacobi, Colorado

The MAB previously included the NGDS Principal Investigator. With the change of the PI at BSU, the interim PI from BSU was invited to attend the meeting. An invitation to the new BSU PI to join the MAB will be made for the next MAB meeting.

COLLABORATION

- While the community of practice GeoNet coalition described in last year's report was not funded by the National Science Foundation, collaborative efforts in cyberinfrastructure for the geosciences has been initiated through the NSF EarthCube program. The goal of EarthCube is to transform the conduct of research through the development of community-guided cyberinfrastructure to integrate information and data across the geosciences. Since NGDS is a working distributed data network it is a potential model for adoption or inclusion in EarthCube. While the funding for formal collaboration did not occur, participants are working informally and through networking events to link and share data. Participants in GeoNet include National Geoinformatics Community, DataONE, Ocean Observing Initiative, OneGeology, Earth Science Information Partners (ESIP Federation), CUAHSI, AuScope, and USGIN.
- AZGS, under the auspices of USGIN, continues to work with the Western Regional Partnership, a collaboration led by the Department of Defense consisting of five state governments and fifteen federal agencies for land use and planning in regards to public lands in the west. WRP will be implementing USGIN protocols to enable certain GIS data layers to be included in the NGDS. WRP is developing a repository of over 10,000 GIS data layers. Work on integrating WRP into USGIN and thus making data accessible to the NGDS is part of the formal work plan for WRP in FY13. Because WRP is a relatively new initiative much of the past year's efforts were focused on developing the organization and collaborations. PI Allison serves on the WRP GIS Committee and represents Arizona Governor Brewer on the WRP Steering Committee.
- Project PI Allison was reappointed to the Executive Committee of the Earth and Space Science Informatics section of the American Geophysical Union, and reappointed to the Editorial Advisory Board for AGU's *Eos* newspaper for the field of informatics.
- Project PI Allison also chairs the Information Committee for the Association of American State Geologists
- Project PI Allison hosted a meeting for advancing the public understanding of science through COPUS (Coalition on the Public Understanding of Science) in Tucson, AZ
- Project members participated in the Earth Science Information Partners meeting in Madison, WI. We are working with DataONE to integrate networks.
- AZGS continues its membership with the Open Geospatial Consortium (OGC) to have better access to standards materials and input on development of new standards.
- CoPI Richard is being supported by Energistics (project partner) to represent the petroleum industry's Metadata Standards Working Group at a meeting of the International Standards Organization (ISO) in Saudi Arabia to establish the Energy Industry Profile for ISO19115, an international standard for geospatial data. The primary objective for the Group is to develop a metadata profile specification for discovery, evaluation, and retrieval of information and physical resources of interest to the energy industry.
- PI Allison and CoPI Richard leveraged external funds to attend the International Geological Congress where talks on the National Geothermal Data System were given. While in Australia,

both took the opportunity to meet with additional groups including GeoScience Australia (GA) and OGC. Allison gave a seminar at GA headquarters on USGIN and NGDS, followed by a half day long roundtable discussion with senior GA staff and representatives from other Australian national agencies. Allison participated in a number of forums and work sessions with the heads of national geological surveys from around the world, in developing priorities and protocols for international collaboration.

- We continued discussions with the Consortium of Universities for the Advancement of Hydrologic Sciences, Inc (CUAHSI) about linking their Hydrologic Information System to NGDS using USGIN. This would supply hydrologic information for over 2 million water wells from across the country to the NGDS.
- AZGS has partnered with Lamont-Doherty Earth Observatory to co-found the International GeoSample Number (IGSN) system. The IGSN preserves the identity of a sample regardless of its current location (repository) which allows researchers to track the history of a sample. The IGSN is generated by the System for Earth Sample Registration (SESAR). The intention is that samples related to the NGDS will be registered with an IGSN and searchable through the catalog. A webinar with Dr. Kerstin Lehnert, Lamont-Doherty and IGSN, was held for NGDS subrecipients; it is available for viewing on the stategeothermaldata.org site.
- PI Allison was invited as the lead US representative in a 2-day workshop in San Francisco hosted by the US National Science Foundation, with representatives from 13 countries to create a strategic plan for international collaboration in e-infrastructure in the geosciences under the Belmont Forum agreement.

STAFFING

AZGS maintained most of the management and technical team established over the last two years of the project. The following are updates on project staffing during the year.

- Christy Caudill was hired as a Geoinformatics Content Specialist to work with data submissions and web services.
- Ron Palmer was hired as AZGS IT manager and is assisting with the virtualization of servers and hub disaster management planning.

COMMUNICATIONS, OUTREACH, TECHNOLOGY TRANSFER

We have maintained the project website at www.stategeothermaldata.org and continue to add improvements and functionality. This year project subrecipients were able to submit deliverables for QA/QC under specific deliverables to aid in the tracking process. This site, and the progress map, continues to be a successful way of tracking deliverables from a project management standpoint as well as for the public. The newsletter functionality within the site allows us to contact specific individuals for the project including financial contacts or principal investigators.

Prior to the end of the fiscal year, we also released www.geothermaldata.org, a NGDS wide front-end Web page for the public. This site provides details for NGDS users, data publishers, and developers. Also included from the site is a direct link to the improved search capabilities described in the technical section of this report. Users can search the site or search the data directly from the search toolbar located in the upper right hand corner of the site.

The tutorials and cookbooks available to NGDS users also continue to expand. Over the year we have published a revised Data Repository and Data Delivery Cycle tutorial and provided a GeoSciML-Portrayal Cookbook for the public.

Overall, we continue an aggressive outreach campaign at scientific and technical meetings. In the next fiscal year we hope to continue this trend to the broader user community through submissions to popular magazines and trade journals.

PUBLICATIONS

Allison, M. Lee, Richard, M., Clark, Ryan C., Patten, Kim, Love, Diane S., Coleman, Celia, Chen, Genhan, Matti, Jordan, Day, Janel, Pape, Esty, and Musil, Leah, 2011, "Online, interactive assessment of geothermal energy potential in the U.S." Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering. Stanford University, Stanford California, January 30-February 1, 2012

PRESENTATIONS

TALKS

Anderson, Arlene F., Cuyler, David, Snyder, Walter S., Allison, M. Lee, Blackwell, David D., and Williams, Colin F., 2011, National Geothermal Data System: Geological Society of America Abstracts with Programs, v. 43, n. 5, abstract 9-10 (Sunday, October 9, 2011, 10:50 AM)

Allison, M. Lee and Gallagher, Kevin T., 2011, U.S. Geoscience Information Network: A Critical Path for Data Integration in the U.S. Earth Sciences: Geological Society of America Abstracts with Programs, v. 43, n. 5, abstract 170-10 (POSTER, Tuesday, October 11, 2011, 9:00 AM – 6:00 PM)

Jackson, Ian, Broome, John, and Allison, M. Lee, 2011, Delivering Geoscience Knowledge in Federal Systems: Geological Society of America Abstracts with Programs, v. 43, n. 5, abstract 223-10 (Wednesday, October 12, 2011, 11:00 AM)

Love, Diane S., Coleman, Celia, Pape, Esty, Clark, Ryan C., Richard, Stephen M., and Allison, M. Lee, 2011, State Geothermal Survey Contributions to the National Geothermal Data System: Geological Society of America Abstracts with Programs, v. 43, n. 5, abstract 9-10 (Sunday, October 9, 2011, 11:05 AM)

