

AASG State Geological Survey

Contributions to the NGDS

Project Officer: Arlene Anderson

Total Project Funding: \$21,858,224

April 22, 2013

Principal Investigator :
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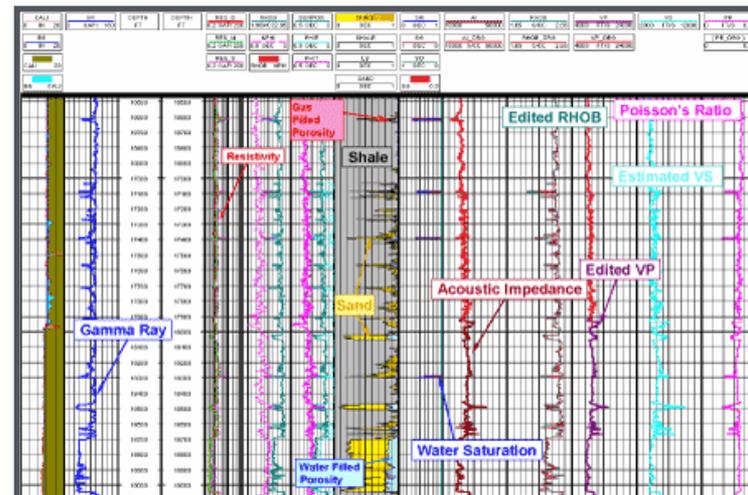
Co – PI:
Stephen M. Richard, Ph.D.

Arizona Geological Survey

Data Systems

Relevance/Current Challenges

- Data Access for Industry and Policy-makers
 - Lack of publicly available data
 - Availability of consistent, interoperable, and reliable geothermal-relevant data
- Cost
 - High cost and risk associated with exploration hampers industry growth
 - High cost of staff time devoted to finding, retrieving, converting, and verifying information

