

www.stategeothermaldata.org

AASG State Geological Survey Contributions to the NGDS

May 9, 2012

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Data Systems



Timeline:

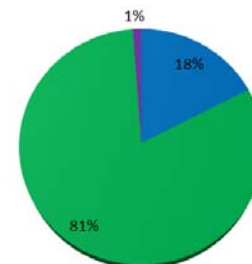
- Project Award Date: January 8, 2010
- Subrecipient Awards: May 2010
 - Kick-off meeting and 3-year contracts to May 2013
- Contracted End Date: February 1, 2013
- Anticipated End Date: December 31, 2013
 - No-cost extension requested to accommodate subrecipient contract date and NEPA environmental review
- Percent Complete, Deliverables & Work Load: approximately 40% as of 03/23/12

Budget:

- Total Project Funding: \$22,117,121
 - DOE Share: \$21,858,224
 - AZGS: \$ 3,857,775
 - Sub Recipients: \$18,000,449
 - Awardee Cost Share: \$ 258,897
- Total Spent as of 3/23/2012: \$7,695,544 or 35%
- Cost Share Reported as of 3/23/2012: \$182,591 or 70%

**State Geological Survey
Contribution to the National
Geothermal Data System**

■ AZGS Share ■ Sub Recipient Share ■ Cost Share Amount





- Three Year Contracts to Sub recipients awarded 5/24/2010
 - Quarterly and annual subrecipient on budget and deliverables
 - Annual project meetings for subrecipients
 - May, 2010 in DC
 - June, 2011 Association of American State Geologists (AASG) in Dubuque, IA
 - June, 2012 AASG in Austin, TX
- Management/Coordination through External Expert Advisory Boards
 - Management (MAB) and Science (SAB) have DOE participation with ex officio membership
 - Technical Advisory Board through the NGDS Architecture Design, Testing, and Implementation Project – Geothermal Data System Development and Population Technical Working Group (GDSDPWG)
- Application of Resources
 - Leveraging additional resources, e.g. NSF and USGS funds, Energistics Energy Industry Profile
 - Spending checks and balances, e.g. data deliverable review per invoice and annual SAB review
- Program Integration
 - Key data contributions to the NGDS through coordination of all 50 states as data provider nodes
- Coordination with Industry & Stakeholders by Project Management
 - Aggressive Education Outreach and Training (EOT) including 50 talks, 15 briefings, 6 publications, 11 webinars/webcasts, 7 exhibits, 3 workshops, and multiple news media interviews since project inception by prime contractor
 - Additional outreach performed by subrecipients, tracked at www.stategeothermaldata.org
 - End user feedback collected at exhibitions and conferences; online user survey implemented



Variance in Planned Schedule and Deliverables:

- Delays in subcontracting - organization of 44 sub-recipients, and 6 in-kind contributors
- Delays in staffing at lead institution (AZGS) and sub-recipient institutions
 - Hiring freezes in state government
 - Qualified workforce
- NEPA review on field work and new data collection

Implemented Solutions:

- Adjust YR-1 and YR-2 deliverables and SOW dates to signed contract dates (often Fall of 2010), shorten YR-3
- Employ contract labor where hiring freezes are implemented or work with appropriate entity to hire based on available funds
- Request no-cost extension from DOE through December of 2013 to accommodate subrecipients with late contract and startup and NEPA review. A reasonable estimate for concluding most of the existing data collection efforts is Fall of 2013; no cost extension permits AZGS to appropriately validate data and serve data.