Patten, Kimberly, Allison, M. Lee, and Richard, Stephen M., 2011 U.S. Geoscience Information Network: Distributed Deployment Across 50 States: Geological Society of America Abstracts with Programs, Vol. 43, No. 5, abstract 170-11 (POSTER, Tuesday, October 11, 2011, 9:00 AM – 6:00 PM)

Allison, M. Lee, Renewable Energy, Geologic Hazards, and Risk," Arizona Land Subsidence Group and Association of Environmental & Engineering Geologists (AEG) Conference on "Opportunities for Alternative Energy Development in Arizona and the Southwest – Geologic/Hydrologic Considerations," 2011 Shlemon Specialty Conference, Tempe, AZ, October 27, 2011

Wunsch, David, and M. Lee Allison, "Web-based Information Services Available from State Geological Surveys to Assist Your Well Contracting Business," National Ground Water Association Annual Meeting and Expo, November 30, 2011

Andersen, Arlene F., David Cuyler, Walter S. Snyder, M.L. Allison, David D. Blackwell, Colin F. Williams, "National Geothermal Data System," American Geophysical Union Annual Conference, San Francisco, CA, December 7, 2011

Allison, M.L., Stephen M. Richard, Ryan Clark, Celia Coleman, Diane Love, Esty Pape, Leah Musil,

"Online, interactive assessment of geothermal energy potential in the U.S." American Geophysical Union Annual Conference, San Francisco, CA, December 7, 2011

Gallagher, Kevin T., M.L. Allison, "A Critical Path for Data Integration in the U.S. Earth Sciences," Poster Session, American Geophysical Union Annual Conference, San Francisco, CA, December 9, 2011

Jackson, Ian, Henry John Broome, and M.L. Allison, "Delivering Geoscience Knowledge in Federal Systems: What Can the Old and New Worlds Learn from Each Other?" Poster Session, American Geophysical Union Annual Conference, San Francisco, CA, December 9, 2011

Allison, M. Lee, Richard, M., Clark, Ryan C., Patten, Kim, Love, Diane S., Coleman, Celia, Chen, Genhan, Matti, Jordan, Day, Janel, Pape, Esty, and Musil, Leah, 2011, "Online, interactive assessment of geothermal energy potential in the U.S." Thirty-Seventh Workshop on Geothermal Reservoir Engineering. Sanford University, Stanford, CA, January 30-February 1, 2012.

Anderson, Arlene, Cuyler, David, Snyder, Walter, Allison, M. Lee, Blackwell, David, and Williams, Colin, "National Geothermal Data System," [poster] American Association of Petroleum Geologists Annual Conference, Long Beach, CA, April 24, 2012.

Allison, M. Lee, Richard, Stephen M., Clark, Ryan C., Patten, Kim, Love, Diane S., Coleman, Celia, Chen, Genhan, Matti, Jordan, Day, Janel, Pape, Esty, and Musil, Leah, "Online, Interactive Assessment of Geothermal Energy Potential in the U.S.," [poster] American Association of Petroleum Geologists Annual Conference, Long Beach, CA, April 24, 2012.

Allison, M. Lee, "Geothermal Exploration: Everything Digital, Online, and Interoperable," luncheon address, Energy Minerals Division Annual Meeting, American Association of Petroleum Geologists Annual Conference, Long Beach, CA, April 25, 2012.

Allison, M. Lee, Atkinson, R., Arctur, David K., Cox, Simon, Jackson, Ian, Nativi, Stefano, Wyborn, Lesley A., "International Convergence on Geoscience Cyberinfrastructure." European Geosciences Union, Vienna, Austria, April 25, 2012, Stefano Nativi presenting.

Allison, M. Lee, Gallagher, Kevin T., Richard, Stephen M., Hutchison, Vivian, B., "Strategic Roadmap for the U.S. Geoscience Information Network." European Geosciences Union, Vienna, Austria, April 25, 2012. [Poster]

Baru, C., L. Allison, P. Fox, C. Keane, R. Keller, and S. Richard, "GET21: Geoinformatics Training and Education for the 21st Century Geoscience Workforce," European Geophysical Assembly 2012, Vienna, Austria, Vol. 14, EGU2012-13196, April, 2012

Allison, M. Lee, "State Geological Survey Contributions to the National Geothermal Data System," U.S. Dept. of Energy Geothermal Technologies Program Annual Peer Review, Westminster, CO, May 9, 2012

Day, Janel, "Moving toward a new geologic map database standard, NCGMP: the good, the bad, and the ugly." Digital Mapping Techniques, Champaign, IL, May 21, 2012

Clark, Ryan, "Online Geologic Maps: A Simple Application for Publishing NCGMP09 Databases." Digital Mapping Techniques, Champaign, IL, May 21, 2012

Allison, M. Lee, Richard, Stephen M., Clark, Ryan, Patten, Kim, Coleman, Celia, Caudill, Christy, Chen, Genhan, "Implementing USGIN, a Distributed Data Network for Geoscience Information," ESIP Federation Summer Meeting, Madison, WI, July 17, 2012

Allison, M. Lee, "EarthCube: How do we Organize, Manage, and Govern?" seminar, ESIP Federation Summer Meeting, Madison, WI, July 19, 2012

Allison, M. Lee, "Building Cyberinfrastructure in the Geosciences - the USGIN Experience," Geoscience Australia, Canberra, Australia, July 30, 2012

Allison, M. Lee, Kevin T. Gallagher, Stephen M. Richard, and Vivian Hutchison, "Strategic Roadmap for the U.S. Geoscience Information Network," 34th International Geological Congress, Brisbane, Australia, August 6, 2012

Allison, M. Lee and Stephen M. Richard, "U.S. Geothermal Data System," 34th International Geological Congress, Brisbane, Australia, August 6, 2012

Allison, M. Lee, Rob Atkinson, David Arctur, Simon Cox, Ian Jackson, Stefano Nativi, and Lesley Wyborn, "International Convergence on Geoscience Cyberinfrastructure," 34th International Geological Congress, Brisbane, Australia, August 9, 2012

Richard, Stephen M. and M. Lee Allison, "Access to State Geological Survey data for geothermal energy development in the United States," 34th International Geological Congress, Brisbane, Australia, August 7, 2012

Allison, M. Lee, "Arizona Contributions to the National Geothermal Data System," Arizona Governor's Office of Energy Policy's Geothermal Workshop, September 6, 2012

Allison, M. Lee, "Big Data" (presentation and panel discussion), American Geoscience Institute Leadership Forum, Washington DC, September 10, 2012

Received Best Presentation at GRC Annual Meeting: Allison, M. Lee, Richard, Stephen M., Clark, Ryan C., Patten, Kim J., Love, Diane S., Coleman, Celia, Chen, Genhan, Matti, Jordan, Day, Janel, Pape, Esty, Musil, Leah, and Caudill, Christy, "A Geothermal Data System for Exploration and Development," October 1, 2012 [paper and oral presentation] (included since the meeting began in the 2012 FY)

BRIEFINGS

Allison, M. Lee, "Geoscience foundation for geothermal energy utilization in the US," Environmental Planning Advisory Committee, Pima Association of Governments, Tucson, AZ, January 6, 2012

Allison, M. Lee, "AASG Update," AIPG National Board Mid-Year Meeting, Tucson, AZ, February 10, 2012.