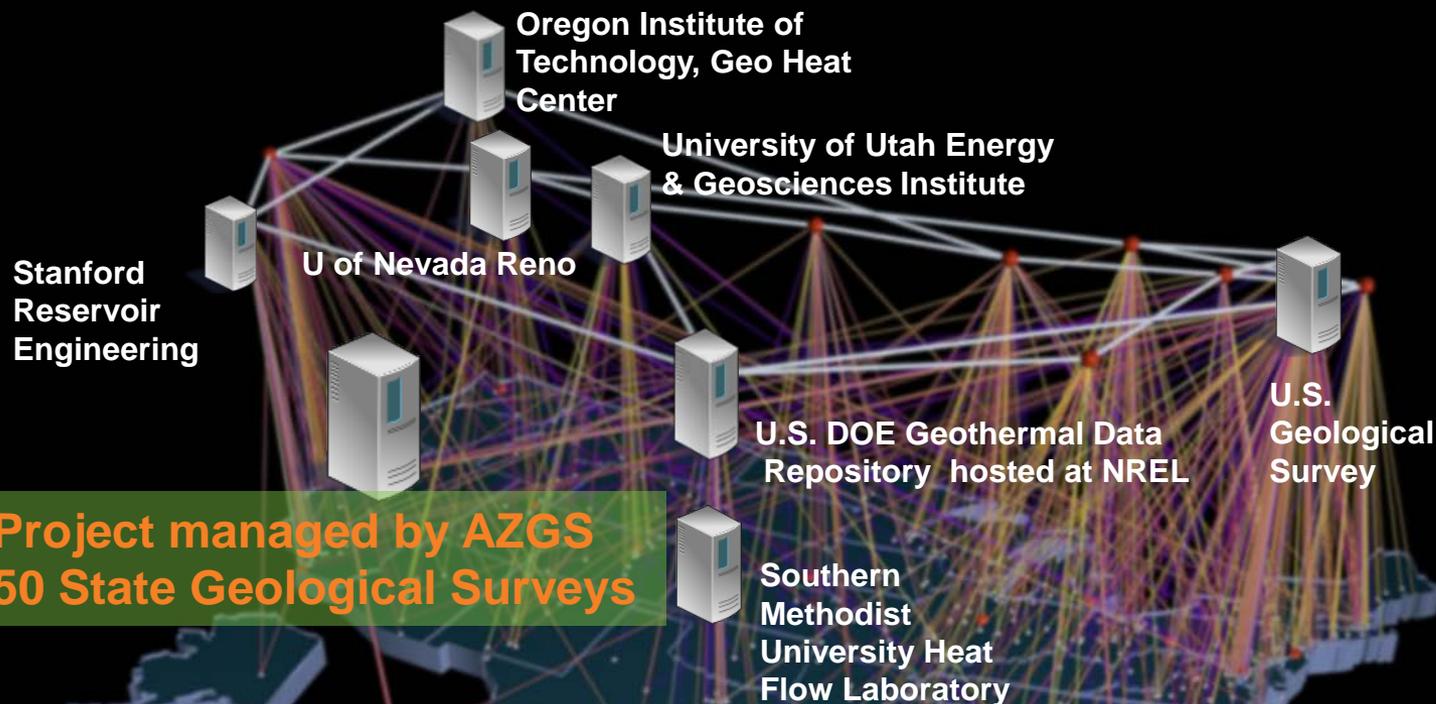


Impact

- This project facilitates and streamlines the discovery, access to, and integration of geoscience and geospatial information used to locate, evaluate, and develop geothermal resources
 - EERE GTO Goals Relevance:
 - Lower risks and costs of exploration and exploration
 - Expand reference and resource data for Research and Development activities, including data in low-temperature locations
 - Lead to Innovative Exploration Technologies through increased data availability on geothermal energy capacity while collecting new data in previously unexplored or under-explored locations
- Prototypes data interoperability and distributed data networks from concept into production
- Provide a framework for a new paradigm in data stewardship and delivery that supports broader open government, digital government, and Big Data initiatives



**Project managed by AZGS
50 State Geological Surveys**



- data “nodes” digitize, archive, manage, and provide content independently
- open source software and standard protocols
- *distributed framework* and a unified catalog search interface

Relevance/Impact of Research Impact on NGDS

- ~4.5 million data points online
- 294 Layers in 193 Web Services with nearly all data exchange types represented
- >17,000 records – documents & data sets - in the AASG State Geothermal Repository
 - Includes some NGDS Design-Test (BSU) subrecipient items

The screenshot shows the AASG State Geothermal Repository website. At the top, there is a navigation bar with 'Home', 'Browse Collections', and 'Find Resources'. Below this, there are sections for 'Site Information' (About this Repository, Terms of Use, About Metadata) and 'Latest Contributions' (Coming Soon!). The main content