- Project Collaborators
 - 44 Sub-awardees covering all 50 states
 - *Geological Surveys (State Agency or University Based)*
 - AL, AK, AR, AZ (CA), CO, FL, IA, ID, IL, IN, KS, KY, LA, MA (CT), ME, MN, MO, MS, MT, NC, NH, NJ, NM, NV, NY, OH, OK, OR, PA, RI, SC, TN, TX, UT, VA (DE, GA, MD), VT, WA, WI, WV, WY
 - *Universities*
 - HI, MI, ND, SD (Sinte Gleska University)
 - In-Kind Participants:
 - CA through AZ; CT through MA; DE, GA, and MD through the VA, NE and ND through UND, SD
 - Network Partners and Collaborators
 - USGS Community on Data Integration
 - Western Regional Partnership
 - International GeoSample Number (IGSN) eV (incorporated under German law as a not-for-profit society)
 - GeoNet Community of Practice: DataONE, EarthChem, Energetics, ESIP Federation, AuScope/Australian National Data System, IRIS Data Management Center, NEON, NOAA, Natural Resources Canada, OneGeology, iPlant Collaborative, USGS
 - State of Arizona
 - Industry
 - *Energetics, Microsoft Research*
- Cumulative number of jobs created to date: **237.3 over 8 quarters**
 - **29.66 average per quarter**
 - **FY11 Q3 = 48.83 jobs; FY11 Q4 = 52.01 jobs; FY12 Q1 = 48.58 jobs**

Relevance/Current Challenges

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

Impact

- This project facilitates and streamlines the discovery, evaluation, and access to geoscience and geospatial information used to locate, evaluate, and develop geothermal resources
 - EERE GTP Specific:
 - Lower risks and costs of development 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
- Moves recent development for data interoperability and distributed information from design/prototype into production
- Provide a framework for a new paradigm in data stewardship and delivery that supports broader open government data initiatives