Allison, M. Lee, "AZGS Update," AIPG Arizona Section Annual Business Meeting, Tucson, AZ, February 11, 2012.

Allison, M. Lee, "Geoscience Information Network: A Critical Path for Data Integration," Western Regional Partnership Energy Committee, Reno NV, January 10, 2012

Allison, M. Lee, "Sustainability of USGIN and NGDS," AASG Liaison Meeting, Washington, DC, September 10, 2012

CONFERENCE EXHIBITS

Geothermal Resources Council 35th Annual Meeting and GEA Trade Show, San Diego, CA, October 23-26, 2011 [State Geothermal Data exhibit booth]

Geological Society of America Annual Meeting, Minneapolis, MN, October 9-12, 2011 [State Geothermal Data exhibit booth]

American Geophysical Union Fall Meeting, San Francisco, CA, December 5-12, 2011 [State Geothermal Data exhibit booth]

Geothermal Resources Council Annual Meeting, Reno, NV, September 30- October 3, 2012. [Exhibited the new data search tool, new NGDS website, and new data collection from UT]

WEB PRESENTATIONS

Allison, M. Lee, January 29, 2012, "How GIS works as a User App for Digital Data Networks," GIS in Mining and Exploration Online Summit 2012, Session 8, Webinar series hosted by Mining IQ, January 23-February 3, 2012.

Lehnert, Kerstin. "Introduction to IGSN and SESAR," AZGS hosted webinar, March 8, 2012 [31 attendees]

Martin Kay, Will Gosnold, and Joe Iovenitti "Geothermal Data: How's it Used & Why it's Important" AZGS hosted webinar, April 26, 2012. [37 registered participants]

WORKSHOPS

AASG State Geological Survey's Contributions to the National Geothermal Data System Hub Training Workshop. Tucson, AZ September 5-6, 2012

Arizona Governor's Office of Energy Policy, "Geothermal Workshop," Phoenix, AZ, September 6, 2012

NEWS INTERVIEWS AND OTHER GENERAL INTEREST ARTICLES

Patten, Kim, "Positive Feedback on the State Geological Survey Contributions to the National Geothermal Data System," *Arizona Geology*, Arizona Geological Survey, Fall 2011, <http://azgeology.azgs.az.gov/article/geothermal/2011/09/positive-feedback-state-geological-survey-contributions-national>.

Durham, Louise S. "U.S. Geothermal Database Being Created" with Chacko John (Louisiana Geological Survey), American Association of Petroleum Geologists *Explorer*, January 2012, http://www.aapg.org/explorer/2012/01jan/hot_water0112.cfm

Patten, Kim, "State Geological Survey Contributions to the NGDS Update," *Arizona Geology* Fall 2012, <http://azgeology.azgs.az.gov/article/geothermal/2012/08/state-geological-survey-contributions-national-geothermal-data-system>.

SUBRECIPIENT PRESENTATIONS AND NEWS INTERVIEWS

Rancan, Helen, Bi-monthly reports to the Department Commissioner on Project Status (New Jersey Geological Survey)

Gosnold, Will D., "Minnesota Geothermal Potential," Geological Society of America Annual Meeting, Minneapolis, MN, October 9, 2011 (University of North Dakota, Minnesota Geological Survey)

Dylan Tussel, *Columbus Dispatch*, interviewed Tim Leftwich (Ohio Geological Survey), August 29, 2011 <http://www.dispatch.com/content/stories/science/2011/08/28/dirty-past-clean-future.html> (Ohio Geological Survey)

Angle, Mike, "Geothermal data compilation in Ohio and potential for abandoned underground coal mines to serve as geothermal reservoirs" at the Ball State University Ground Source Heat Pump Information Sharing Retreat, November 9, 2011 (Ohio Geological Survey)

College of Arts and Sciences, "Michigan Geological Repository for Research and Education has Key Role in Geothermal Energy Search," February 15, 2012 <http://www.wmich.edu/cas/alumni/wordpress/2012/02/michigan-geological-repository-for-research-and-education-has-key-role-in-geothermal-energy-search/> (Michigan Geological Survey)

Gustin, Andrew, "The Indiana Shallow Geothermal Monitoring Network: A test bed for optimizing ground-source heat pumps in the glaciated Midwest," North-Central Geological Society of America, Dayton, OH, April 23, 2012 (Indiana Geological Survey)

Wolfe, Mark, Leftwich, Timothy, and Lopez, Dina, "Geothermal potential of abandoned underground industrial mineral mines in Ohio," 48th Forum on the Geology of Industrial Minerals, Scottsdale, AZ May 2, 2012 (Ohio Geological Survey)

Naylor, Shawn, Ellett, Kevin, Gustin, Andrew, "Monitoring near-surface thermal properties in conjunction with energy and moisture budgets to facilitate the optimization of ground-source heat pumps," Indiana Geological Survey's Spring Seminar, Bloomington, IN, May 3, 2012 (Indiana Geological Survey)

Gustin, Andrew, "Indiana Shallow Geothermal Monitoring Network: A test bed for optimizing ground-source heat pumps in glaciated Midwest," GSA North-Central Section, Dayton, OH, April, 2012 (Indiana Geological Survey)

Naylor, Shawn, titled "Monitoring near-surface thermal properties in conjunction with energy and moisture budgets to facilitate the optimization of ground-source heat pumps," IGS Spring Seminar Series, May 3, 2012 (Indiana Geological Survey)

Gosnold, Will. Presented a talk at the 2012 Renewable Energy Action Summit, June 25, 2012 in Bismarck, ND (University of North Dakota)

Arkansas Geological Survey, Geothermal Booth at ECOFEST in Conway, Arkansas. September 8, 2012. 190 Visitors; approximately 70% of visitors requested information about ground source heat pump systems for their homes.

Chales Zuppan, Tiffany Proffitt, Kevin Ellett, and Shawn Naylor and collaborators from the Illinois and Kentucky geological surveys presented methods and results from a multi-state effort to compile and refine BHT data for the Illinois Basin. The work was presented at the AAPG Eastern Section's annual meeting as a poster presentation titled: "Development and application of a new geothermal database for the Illinois Basin". September, 2012 (Indiana Geological Survey)

Gosnold, Will. Invited talk at the American Institute of Professional Geologists Annual Meeting in Rapid City, SD. September 23-25, 2012 (University of North Dakota)

Tutolo, Benjamin M., and Saar, Martin O., "Geothermal Energy in Minnesota: Revised Prospects Based on Heat Flow Measurements." Midwest Ground Water Conference, October 1-3, 2012 (Minnesota Geological Survey)

Oberbeck, Steven, "Big Source of Power Looming in Desert?" *Salt Lake City Tribune*. September 28, 2012 (article on the Utah Geological Survey Supplemental Funding Project). A video based on this article and report was created by UGS and shown at the Geothermal Resources Council; it will also be shown at the Geological Society of America 2012 Annual Meeting. (Utah Geological Survey)

Allis, Rick, et. Al. "Stratigraphic Reservoirs in the Great Basin – the Bridge to Development of Enhanced Geothermal Systems in the U.S." Geothermal Resources Council Annual Meeting in Reno, NV. September 29-October 3, 2012 (Utah Geological Survey)

Hardwick, C. and Chapman, D. "Geothermal Resources in the Black Rock Desert, Utah: MT and Gravity surveys," Geothermal Resources Council Annual Meeting in Reno, NV. September 29-October 3, 2012 (Utah Geological Survey)

University of North Dakota under PI Gosnold presented four talks and posters at the Geothermal Resources Council Annual Meeting in Reno, NV. September 29-October 3, 2012 (University of North Dakota)

SCHEDULE, MILESTONES, AND STATUS

The primary goal for fiscal year 2013 is to complete the majority of data collection efforts, particularly existing data. New data collection efforts may extend until December of 2013. Our other primary objective is to provide for expanded technology transfer. We plan to submit articles and information to leading geothermal publications, both print and on the web, as well as energy related publications. We also plan to provide regional workshops to subrecipients to encourage further data interoperability and web service deployment; thus assisting with the sustainability of the network.