area features three large buttons: 'Browse the Collections' (with an open book icon), 'Manage Resources' (with a code icon), and 'Register for an Account' (with a person icon). Below these is a search interface for 'temperature' with a 'Show Search Area' button. The search results show two entries: 'Kansas Borehole Temperature Observations' and 'Wisconsin Borehole Temperature Observations'. A magnifying glass icon is also present.

Sponsored by the U.S. Department of Energy under award DE-EE0002850 to the Arizona Geological Survey acting on behalf of the Association of American State Geologists.



U.S. DEPARTMENT OF
ENERGY



AASG
Association of American State Geologists

Scientific/Technical Approach Summary

- Adapt the USGS-AASG Geoscience Information Network (USGIN) for use by the NGDS
 - Modular, distributed, web-based, interoperable
 - Open-source or common off-the shelf software
 - Focus on adapting existing capabilities
 - Federated catalog of distributed geothermal-relevant resources using global standards
 - USGIN Metadata profile, utilize ISO standards for encoding
 - Open Geospatial Consortium (OGC) Catalog Service for the Web (CSW)
 - Develop and document protocols for data access
 - OGC Web Map Service (WMS) and Web Feature Service (WFS)
 - Develop simple feature templates for standard data types
 - User tutorials online
 - Webinars & webcasts
 - Developers tools online
- Deploy NGDS across all 50 states
- Work with State and Federal Geological Surveys & Partners to assemble and serve datasets online
- Ensure compatibility with the NGDS Architecture, Design, and Testing project which is utilizing CKAN (open-source software for data publishing) for the Node Deployment Software Stack. CKAN is also utilized by data.gov.