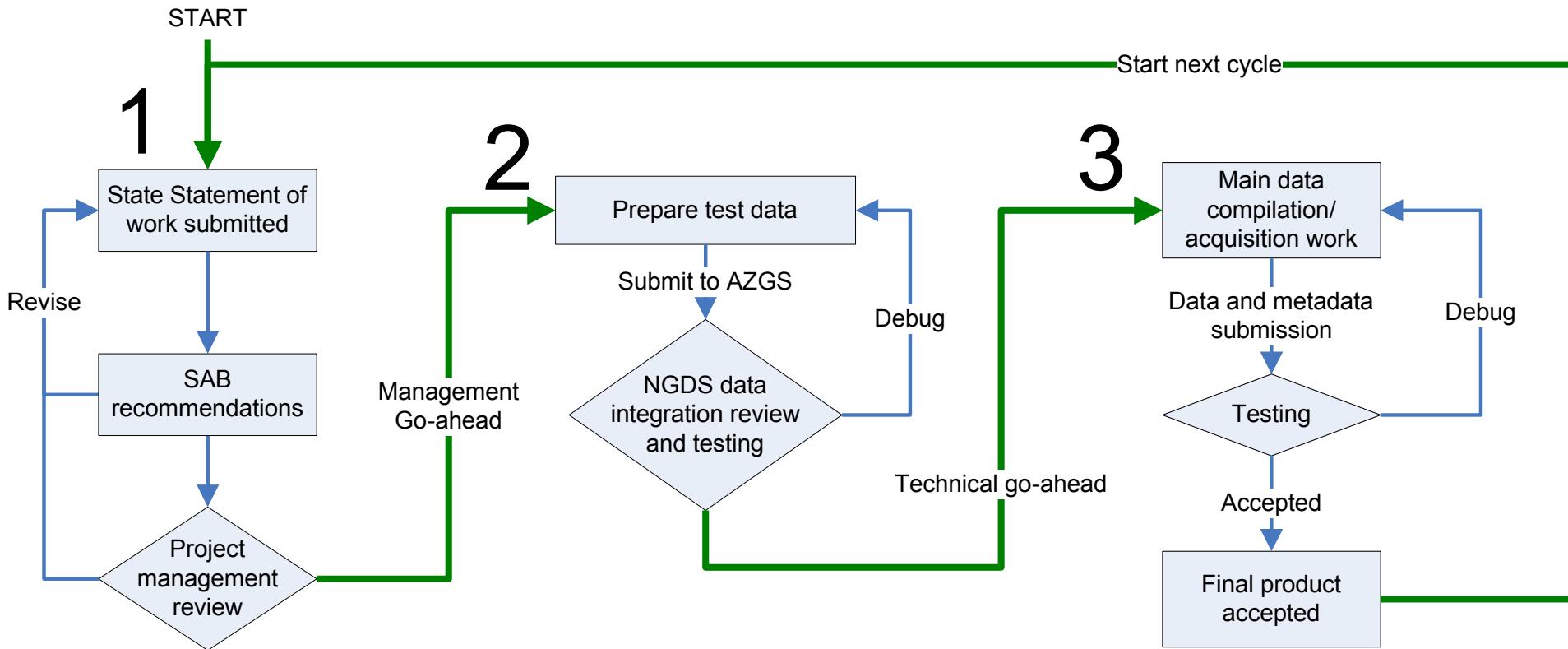


- Adapt the USGS-AASG Geoscience Information Network (USGIN) for use by the NGDS
 - Modular, distributed, web-based, interoperable
 - Open-source or common off-the shelf software
 - Focus on adapting existing capabilities
 - Federated catalog of distributed geothermally relevant resources (<http://catalog.usgin.org/geoportal>)
 - USGIN Metadata profile, utilize ISO standards for encoding (<http://lab.usgin.org/USGIN-ISO-metadata-v1-1>)
 - 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 (http://stategeothermaldata.org/data_delivery/content_model_templates)
 - User tutorials (http://usgin.org/tutorial_view_page)
 - Webinars & webcasts (<http://www.stategeothermaldata.org/media>)
 - Developers tools (<http://lab.usgin.org/>)
- Deploy NGDS across all 50 states
- Work with State and Federal Geological Surveys & Partners to assemble and serve datasets online





Scientific/Technical Approach: Technical Data Development Cycle



- Debug iterations are made between the NGDS system and each data producer until the prototype is demonstrated to work and provides the necessary content.
- 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 node in the network.

StateGeothermalData.org

Discover.

Access.

Explore.

supported by:



Users can:

- **Discover Resources** – search the NGDS federated catalogs to find data relevant to needs
- **Access Resources** – view and download useful data resources in a variety of consumable formats (WMS, WFS, .xls, CSV, XML, and more)
- **Explore Resources** – use the data for calculations or simulations on your desktop, or with third-party web-based software or “apps”
 - Provide feedback on datasets
 - Request additional data content

Data Providers can:

- **Share Resources** – register new resources in the federated catalogs

Example of Virginia's Well Log Data Compilation Workbook 1.4.2 (Excel Based)

	A	B	C	D	E	F	G	H	I	J	K	L	M	
	HeaderURI	WellName	APINo	OtherID	OtherName	BoreholeName	Operator	LeaseOwner	LeaseNo	SpudDate	EndedDrillingDate	WellType	Sta	
1	http://resources.usgin.org/uri-gin/vadgmr/well/VA_VT_Geothermal_Program_Well_56N1/	Virginia Tech Geothermal Program Well 56N1			Montross Geothermal Test Well, Virginia Tech Geothermal Program							1981-05-14T00:00	Geothermal Well	
2	http://resources.usgin.org/uri-gin/vadgmr/well/VA_VT_Geothermal_Program_Well_56N1/	Virginia Tech Geothermal Program Well 56N1			Montross Geothermal Test Well, Virginia Tech Geothermal Program							1981-05-14T00:00	Geothermal Well	
3	http://resources.usgin.org/uri-gin/vadgmr/well/VA_VT_Geothermal_Program_Well_56N1/	Virginia Tech Geothermal Program Well 56N1			Montross Geothermal Test Well, Virginia Tech Geothermal Program							1981-05-14T00:00	Geothermal Well	
4	http://resources.usgin.org/uri-gin/vadgmr/well/VA_VT_Geothermal_Program_Well_C22/	Virginia Tech Geothermal Program Well C22		VDGMR_WWCR	Creeds Geothermal Test Well, Virginia Tech Geothermal Program							1978-10-04T00:00	Geothermal Well	
5														

All content models include worksheets describing the data:

- About – provides basic information on the interchange format including title, version, description, editors, and revision comments
- Notes – describes the various sheets within the workbook
- Dataset Metadata – allows the author/compiler of the dataset to provide metadata on the resource compiler
- Data – varies depending on interchange format
- Reviewer Comments – the reviewer provides feedback on format/interoperability for the resource provider to make revisions
- Field List – describes the data fields, how to enter data, and why the field is important/required (if required)
- Data Valid Terms – industry recognized vocabulary for the specific feature