PLANS FOR FY 2013

The following are highlights and milestones for FY 2013:

- October – Present project at the Geothermal Resources Council/Geothermal Energy Association Annual meeting as both a paper and an exhibit booth. Release coordinated web presence with NGDS site geothermaldata.org, refine based on comments and feedback received at the Geothermal Resources Council Meeting; meet with AASG members during the Fall Liaison meeting providing an update on sustainability of the project.
- November – Present the project in association with the AASG at the Geological Society of America Annual Meeting in Charlotte, NC. Remind subrecipients of the December deadline. Participate in the GDSDPWG meeting.
- Exhibit and demonstrate the NGDS and give technical presentations at the American Geophysical Union Fall Meeting in San Francisco, CA, December 3-7, 2012.
- December – Work with states to expedite deliverables; reviewing deliverable status at the end of the month. Host update call with the hubs.
- January – Host mid-year SAB review; organize MAB meeting based on the results of the review
- February – Participate in the Stanford Geothermal Workshop; conduct testing with at least one of the hubs using virtual servers; participate in the GDSDPWG meeting.

- March – Host regional workshop planning webinar; expand tech transfer to geothermal publications
- April – Host WRP in Tucson to finalize collaboration efforts; conduct organized follow-up with each state nearing the end of their contract and data collection efforts
- May – Host the first regional workshop for sustainability of the system at the Nevada GIS conference. The location was selected as space is provided free of charge and a series of geothermal tours are being conducted in conjunction with the conference.
- June – Attend the AASG annual meeting in South Dakota providing a project update, briefing the AASG Executive Committee
- July – Conduct follow-up with states that are nearing the end of their contract; begin testing phase with NGDS Architecture, Design, Testing, and Maintenance Project
- August – Based on the results of the NGDS Architecture, Design, Testing, and Maintenance Project begin coordinated testing between AASG nodes.
- September – Finish data collection efforts for the majority of states and begin intense QA/QC phase and service deployment.
- September/October – Exhibit and give presentations at the Geothermal Resources Council and Geothermal Energy Association annual meeting and expo in Las Vegas

COST STATUS

As of September 30, 2012 the project has expended \$10,282,688. With the no-cost extension in place and most states expediting deliverables and spending we feel that we will finish on schedule and on budget.

To date a total of \$209,367.10 in cost share has been reported.

ARRA JOBS REPORTING

As reported by the subrecipients, the jobs created or saved have steadied over the past year to an average of 48.46 over the reporting year. We expect this number to remain steady through the first three quarters of FY13 and then steadily decline as the project ends. The following table reflects reported jobs.

Reporting Quarter with Period	Jobs Created or Saved
Q1 (Oct – Dec 2011)	48.58
Q2 (Jan – March 2012)	48.89
Q3 (April – June 2012)	47.62
Q4 (July – Sept 2012)	48.73

Positions created or saved under this award include professional and technical positions in the sciences and computer programming as well as financial and administrative. In addition a number of workforce development positions have been created to educate and train the next generation of scientists.

The following contains a representative sample of the positions reported as created or saved during FY 2012:

- Analyst
- Associate Research Geologist
- Assistant Chief
- Computer Software Engineer

- Contract Labor
- Data Specialists
- Database Administrators
- Electronic Design Coordinator
- Environmental Scientist
- Environmental Technician
- Executive Officer
- Geoinformatics Content Specialist
- Geologic Program Manager
- Geological Technicians
- Geologist I
- Geologist II
- Geologist III
- Geologist IV
- Geologist V
- Geologist in Training
- Geologists
- Geotechnician
- GIMS Database Administrator
- GIS Analyst
- GIS Specialist
- GIS Technician
- Graduate Research Assistant
- Hydrogeologist
- Information Manager/Specialist
- Intern
- Lab Technician
- Librarian
- Natural Resource Scientist
- Petroleum Geologist
- Physical Scientist/Researcher
- Post-Doctoral Associate
- Principal Senior Geophysicist
- Principal Senior Petroleum Geologist
- Program Director
- Programmer
- Professor
- Publications Editor
- Research Associate
- Research Geologist
- Research Scientist
- Scientist
- Senior Cartographer
- Senior Geoinformatics Specialist
- Senior Geologist
- Senior Scientist
- Senior Systems Administrator
- State Geologist\
- Supervising Environmental Engineer
- Supervising Environmental Specialist
- Technical Assistant
- Technology Transfer Specialist
- Web Administrator
- Web Applications Developer

ACTUAL OR ANTICIPATED PROBLEMS OR DELAYS

Due to the NGDS Architecture, Design, Testing, and Maintenance Project reboot at BSU and the no-cost extension for this project to April 30, 2014 we are not anticipating any delays to the project. The BSU NGDS Architecture, Design, Testing, and Maintenance reboot provided a detailed plan for achieving the project's goals and incorporated a number of highly qualified individuals to the project, which is affecting the AASG project positively.

The no-cost extension provides the majority of the subrecipients three full years since their initial contract execution. The extension allows also for us to ensure that all services are adequately reviewed prior to service deployment. Finally, the extension allows us to accommodate and coordinate a testing period between hubs and nodes on the network and end users.

Our concerns regarding delays due to the National Environmental Policy Act (NEPA) compliance have been allayed by receiving clearance on all non-drill projects and all but one of the drill projects. We will continue to work with the outstanding drill project in order to ensure compliance as quickly as possible.

At this time, we have resolved all issues with our subrecipients. In some cases a new Principal Investigator took on a delayed project, in others, the work plan was revised. In FY13 we will be reassessing each of the projects and potentially reallocating funding to ensure the maximum utility and timeliness of the funds provided.

STATEMENT OF PROJECT OBJECTIVES STATUS OF TASKS AND MILESTONES

The Purpose, Approach, Milestone, and Outcome are directly from the projects Statement of Project Objectives (SOPO). Status updates are as of September 30, 2012. Future goals is reflected in the Plans for FY2013 section.

PHASE 1 – DATA RETRIEVAL, COLLECTION, DEVELOPMENT, AND QUALITY ANALYSIS

Task 1. RDC and QA vision

Purpose: Specify how this project will advance and dovetail with ongoing NGDS design, testing, and management

Approach: Meet with NGDS Boise State project team to plan coordination between the data acquisition activities of this project and NGDS system development.

Milestone: Meetings and conference calls of project managers and developers from Boise State NGDS project and AASG NGDS project to plan project coordination.

Outcome: A coordinated approach and vision for NGDS development.