USGIN



ckan
The Data Hub Software

- **Tier One Data: Data Online and can be Discovered**
 - Format: downloadable file or a service
 - Requirement: catalogued in a meaningful way, e.g. provide a USGIN-style metadata record to catalog that is part of the NGDS System
 - Result: no interoperability, only discoverability
 - Difficulty: Easy
- **Tier Two Data: Data Discoverable with Basic Interoperability**
 - Format/Requirement: data tabular (i.e. Excel, Access), and available in standard (e.g. OGC web service); metadata are in a catalog
 - Result: Tier One discoverability and a basic level of interoperability since software can be written to ingest data directly
 - Difficulty: translating the data to tabular format can be time consuming, there may be restrictions from internal IT for service deployment; however, setting up an OGC service is free and fairly simple
- **Tier Three Data: Analyze Across Data Sets**
 - Format/Requirement: data are transformed into a standard interchange format, are accessible via OGC web service, and metadata are in a catalog for them
 - Result: data are discoverable, software can ingest data through standard OGC service calls, software can know what the data means, directly comparable across datasets; i.e. **Software can now do analyses that cross dataset boundaries – Interoperability!**
 - Difficulty: ETL can be time consuming and consensus on data exchange formats can be difficult

Scientific/Technical Approach

Data Types, Tier 3 Data

Active Fault/Quaternary Fault

Aqueous Chemistry –wells & springs

Borehole Lithology Intercepts

Borehole Temperature

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

Rock Chemistry

Seismic Event Hypocenter

Thermal Conductivity

Thermal/Hot Spring Feature

Volcanic Vents

Well Fluid Production

Well Header

Well Log Data Compilation

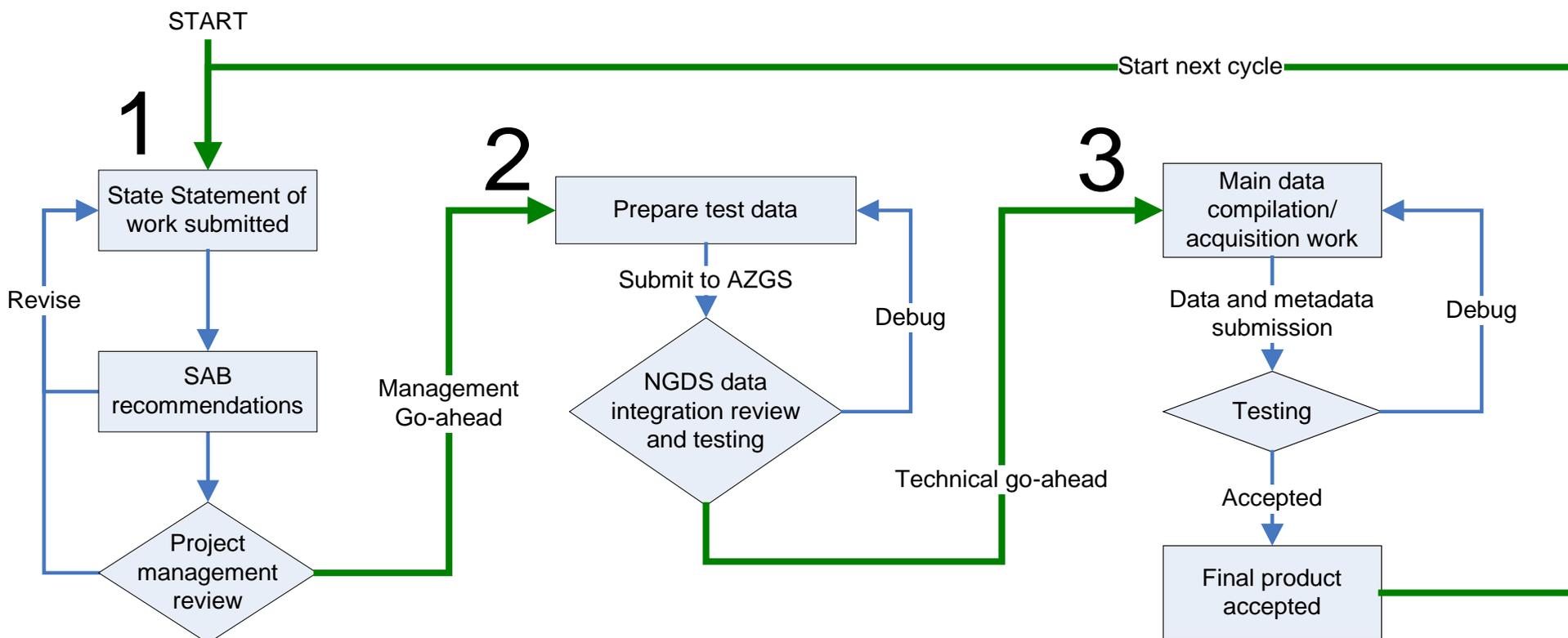
Workbook

Well Log Observation

Well Tests



Scientific/Technical Approach Data Identification & Collection Logic



1. Annual Statement of Work review by the Science Advisory Board – a panel of Geothermal Experts identified to review the applicability and utility of the proposed data collection efforts for each state.
2. Debug iterations are made between the NGDS system and each data producer until the prototype is demonstrated to work and provides the necessary content
3. The prototype dataset is made accessible online in the system, but flagged as development data set; the final submission provides the complete dataset evolved from the prototype and made accessible online as a web accessible dataset through a node in the network.

- Use of Existing Formats whenever possible
 - ISO 19115 for Metadata; ISO 19139 for XML encoding