Scientific/Technical Approach: Interchange Formats for Content Models

- Active Fault/Quaternary Fault
- Aqueous Chemistry
- Borehole Temperature Observation Feature
- Direct Use Feature
- Drill Stem Test Observations
- Fault Feature
- Geologic Contact Feature
- Geologic Unit Feature
- Geothermal Area
- Geothermal Fluid Production
- Geothermal Power Plant
- Heat Flow
- Heat Pump Facility
- Lithology Interval Log Feature
- Metadata
- Seismic Event Hypocenter
- Thermal/Hot Spring Feature
- Volcanic Vents
- Well Header
- Well Log Data Compilation Workbook



- Supplemental Funding Contracts Complete
 - Over \$3.6 million in drilling and field work for new data collection
 - NEPA evaluation complete or in progress for supplemental projects field work
 - 2 states NEPA cleared;
 - 10 states in final phase;
 - 5 drill projects and 1 state remaining
- Web tools for tracking data submission and review process status through the USGIN Tasks website (internal) and Data Collection Tracking Map (external)
 - Project management access for processing submissions
 - Public access to data links and viewable data tracking available at www.stategeothermaldata.org
- User Access in Development (through client side plugins and webportals)
 - Current access portals released at GEA/GRC, GSA, and AGU Fall 2011 exhibitions, public comments reviewed and assessed, implementation of public comments in process
 - Developers tools and client side user access tools available; currently plug-in available for ArcMap; Excel plug-in in progress; available at www.lab.usgin.org and www.stategeothermaldata.org
 - Catalog search at <http://catalog.usgin.org/geoportal> or on www.stategeothermaldata.org

- Currently **20** Interchange Format Content Models complete and reviewed by the GDSDPWG
- Data maintenance and new resources added to the Catalog (<http://catalog.usgin.org/geoportal>)
 - Accessibility efforts include a revised metadata editor to minimize duplication and help cluster related datasets, as well as a browser tree to search for the data by state or by data type

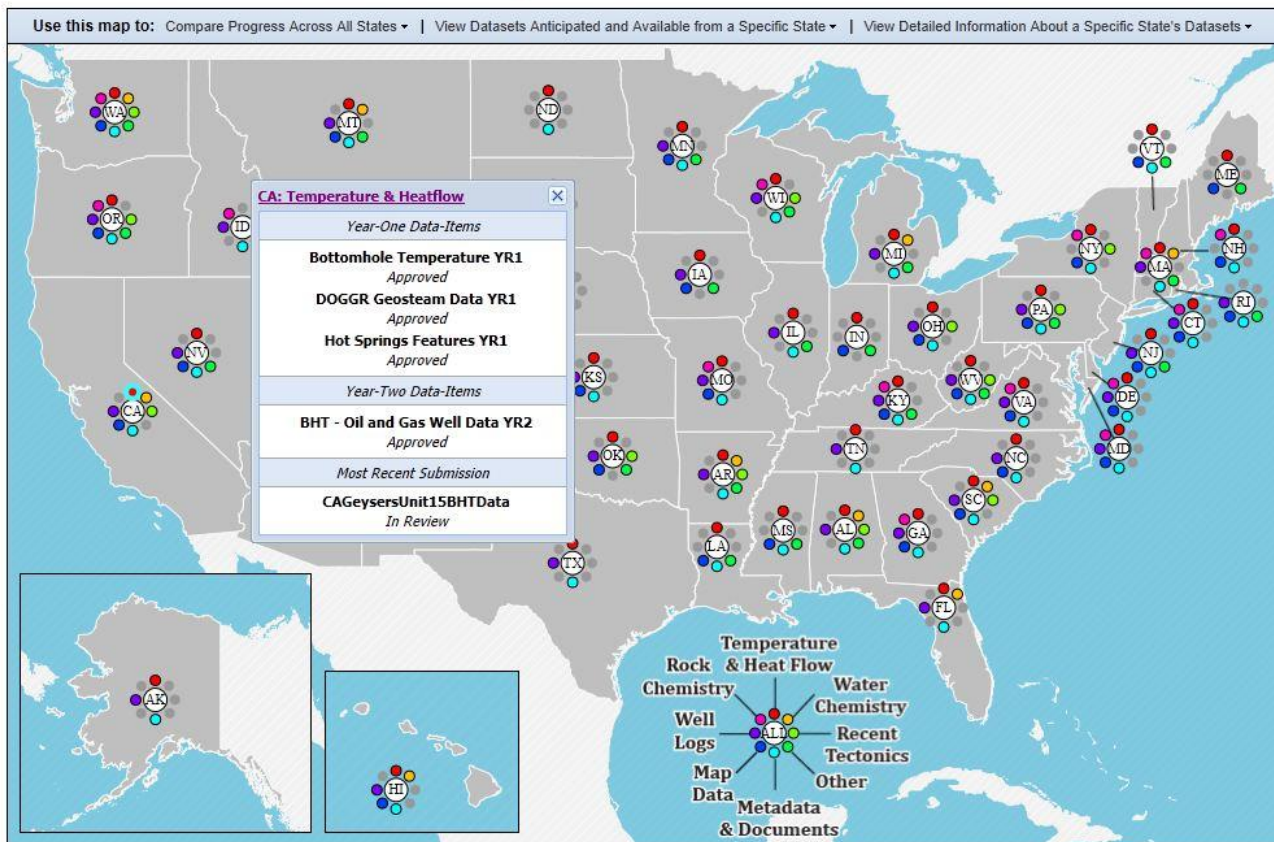
Tracking Status – Data Sets hosted by AZGS or Hub	Datasets	records
Data status Submitted, In Review, or Returned	148	1,352,439
Data status Approved (pending XML review and service prep)	117	48,093
Data status Online (documents in the repository: content model datasets, documents, logs, metadata datasets)	208	375,607
Total status - All	473	1,776,139