STATUS: Milestone completed. PI Allison, Co-PI Richard, Programmer/Developer Clark, Project Manager Patten participated in the NGDS Architecture, Design, Testing, and Maintenance reboot in June of 2012 at Boise State University. The result of the meeting was a coordinated approach to completing the NGDS with a Resource Loaded Plan (RLP) and an addendum to the SOPO. In addition to the aforementioned, Geoinformatics Content Specialists Caudill and Coleman participated in all project management, system requirements, user experience, and data assessment phone calls and webinars possible. In addition one-on-one communications with the BSU subrecipients were held. These efforts were made to contribute to the NGDS Architecture, Design, Testing, and Maintenance project success and thus our data collection efforts are successful and accessible to the end user – ensuring a true system-wide vision.

Task 2. Data Retrieval, Collection, and Development

Purpose: Consistently identify, add, collect, and document data from participants to the NGDS

Approach: The Project's Science Advisory Board (SAB) will serve as a peer review panel to evaluate and make recommendations on the data types, amounts, and priorities for deliverables on an annual basis for each Project participant.

Milestone: The SAB will review and recommend approval or changes to each participant's Scope of Work for each year of the project. Each subcontractor will be expected to deliver at least one data product for each Phase One cycle in which they receive funding. Bring IT specialists aboard at beginning of Phase I to manage the servers and provide support to participants.

Outcome: Appropriate prioritization of each participant's contributions to NGDS.

STATUS: Annual milestone complete. Data continues to pour in as the impending Year 1 & Year 2 final deliverables are due December of 2012. In order to expedite the deliverables we have implemented a revised submission process where subrecipients are required to indicate which deliverable they are submitting a dataset to in order to upload it to the StateGeothermalData.org project web site; this includes both data and metadata for the initial QA/QC process. Once the data has been QA/QC'd it is returned to the provider or hub for deployment as a web service. A mid-year review was requested for a number of states in addition to the mid-year deliverables review. This SAB review will be scheduled in late January.

Subtask 2.1 Determining amounts and types of data that will be made available

Purpose: To identify the types of data most relevant to the geothermal resources in each state, prioritize that to be added to NGDS, and establish annual deliverables and milestones for

subcontractors.

Approach: Each state will identify the types of data most in demand or most critical to identifying and characterizing its geothermal resources by cataloguing its data resources, and submitting a statement of work to the Science Advisory Board for review and approval at regular intervals. This Scope of Work will explicitly identify deliverables and milestone for the subsequent work period.

Milestone: Submission of Scope of Work listing the amounts and types of data proposed for digitization and inclusion. At regular intervals, submission of deliverable products is a prerequisite for submission of a Scope of Work for the work period.

Outcome: State-by-state determination of data priorities to support local situations, milestones and deliverables as metrics for subcontractor performance.

STATUS: Annual Milestone Complete. We continually to work with data providers to ensure all SAB comments and concerns are addressed.

Subtask 2.2 Collection, digitization, and indexing of “legacy” data

Purpose: Digitize existing priority data to add to state-based data bases.

Approach: Each state will digitize data, beginning with their highest priorities developing metadata as they do so and populate state-based data bases. AZGS will coordinate data structures to promote compatibility between data from different states.

Milestone: Data will be added incrementally and continually. Specific product delivery schedules will be based on SAB-established priorities and the size and complexity of targeted data.

Outcome: Populating of state data bases with the most at risk or important data.

STATUS: Ongoing. All states are required to submit data on an annual basis and encouraged to do so more frequently as data are compiled and available. All Year 1 and Year 2 data are due December of 2012 unless a special circumstance is arranged.

Subtask 2.3 Documenting and adding digital data bases to the NGDS

Purpose: Add existing digital data to the NGDS with appropriate metadata

Approach: Expose existing digital data bases to the NGDS or convert obsolete digital databases to data schema and formats suitable for incorporation in to NGDS, based on priorities established by the Science Advisory Board.

Milestone: Digital databases will be converted and/or documented incrementally and continually. Specific product delivery schedules will be based on SAB-established priorities and the size and complexity of targeted data.

Outcome: Preservation and addition of digital data to the NGDS and conversion of at-risk digital data for inclusion in NGDS.

STATUS: Ongoing. Based on databases housed at the subrecipients and recommendations from the SAB existing databases are being converted into interoperable formats with metadata that are searchable within the catalog. Examples of these databases include numerous oil and gas borehole databases, water well databases, and earthquake databases. Coordination with related organizations (such as CUAHSI, WRP, etc.) is also underway. We harvested the OneGeology catalog in early 2012. A one-on-one meeting with WRP occurred in July of 2012 to begin harvesting data from the WRP catalog; WRP has since initiated a series of webinars to discuss collaborative efforts between AZGS, WRP, DataBasin, and the Homeland Infrastructure Foundation-Level Data (HIFLD) Working Group. These efforts could lead to greatly expanded data and applications.

Subtask 2.4 Collection of new data

Purpose: Make new measurements calculations, and interpretations, and collect samples.

Approach: Each state will assess the extent, usefulness, and nature of data to determine what gaps are most critical to fill.

Milestone: Data will be collected incrementally and continually. Specific product delivery

schedules will be based on SAB established priorities and the size and complexity of targeted data.

Outcome: New data will lead to derived geothermal gradients, heat flow, thermal conductivity, radioactive heat production numbers, and other geothermal relevant data as necessary in areas where such data are inadequate or lacking.

This subtask will include new data contributions from the following:

- Subtask 2.4 (A) Wisconsin: See general Subtask 2.4 description above.
- Subtask 2.4 (B) New Mexico: See general Subtask 2.4 description above.
- Subtask 2.4 (C) Washington: See general Subtask 2.4 description above.
- Subtask 2.4 (D) Indiana: See general Subtask 2.4 description above.
- Subtask 2.4 (E) West Virginia: See general Subtask 2.4 description above.
- Subtask 2.4 (F) Oklahoma: See general Subtask 2.4 description above.
- Subtask 2.4 (G) Massachusetts: See general Subtask 2.4 description above.
- Subtask 2.4 (H) Connecticut: See general Subtask 2.4 description above.
- Subtask 2.4 (I) Vermont: See general Subtask 2.4 description above.
- Subtask 2.4 (J) Colorado: See general Subtask 2.4 description above.
- Subtask 2.4 (K) Idaho: See general Subtask 2.4 description above.
- Subtask 2.4 (L) Utah: See general Subtask 2.4 description above.
- Subtask 2.4 (M) Oregon: See general Subtask 2.4 description above.
- Subtask 2.4 (N) Nevada: See general Subtask 2.4 description above.
- Subtask 2.4 (O) Maine: See general Subtask 2.4 description above.
- Subtask 2.4 (P) Arizona: See general Subtask 2.4 description above.
- Subtask 2.4 (Q) New Jersey: See general Subtask 2.4 description above.
- Subtask 2.4 (R) Pennsylvania: See general Subtask 2.4 description above.

STATUS: Ongoing. All non-drill projects have received NEPA clearance; all but one drill project have received NEPA clearance. Preliminary results of the new data collection have been positive, including Utah's discovery of a significant new geothermal resource in the Black Rock Desert Basin.

Subtask 2.5 Creation of metadata catalogs

Purpose: Provide for easy user discovery of and access to data in the NGDS

Approach: Set standards and requirements for metadata content and procedures for entry and preservation of metadata for all information resources exposed to the NGDS. Metadata will be made available through the standard Open Geospatial Consortium Catalog Services for the Web (CSW) interface. AZGS will work with each data provider to determine the most efficient procedure to create metadata and enter it into the NGDS catalog.