 - Open Geospatial Consortium (OGC) services
- Use of Free and Open Source Software
 - CKAN content management system (also used by Data.gov)
 - GeoPortal catalog service implementation
 - GitHub for code sharing
- Loose Coupling
 - Based on WWW architecture
 - Third party user applications (“apps”) can use data from any server offering a compatible service profile
 - Catalog is standardized to allow user applications to automate data access

Discover, Access, Explore

Accomplishments, Results and Progress

Original Planned Milestone/ Technical Accomplishment	Actual Milestone/Technical Accomplishment	Date Completed
No-Cost Extension	Received NCE through 4/30/2014 to accommodate subrecipient contracting delays and expand upon the sustainability of the network	06/2012
Comprehensive Data Production	Ongoing; finalized nearly all YR 1 and YR 2 data; reached mini-goal of data for more than 1 million wells in the system	12/2012
Enhanced User Access	Released enhanced www.geothermaldata.org prior to the GRC/GEA Annual Meeting & Expo; will combine our experiences with the NGDS Architecture, Design, & Testing UI work	09/2012
New Field Data Collected	Ongoing; 4 of 6 states have completed their thermal gradient wells, majority of additional data collection (well logging, spring sampling) is well underway; Accomplishment: UT discovered geothermal reservoir in sedimentary basin	ongoing
Sustainability Plan for the Network	Extensive outreach and engagement of external parties; planning of AASG subrecipient end-user workshops for sustaining the network; business models under development	ongoing

greentechmedia:

UGS discovery in the Black
Rock Desert listed as #7

NEXT >
2013: Year of the Water-
Energy...



Geothermal's Big 12 Events of 2012

With 128 megawatts of
geothermal coming on-line in
2012, we present a geothermal
year in review.



HERMAN K. TRABISH
2012

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New Geothermal Data System Could Open Up Clean-Energy Reserves

Forgotten and filed away decades ago, millions of documents on geothermal research are now helping scientists make harvesting Earth's energy affordable

By William Ferguson

GRC Best Presentation Award

In recognition of quality of Content and
Presentation at the Exploration 1 Session

A Geothermal Data System for Exploration and Development

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 & Caudill, Christy

**2012 GRC Annual Meeting
Reno, Nevada • USA**

Steve Ponder
GRC Interim Executive Director

One of 34 Best Presentation
Awards from over 180
presentations at 2012 GRC

Accomplishments, Results and Progress

Improved Search Functionality

Regional Search for Well Headers; data results displayed within search

Additional Search Tool Functionality:

- More Details on the Dataset
- XML metadata
- Access WMS/WFS (and preview)
- Access Esri services (and preview)
- Preview data table
- Download File
- Get OGC WMS/WFS Capabilities
- Esri Service Endpoint
- Contact Distributor

search.geothermaldata.org/#well headers/bbox=-92.8125,36.137875,-79.9805,36.137875 www.geothermaldata.org

NGDS National Geothermal Data System

well headers

United States

Hide Search Area Defined Area: N: 42.7147, S: 36.1379, E: -79.9805, W: -92.8125 Clear Defined Search Area

Results 12 total results Next 2 Results >

Ohio Well Header Data
This collection is a compilation of well headers compiled by the Ohio Department of Natural Resource - D...
Web feature service, a web map service, and ESRI service and as an Excel spreadsheet for the National Ge...
By Joe Wells - Published on Fri Nov 04 2011 - Modified on Sun Nov 04 2012
Keywords: Geology Well Header WMS Geothermal Wells Ohio WFS ESRI Services WFS Services WMS Services Downloadable

Indiana Well Headers
This spreadsheet is a compilation of Well header information compiled by the Indiana Geological Survey, p...
National Geothermal Data System. The document contains 9 worksheets, including information about the...
By Andrew Gustin - Published on Fri May 25 2012 - Modified on Thu Dec 27 2012
Keywords: Geothermal well Indiana North America United States Indiana Geological Survey Well Headers ESRI Services WFS Se

Kentucky Well Headers

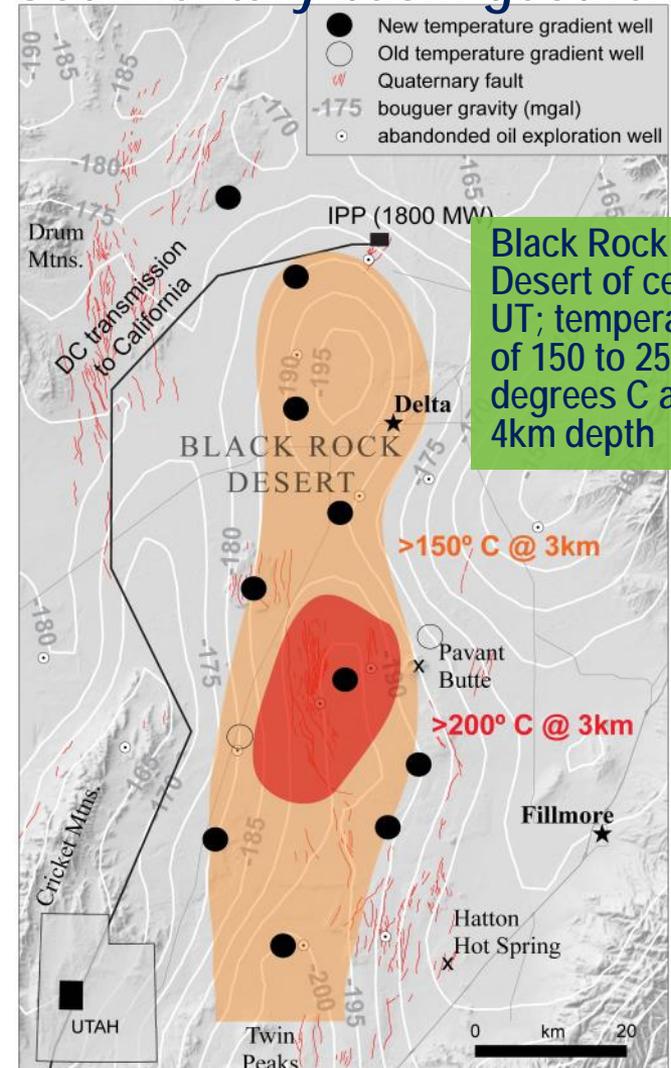
Accomplishments, Results and Progress

New Data Collection

New temperature gradient wells completed in UT, ID, WA, & WI; pending wells in OR & NV



Sedimentary basin geothermal



Black Rock Desert of central UT; temperatures of 150 to 250 degrees C at 3-4km depth