Web Map Services (WMS) and Web Feature Services (WFS) in the System	
Online Services (includes States' self-served data)	219
Pending Services (at HUB)	2



• Available on StateGeothermalData.org

Interactive Data Contribution Map



- Designed for users and sub-recipients to track data collection efforts
- Search by state or by data category
- Pop-ups indicate the datasets proposed for collection and their status
- Access a state specific or project wide report (shown on next slide)
- Access the data through the state report
- Pop-up example is California's Temperature & Heatflow data

About this map

This map provides the ability to view data collection status across all 50 states.

- Select a state report - Go



Report accessed at www.stategeothermaldata.org or directly at <http://services.usgin.org/track/report/CA>

STATE GEOTHERMAL DATA

Summary Report for California (All Project Years)

Content Category	Expected Deliverables	Completed Deliverables	Percent Complete	Records Online	Most Recent Submission
State: California					
Map Data	4	3	75%	141	Jul 26, 2011
Temperature & Heatflow	4	4	100%	42882	Jan 9, 2012
Recent Tectonics	2	2	100%	170	Jul 24, 2011
Water Chemistry	2	2	100%	23224	May 13, 2011
Well Logs	2	1	50%	344	Dec 2, 2011
Metadata and Documents	6	5	83.33%	146	
Totals for California	20	18	90%	71467	

Summary Report – all project years, including expected deliverables, completed deliverables, percent complete, records online, and most recent submission

California Data Available Online

- Downloads
 - California Oil and Gas field Reservoir Temperatures
 - CaGeoThermalVentsData7.5Quads
 - CaGeoThermalVentsData7.5Quads
 - California Active Faults
 - California Thermal Wells Aqueous Chemistry
 - California Volcanic Vents
 - California USGS Long Valley Geothermal Well Logs
 - California Idle Wells
 - California Long Valley Borehole Temperature
 - California Well Headers
 - California Borehole Temperatures
 - California Thermal Springs Aqueous Chemistry
 - California Thermal Springs Aqueous Chemistry
 - California Geothermal Documents
 - CA Geothermal Fields
 - California Geothermal Fields
- Services
 - California Active Faults
 - California Thermal Wells Aqueous Chemistry
 - California Volcanic Vents
 - California USGS Long Valley Geothermal Well Logs
 - California Idle Wells
 - California Volcano Hydrothermal Systems
 - California Well Headers
 - California Borehole Temperatures
 - California Thermal Springs Aqueous Chemistry
 - California Thermal Springs Features
 - Geothermal Map of California 2002 Map S-11
 - 1994 Youngs California Low-T Geot Resources Update 1993
 - California Geothermal Fields