Milestones: Profiles for metadata content and catalog service implementation are being developed currently, under the primary (BSU-managed) NGDS project. Implementation of the catalog system will be demonstrated during Phase I of that project. Metadata production and entry into the catalog will be an integral part of data acquisition, so milestones for this task will be synchronized with milestones for Subtask 2.2, 2.3, and 2.4.

Outcome: Accessible and searchable online metadata describing the type, nature, amount, and location of data available through NGDS will be available for NGDS users and for external applications in open source environments.

STATUS: Complete. The Geoportal-enabled Catalog Service for the Web (CSW) was one of the first items completed on the project; however, after reviewing the internal infrastructure of the catalog and metadata submissions we opted to revise the catalog over the past year. This resulted in more efficient search results. We closed the USGIN Metadata Wizard and Repository for new data for approximately five days while we transitioned to the new repository, stategeothermaldata.org. Once the new site was online we hosted a data delivery webinar for the AASG subrecipients (this occurred Oct. 4, 2012 and is thus just outside the time frame of this

report). We have updated data delivery tutorials for our subrecipients and made them available via the usgin.org site, which has direct links from the stategeothermaldata.org site.

Task 3. Quality and integrity analysis of the data

Purpose: To ensure the quality and integrity of the data provided to NGDS meets the system standards.

Approach: AZGS will follow the guidelines of the EPA "Guidance for Quality Assurance Plans." AZGS will also use guidelines in place and under development for the NGGDPP National Digital Catalog that are being used by all the SGSs currently, and guidelines developed for the US Geosciences Information Network. In addition, AZGS will employ standard measures of quality using statistical tools expected to be provided by the NGDS to assess variability, bias, systematic error, imprecision, accuracy, precision, reproducibility, etc.

The project will disseminate preliminary guidelines for data content, format, and quality to all participants at the start of the project and require that each participant address them in the Scopes of Work to be reviewed for the first cycle of Phase 1 by the SAB. Final policies and procedures for metadata and data submission, validation and acceptance will be developed by the technical team, in collaboration with the NGDS prime development team during Phase 1, and submitted to the Management Board for review and approval, and subsequent Scopes of Work will be required to conform to these policies.

Milestone: Regular reviews of each data provider's Scope of Work and regular reviews of accomplishments, to ensure compliance with NGDS procedures and goals.

Outcome: Establishment, documentation, and maintenance of data quality in the NGDS.

STATUS: Ongoing. Data QA/QC is completed as data deliverables are submitted. We conduct monthly invoice reviews with the project technical team or via the tracking site; we then follow up with the subrecipients. This is conducted either by the Project Manager, technical team, or PIs. Tasks are tracked internally via a task website (task.usgin.org); data deliverables are tracked at stategeothermaldata.org.

Task 4. Establish regional technical resource centers

Purpose: To provide training, guidance, and assistance to Surveys in developing and implementing data quality and integrity guidelines, developing metadata, implementing data services, and configuring their servers to link seamlessly with the NGDS.

Approach: The project will establish multiple regional technical resource centers with a programmer/developer in each one, to serve that region. These centers will utilize existing facilities at the host agency.

Milestone: Hiring of the regional programmers will occur during the beginning of Phase I.

Outcome: Technical resources will be working with participants to meet project goals and standards.

STATUS: Complete and Ongoing. Complete in that there are four regional hubs currently operational. This is ongoing in that there is continuing maintenance at each hub and in the hub networking. The annual hub meeting was held September 5-6, 2012 at AZGS offices in Tucson. A draft disaster recovery plan was formed, implementation of which will occur in the next FY. We also discussed regional workshops, one of which will be held in conjunction with the Nevada GIS meeting in mid-May, 2013.

PHASE 2 – TRANSFER AND VALIDATION OF INFORMATION TO DATA SYSTEM

Task 5.0 Data integration into NGDS

Purpose: Enable catalogs and databases to be exposed to the network for discovery, access, and retrieval

Approach: Develop, document, implement, and deploy web services to enable open access to information resources of the NGDS

Milestone: Service specifications are being developed as part of the BSU-led NDGS Prime project and will be ready for deployment early in Phase I. Data exchange procedures are ready to be implemented now, but they will be made more user-friendly throughout the project. Service implementation and

deployment will be prioritized to make data that the SGS collaborators are producing during each cycle accessible.

Outcome: The NGDS is an effective system to enable discovery and access to data provided by the state geological surveys using standard interfaces.

STATUS: Ongoing. Participation in multiple meetings with the NGDS Architecture, Design, Testing, and Maintenance project including the system vision and software requirements have occurred. There is now a clear plan forward for integration with the NGDS. We continue to add AASG subrecipient data to the catalog as it becomes available. Data delivery procedures are in place at stategeothermaldata.org and through USGIN tutorials.

Subtask 5.1 Registration of resources.

Purpose: Enable data providers to register their resources by publishing metadata in the NGDS catalog. Verify that metadata meets requirements, and that registered resource exists and can be accessed using information in metadata.

Approach: Acceptance and publication of metadata in the NGDS catalog will be the formal mechanism for making a resource part of the NGDS. The publication process requires a validation process to determine that metadata and the described resource are conformant with system requirements. This is a technical validation, not a scientific review. Project technical staff will work with data and application providers to efficiently produce metadata meeting system requirements and publish it using the NGDS core, and to develop automated processes for data and metadata validation. Policies for this validation process developed by Project technical staff and the NGDS core team, reviewed for approval by the Technical Advisory Board, and once approved, will be made publically available.

Technical approaches for metadata publication include provider exposing conformant metadata through their own catalog service, use of web crawling software to harvest metadata from other online information provided by data provider, submission of metadata in a structured file for import to the metadata catalog, or production of metadata directly into the catalog using online forms. Once metadata are available from at least one catalog server in the system they can be harvested to archive in the NGDS Core catalog.

Milestone: Data delivered by project participants as Task 2 deliverables validated and registered to become part of the NGDS following a documented process.

Outcome: Allows participants to expose data, metadata, and catalogs to the NGDS as soon as they are available using a standard registration, validation, and publication process that provides data consumers with confidence in the quality of the products.

STATUS: Resources are being registered by entering metadata in USGIN repository or submitting Excel Workbooks with metadata loaded into XML. The metadata.stategeothermaldata.org is now available; this replaces the USGIN metadata wizard. The new catalog and repository was released prior to the GRC annual meeting.

Subtask 5.2 Implementing data exchange software 'wrappers' to provide for interoperability of databases

Purpose: Provide tools and guidance to map data into interchange formats used by web services to make data available interoperability.

Approach: Project technical staff will prepare training manuals ('cookbooks') and offer workshops on how to encode information for transmission and integration into NGDS. The technical staff will consult by phone and online with data providers. For providers without the technical staff to implement the interchange mapping, the AZGS project staff will do it for them. Schema and vocabulary mapping necessary to produce the interchange formats may be done using queries in a database, through xml transformations, or using custom software. Standardization of the interchange formats will reduce the amount of development required by enabling reuse of components and workflows.

Milestone: Each data delivery package will require implementation of access through NGDS

services using standard interchange formats, so the mapping of data schema and vocabulary, and document formatting required to produce interchange-format documents will be coupled with data delivery (subtasks 2.2, 2.3, 2.4). Training and assistance will be carried out continuously throughout all Phases.