>150° C @ 3km

>200° C @ 3km

Program Officer Arlene Anderson and ID Geological Survey PI, John Welhan pose at one of three drill sites within the Blackfoot-Gem Valley of SE ID



Accomplishments, Results and Progress

New Data Collection



Thermal Spring Sampling in WA & AZ: results being entered into the NGDS



Temperature logging in WA



Accomplishments, Results and Progress Outreach & Engagement

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The Salt Lake Tribune



Expanded National Press including *Scientific American*, *The Salt Lake Tribune*, and *The Associated Press*

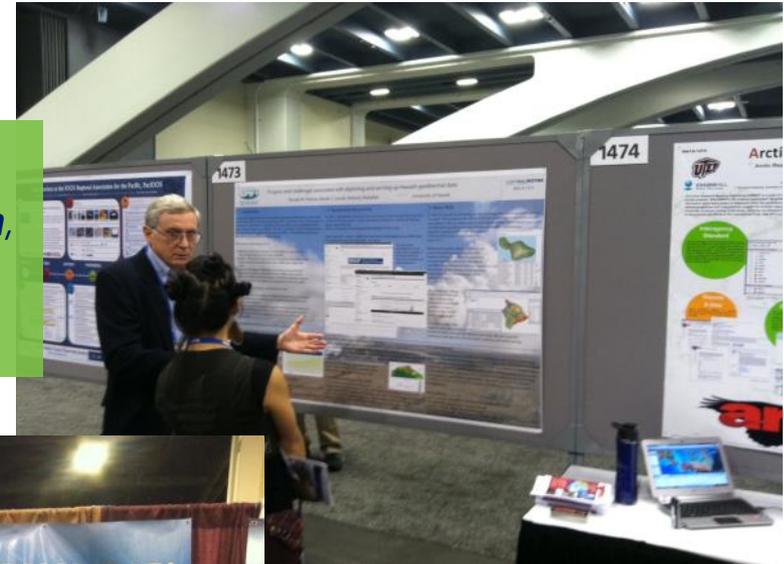


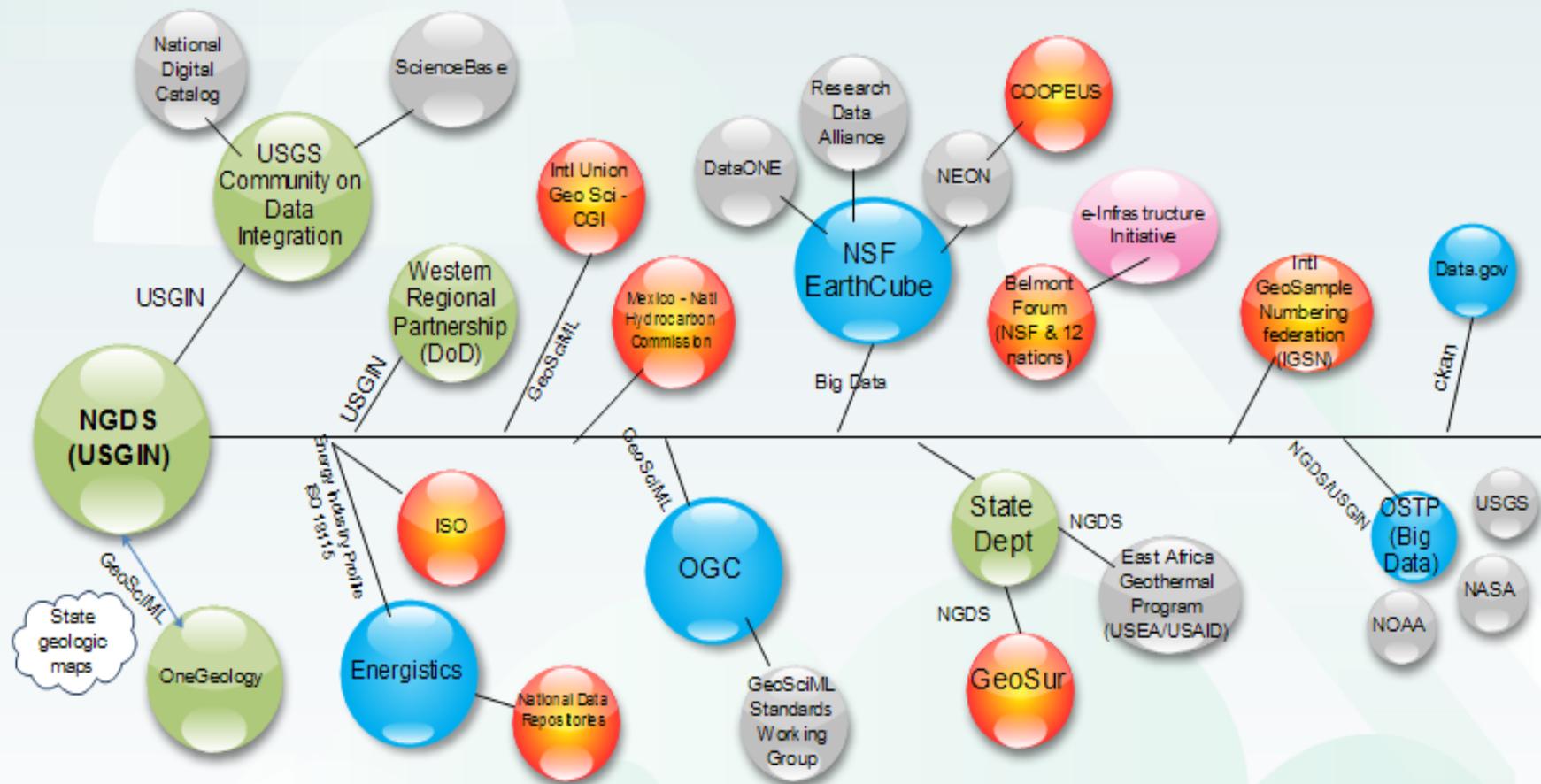
Exhibit Booth at the 2012 AGU Fall Meeting (above) and at the GSA Annual Meeting (right) with Jamie Robertson, WI State Geologist and Co-PI Richard