Outcome: Data providers will have the ability to transform their own data and assistance and tools will be available for others to map their data into NGDS interchange formats.

STATUS: We continue to support data providers on interchange mapping which can be done using database queries, XML transformations, or custom software. We have updated data delivery tutorials and made them accessible for the NGDS. Content models for data interchange have expanded over the last year due to increased participation from all related NGDS projects and the GDSDPWG. All content models are available online through geothermaldata.org or stategeothermaldata.org; improvements to the management of these will occur in 2013.

Task 6.0 “Uploading” data to the NGDS

Purpose: To make each provider’s data accessible to the NGDS through standard web service interfaces.

Approach: Providers will publish their data via services, which they may implement themselves, or work through arrangements with other providers or the NGDS core. Services will follow documented NGDS service conventions.

Milestone: Have multiple NGDS nodes delivering data live in an operational prototype network for the data delivered in the first Phase One data acquisition cycle, with at least one operational, production OCG CSW catalog service. Later, have data services implemented and in production operation for data delivered in the second Phase One cycle, and have services implemented and tested for inclusion of data delivered at the end of the third Phase One cycle.

Outcome: Data available to NGDS clients; establish pattern and technology for open data publication that will enable growth of the data cloud independent of any particular project.

STATUS: Ongoing. Initial milestone of having multiple NGDS nodes delivering data live in an operational prototype network is complete. Nodes include the hub states as well as states that are self-serving data. Oregon has recently indicated an interest in becoming a node for serving their data.

Task 7.0 Establishing links and/or virtual portals to the retrieved/collected/developed data

Purpose: To make data and service products available through the NGDS Geothermal Desktop and other web portals

Approach: Project technical staff will work with the NGDS Geothermal Desktop developers and external groups to create necessary web services, ontologies, and interface standardization to link the aggregated data resources of the project to NGDS web portal and enable other, independent portals to interface with the System. Work with other client application developers to implement connectors to NGDS catalog and data services. The objective is to enable widely used, off the shelf, ideally low-cost or free, software to access data provided by NGDS.

Milestone: Demonstrate access to at least one NGDS data service by client applications (desktop or web based). Demonstrate access to all implemented NGDS services by at least one client application. The NGDS Prime Geothermal Desktop is an obvious first choice of clients, but software development for this application is under control of the NGDS core project, so AZGS cannot set milestones based on development if its functionality.

Outcome: Software applications are available that will access and utilize project resources.

STATUS: The BSU Geothermal Desktop application was dropped as a deliverable as a consequence of that projects reboot. We completed a tool for accessing WFS data, which is available at <http://data.geothermaldatasystem.org/> and through the NGDS website at www.geothermaldata.org. The tool was presented at the ESIP Summer Meeting to positive reviews from the session crowd.

Functionality includes the ability to search AASG/NGDS WFS services, preview them and export the services into an html data table which can be copied and pasted into an Excel spreadsheet (or similar program). We have also participated in regularly scheduled NGDS User Experience project calls, when

invited, and incorporated many of the key concepts in the design of the NGDS website. In addition, we have been discussing NGDS data integration in the National Renewable Energy Lab (NREL) designed Geothermal Prospector front-end application; we will continue these collaborations in the next year.

We will continue to work with the software developers for the NGDS Architecture, Design, Testing, and Maintenance project in order to ensure that the products and services deployed for the AASG project are compatible with the final user interface developed.

Task 8.0 System testing in conjunction with NGDS

Purpose: By the time AZGS is in late Phase I and Phase II, where AZGS are starting to register data services with catalogs and implement data exchange standards, the NGDS will still be in development and testing of key components of the system.

Approach: Work with NGDS Core development team (BSU led) to test services and data formatting. NGDS core has stated intention to implement service status monitoring, and AZGS hopes to include conformance testing of data services against technical specifications. An operational network will require ongoing monitoring, and standardized performance and reliability testing. In collaboration with NGDS core developers, define standard tests of NGDS services that can be run to determine if service instances are functioning properly.

Milestone: Development of system to monitor service availability and make current status of system services visible to users. Implement more than one functional unit test modules by end of project.

Outcome: Beta-style development, deployment, and testing of key components of NGDS increases reliability of services and quality of data and metadata.

STATUS: Ongoing. NGDS System Requirements documentation is ongoing at the NGDS Design & Testing project, in which we are playing an active role in development of the requirements. We are scheduled to test against and with the NGDS in the late summer/fall of 2013. In the interim we have been working with our regional hubs to develop system testing; a test between the Arizona and Nevada hub will occur in early 2013.

Task 9.0 Assurance of the integrity of the original data set

Purpose: Establish criteria that can be used to filter data and categorize them according to established and user-defined quality levels.

Approach: Research will be necessary to identify automated processes that may be used to assess quality of data offered by a service. Automation can be used to assess conformance to usage of controlled vocabularies and schema cardinality requirements, the percentage of data fields that are null or have invalid data type values, and other similar metrics. More subjective judgment of data quality can be made by the data provider and provided in metadata data quality elements, but these will probably not be mandatory in the near term because the information is commonly not available. A system for user feedback on data quality will be investigated as well. Implementation of such complex advanced features is not within the scope of the current project, but AZGS will work with NGDS core developers to identify approaches that can be implemented with resources available. Available quality information will be reported with each metadata search. When data with incomplete metadata is identified the entity responsible for the metadata will be notified.

Milestone: Criteria will be reviewed with the NGDS Architecture, Design, Testing, and Maintenance project during service development. At least one integrity test will be selected for implementation with service per year

Outcome: The system will assist users to evaluate data quality and enable filtering of datasets according to their needs.

STATUS: As part of the data delivery process all data submitted by the states are reviewed in spreadsheet formats before deployment as a web service. Prior to deployment a rule-based validation tool to test metadata records for conformance with specifications is run. An improved metadata tool for the AASG Contributions Repository is complete; AZGS staff has worked to update all existing metadata using this tool.

PHASE 3 – EXECUTION OF DATA MAINTENANCE SUSTAINABILITY PLAN

Task 10.0 Formulation of the data maintenance and sustainability strategy

Purpose: Ensure availability, reliability, and update of data and services in the NGDS during and beyond the project.

Approach: Educate system data providers and users through workshops at the regional technical resource centers. Data provided by state geological surveys can be hosted by the originating survey, at one of the regional centers, or by the NGDS core, and depending on policies developed by NGDS may be mirrored by other NGDS system servers. Regional centers will mirror and backup data for their region, and provide redundant service instances to prevent a single point of failure. Develop a business model to sustain system maintenance for data and services by engaging stakeholders who have financial resources available and an interest in continuing system operation.

Milestones: Create a network of NGDS servers with the regional centers, and determine what resources each center will mirror and backup. Implement mirroring and backup during Phase 3. Sustainability plan must be in place.

Outcome: Data and services are backed up and a system is in place for continuity beyond the duration of the project.

STATUS: Ongoing. We successfully hosted the hub meeting and established a general plan for disaster recovery. One of the concepts included in the disaster recovery plan was the concept of virtualized servers. The NGDS hubs will implement virtualized servers of their existing servers to begin the testing phase which will begin in early 2013. Also discussed was the total cost of operations. The hubs were asked to submit a cost maintenance plan for review. Finally, PI Allison leveraged travel funds from a separate project to attend the National Data Repository meeting, sponsored by Energistics. The conference hosted over 180 participants from 30 countries to share challenges and best practices and develop common standards and procedures to better curate and preserve data and samples. This meeting provided additional insight on options for long-term funding and governance models for data systems and repositories. Information gathered at this meeting will be placed in the sustainability plan. PI Allison was appointed to chair an international work group on identifying and evaluating business models for data repositories.

Subtask 10.1 Implementation of regional aggregation services and back-up of data

Purpose: To ensure data backup, continuity of service, and the potential for a permanent repository

Approach: Each regional center will host a data server that provides multiple functions: mirrored services for state servers in that region to ensure data backup, continuity of service, and the potential for a permanent repository.

Milestone: Multiple regional backup and mirroring systems will be set up and configured.

Outcome: Data are backed up and aggregated for enhanced functionality.

STATUS: Ongoing. Hubs are in the process of virtualizing their servers; two of the four hubs are currently virtual (cloud-based). A test between the two virtual machines will occur in early 2013.

Task 11.0 Adding new technical or institutional data

Purpose: Add new data from participants and add participants

Approach: Participants will revise their Scopes of Work regularly in accord with guidance from the Scientific Advisory Board. Project management will be seeking participation by additional data and service providers throughout the project.

Milestone: Participants will quantify and identify their data to be provided at the beginning of the project and update plans regularly as new data become available.

Outcome: The system operates in a mode of continual update and expansion.

STATUS: Ongoing. Project management is continually seeking new avenues and data providers for the system. We continue to engage with WRP, CUAHSI, USGS, IGSN, and others in order to harvest

information for the system. We also continue to engage with communities of data-heavy end users to learn new techniques for data delivery. These include OGC, ESIP, and NSF's new EarthCube cyberinfrastructure initiative.

Task 12.0 Publicizing addition of the new data

Purpose: To keep providers and users aware of new data available

Approach: Use the project Technology Transfer plan (Subtask 13.4) and provide notification and syndication features in the servers and portals so that users can receive automatic notification when new data are available, including ability to select only data from certain areas or of certain type.

Milestone: Technology Transfer and public outreach have begun during the project negotiation phase and will be ongoing throughout the project.

Outcome: Increase the use and value of the NGDS.

STATUS: Ongoing. We continue to promote the NGDS through an aggressive community engagement and outreach program as demonstrated by the many talks and presentations listed above. We also provide live demonstrations of the data at high-profile national meetings, which include the Geothermal Resources Council Annual Meeting, Geological Society of America Annual Meeting, and the American Geophysical Union Fall Meeting.

Task 13.0 Project Management and Reporting

Purpose and Approach: Reports and other deliverables will be provided in accordance with the Federal Assistance Reporting Checklist following the instructions included therein. Comprehensive reports at the end of each project phase will serve as the basic milestones for each of the tasks and their subtasks. These reports will serve as the basis for go / no-go decisions for the project as a whole and for the various tasks. It is anticipated that the review of the reports will also lead to revisions of the tasks and subtasks as necessary.

Outcome: Quarterly and Phase I Reports.

STATUS: Ongoing. All ARRA Jobs Reporting and Quarterly Reports were submitted on schedule and approved. This report completes the Annual Report requirement as outlined in the Federal Assistance Reporting Checklist.

Subtask 13.1 Implementation of organization structure

Purpose: To achieve project goals on budget and on schedule

Approach: Establish a management team at AZGS for the project; outline duties of the Management and Scientific Advisory Boards and appoint members; coordinate with the external Technical Advisory Board; implement the project Communications Plan; develop the Technical Training Plan.

Milestone: The Management Team is already in place, with the hiring of a full-time project manager and administrative assistant. The MAB and SAB duties will be established and members appointed by the official start of the project. The Communications Plan is under development and will be completed during the beginning of Phase I. The web developer/graphic designer has been hired. The Technical Training Plan will be developed during the beginning of Phase I.

Outcome: The Management Team is in place prior to the project kick-off to ensure that project goals will be met.

STATUS: Complete. Over the last year changes in project team staffing occurred and the Technical Advisory Board was absorbed by the NGDS-wide technical committee - GDSDPWG.

Subtask 13.2 Coordination among participants, collaborators, NGDS, and stakeholders

Purpose: To ensure the project meets the needs of the NGDS, as well as project participants, collaborators, and stakeholders.

Approach: Establish advisory boards (describe in Tasks 2, 3, and 13.1); integrate NGDS key

personnel into the project management and technical processes; hold regular meetings with NGDS and participants; establish formal affiliations among participants and collaborators; develop regular working relationships among the parties.

Milestone: The formal relationships will be largely complete prior to the project kick-off. Informal working relations are established and will continue to be nurtured. Schedules and plans for formal meetings and reviews will be partly completed prior to the project kick-off and finalized during the beginning of Phase I. Meeting schedules will be set on a regular basis.

Outcome: AZGS will have a well-coordinated and effective interactions and collaboration among all parties.

STATUS: Ongoing. We have daily one-on-one communications through email and phone calls with subrecipients. We also have an eNews mailing through the stategeothermaldata.org site, which we try to provide at least monthly updates. Over the next year we will host a series of regional workshops with subrecipients to ensure sustainability of the network. At these workshops we will discuss service deployment and node deployment hopefully utilizing the work completed under the NGDS Design and Testing project.

Subtask 13.3 Milestones

Purpose: To coordinate the project deliverables with the NGDS

Approach: Management and technical staff from the project and from NGDS are working collaboratively and will be formally integrated into the respective projects.

Milestone: NGDS standards and protocols will be developed during Phase I and implemented for project data concurrently. Networking functions will be implemented during Phase II.

Outcome: NGDS standards and protocols will be available to project data providers at the appropriate time to contribute to the NGDS

STATUS: Ongoing. We are encouraged by the progress of the NGDS Architecture, Design, Testing, and Maintenance project under the new Principal Investigator at Boise State University as well as the new technical team in place to complete the project. The system vision is complete and the requirements and specifications are in draft completion. Development sprints are scheduled to take place in late 2012/early 2013.

Subtask 13.4 Technology Transfer

Purpose: To reach out beyond the project participants and collaborators

Approach: Make presentations at geothermal and geosciences meetings and conferences; exhibit at technical and industry conferences (in partnership with NGDS core, AASG, and others as opportunities permit); maintain and contribute to Web site(s); hold workshops and seminars (for data providers) opened to non-SGS's; prepare and distribute training materials (cookbooks and online tutorials) freely to anyone.

Milestone: Presentations and exhibits are already being made prior to the kick-off. A regular work plan will be developed in the beginning of Phase I and updated as needed.

Outcome: Effective communications to data and service providers and users about the NGDS capabilities and opportunities.

STATUS: Ongoing. Tutorials are developed based on user and subrecipient feedback. Conferences and exhibits are selected using the following criteria: a) applicability to field of informatics, b) AASG sponsored or heavily attended events, and c) geothermal industry sponsored or heavily attended events. Currently available online tutorials include:

- Content Model
- Feature Search and Map Client
- Naming Conventions
- Rasters and Vectors: A Comparison
- CSW Client

- Metadata
- URI
- XML
- AASG Geothermal Data Repository
- Data Delivery Cycle
- GeoSciML-Portrayal Cookbook