One example of the more than 30 talks and presentations by the AASG subrecipients: Don Thomas, PI for the HI data collection at the 2012 AGU Fall Meeting (above)

- NGDS is *sustainable, stable, and extensible* since it encourages distributed knowledge sharing through open source online data discovery and access
 - Concept can be expanded for adoption by a variety of communities, e.g. adoption by WRP
- Low barrier to entry enables broad participation
 - Tier 1 data entry requires minimal time; building a community of practice around data sharing will make quality metadata creation a step in the scientific process rather than a burden
- Promoting awareness to the end user community is critical to sustaining the network
 - End User Engagement through Workshops, Training Sessions
 - End User Awareness through Outreach, Engagement, and Marketing of the System and its capabilities
- Large number of potential collaborators and uses

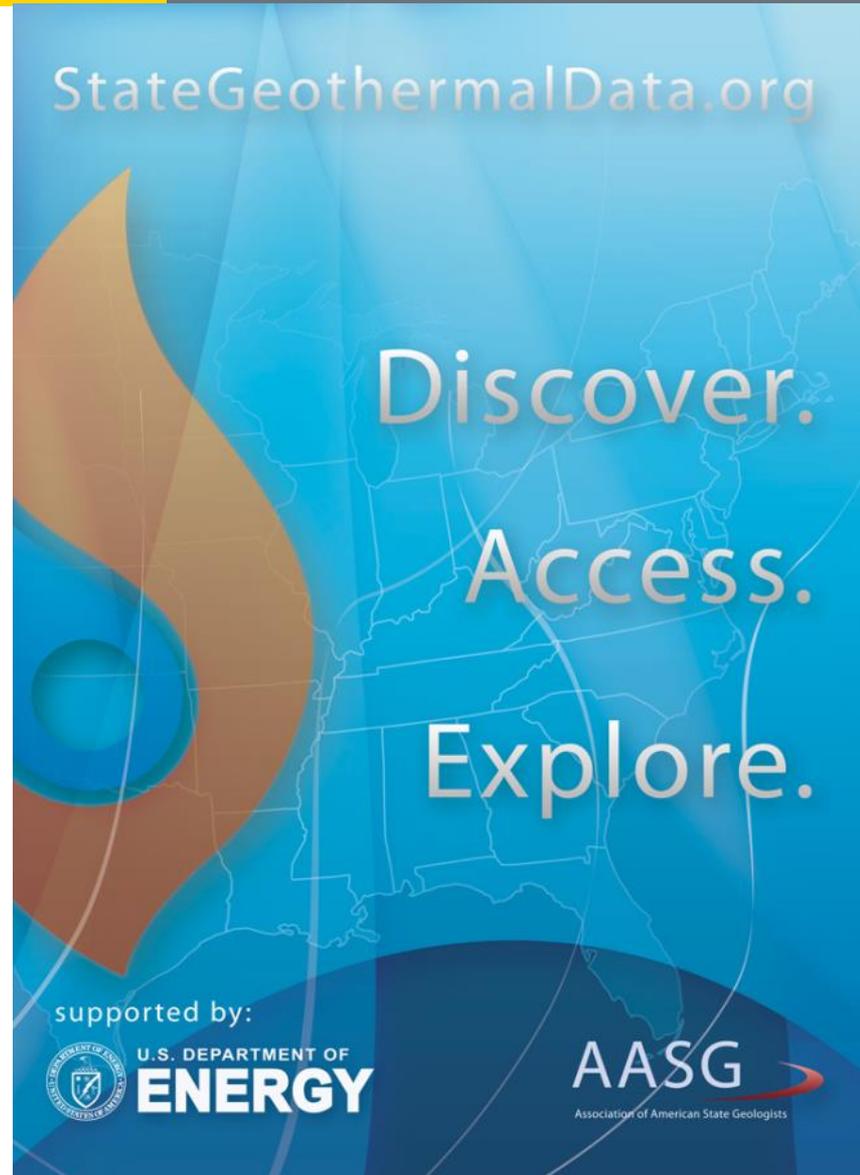
Future Directions Collaborators & Linkages



Milestone	Status & Expected Completion Date
Conduct status review to ensure target completion date	Planned: June 2013
Publish enhanced end-user material for broader system deployment	Planned: July 2013
Host at least two participant workshops on network sustainability	Planned: May 2013 & July 2013
Have initiated at least 2 collaborative efforts on sustaining the network	Planned: September 2013
Complete at least $\frac{3}{4}$ of the data collection efforts from subrecipients	Planned: October 2013
Finalize data collection efforts from subrecipients	Planned: December 2013
Finalize system for delivery to sustaining institution	Planned: April 2014

NGDS is a prototype functional system with nationwide data online *today*

- Production mode on data accessibility and digitization of legacy data
- Improved user interface
- Improved collaboration with the NGDS Architecture, Design, and Testing
- New geothermal data collection underway
- Expanded industry and stakeholder collaboration



Project Management On Schedule

Timeline:	Planned Start Date		Planned End Date		Actual Start Date		Current End Date	
		02/2010		02/2013		02/2010 at AZGS Contractors started Fall 2010 to Spring 2011		04/2014

Budget:	Federal Share	Cost Share	Planned Expenses to Date	Actual Expenses to Date	Value of Work Completed to Date	Funding needed to Complete Work
		\$21,858,224	\$258,897	\$14,560,985	\$13,945,129	\$13,945,129

Application of Resources

- Leveraging additional resources, e.g. NSF and USGS funds, Energistics Energy Industry Profile
- Exceeded Cost-Share in FY13 Q1
- Subrecipient spending checks and balances, e.g. data deliverable review per invoice and Science Advisory Board annual review

Integration with Other Projects

- Contributing to the NGDS Architecture, Design, and Testing by providing data from all 50 states as well as systems architecture
- Advising the SMU and Geothermal Data Repository projects on node requirements

Coordination with Industry & Stakeholders

- Aggressive Education Outreach and Training including 34 talks, workshops, and publications; 3 exhibit hall presentations; and more than 30 talks, presentations, or publications by the subrecipients
- Received a best presentation award from the 2012 Geothermal Resources Council Annual Meeting
- Initiated numerous discussions on sustainability and utilization of the network

All States Have Submitted Data