Data for Download - data sets, WMS, WFS

Annual Deliverables by Year

Title	Submitted On	Status
Year One Deliverables		
Geothermal Fields YR1 (Map Data)		
California Geothermal Fields	Oct 26, 2010	Online as of Oct 06, 2011
State Map with Geothermal Data YR1 (Map Data)		
Geothermal Map of California 2002 Map S-11	Mar 18, 2011	Online as of Aug 29, 2011
Documents - CGS YR1 (Metadata and Documents)		
No submissions yet...		
Year Two Deliverables		
Geothermal Energy Documents YR1 (Metadata and Documents)		
CA: geothermal energy production documents	Feb 09, 2011	Online as of Oct 05, 2011
1994 Youngs California Low-T Geot Resources Update 1993	Dec 15, 2010	Online as of Aug 29, 2011
1994 Youngs California Low-T Geot Resources Update 1993	Jul 15, 2011	Online as of Jul 15, 2011
Temperature Gradients for Sedimentary Basins YR1 (Metadata and Documents)		
California USGS Long Valley Geothermal Well Logs		
California USGS Long Valley Borehole Temperature Logs in catalog		
Active Volcanic Vents YR1 (Recent Tectonics)	Jun 20, 2011	Online as of Oct 05, 2011
California Volcanic Vents		
California Active Faults	Jul 13, 2011	Online as of Oct 05, 2011
Bottomhole Temperature YR1 (Temperature & Heatflow)		
California Long Valley Borehole Temperature	May 28, 2011	Online as of Jul 15, 2011
Year Three Deliverables		

Annual Deliverables by Year – including title, date submitted, status (In Review, Returned, Accepted, Online), with comments





The screenshot shows the STATE GEOTHERMAL DATA.org website. At the top, there is a navigation menu with 'HOME', 'ABOUT', 'DATA DELIVERY', 'PROGRESS' (highlighted with a green box), 'NEWS', 'FORUMS', 'MEDIA', and 'MEMBERS'. Below the menu is a search bar with a 'Search' button. The main content area features a map of the western United States with a search box at the top left. A 'Map Contents' panel on the right lists 'Overlays' including 'ActiveFault' and 'Search Result Footprints', and 'Base Layers' including 'Google Terrain'. A 'Search the USGIN Catalog' panel is also visible, with a search box containing 'active faults' and a 'Search Results (24348)' section. The search results list 'California Active Faults, AASG State Geothermal Data WMS', 'Utah Active Faults, AASG State Geothermal Data WMS' (highlighted with a green box), and 'Arizona Active Faults, AASG Geothermal Data WMS'. Each result includes a 'Zoom To' button and other interactive options. The website also displays 'CONTACT | LOGIN | NEW USER?' and 'BETA VERSION -- WORK IN PROGRESS'.

Accessing data through a map based search on www.stategeothermaldata.org:

Search Box

WMS Functions:

- Zoom To
- Lock (in Search)
- Remove (from Search)
- Add to Map
- Add to ArcMap
- Details

Other Dataset Functions:

- Zoom To
- Lock
- Remove
- Download
- Details

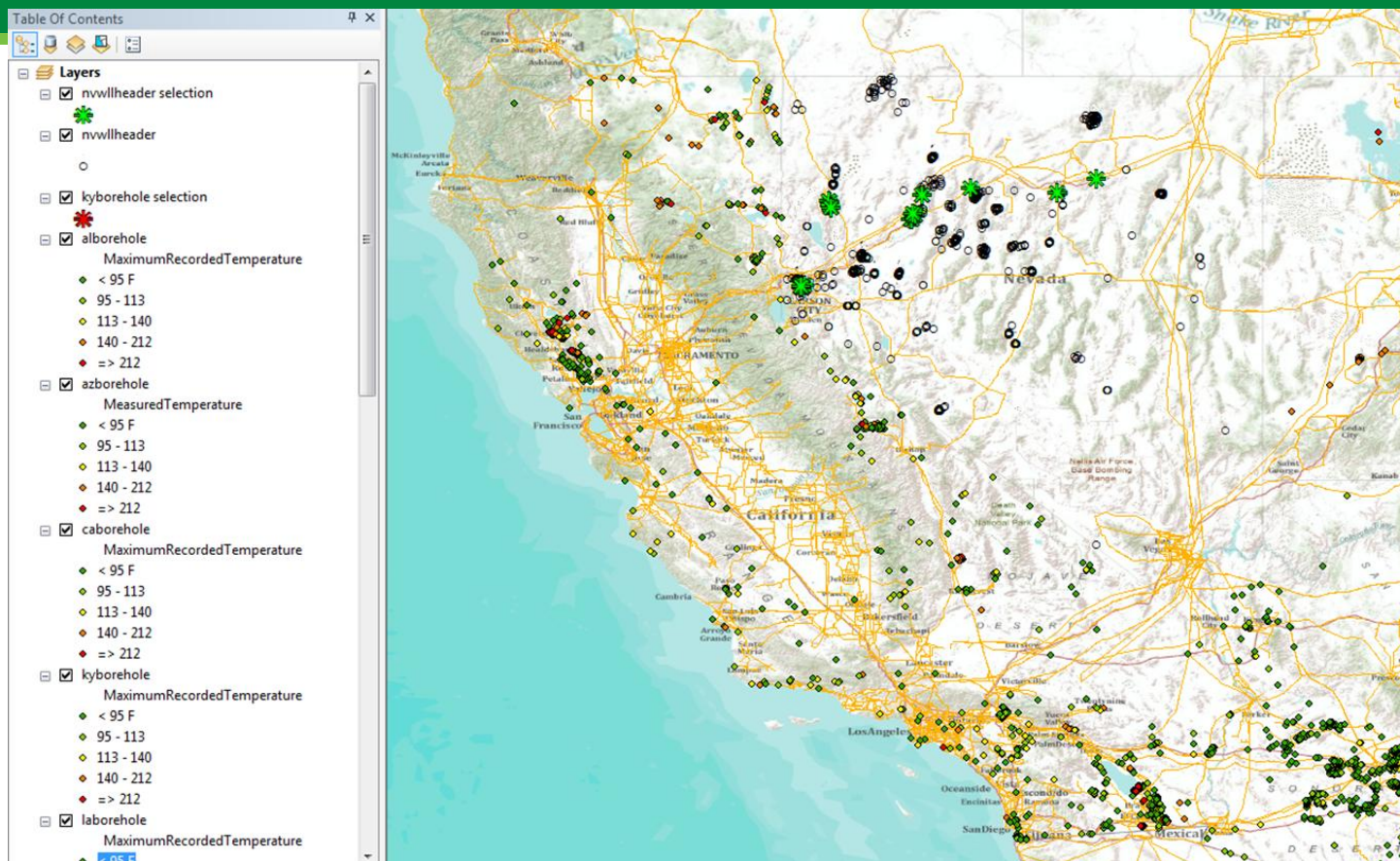


Discovering Map Services in Esri ArcMap via AASG designed plug-in

The screenshot shows the ArcMap interface with the 'Find' dialog box open. The 'Find' dialog box has the following fields and options:

- Find:** [Empty text box]
- Maximum:** 10
- In Catalog:** AzGS Deegree AWS
- Find** button
- Live Data and Maps Only
- Use Current Extent
- Results (1):** A list of search results with icons. The first result, 'Geologic Map of Arizona', has a map service icon circled in red. A green arrow points from this icon to the map view on the right.
- Abstract:** Geologic Map of Arizona at 1:1,000,000 scale.

The map view on the right shows a colorful geologic map of Arizona. The status bar at the bottom indicates coordinates: -113.436 37.789 Decimal Degrees.



- Analysis using Geological Survey and WRP datasets; Query is “show all well headers within 200m of a transmission line” (application is Esri ArcMap)
 - Borehole Temperatures (CA, AZ)
 - Well Headers (NV)
 - Transmission Lines (Western Regional Partnership)

Primary Objectives

Facilitating sharing of geothermal-relevant data

Making data resources readily available online

- Multi-tiered architecture
 - Simplest data sharing is via file access in web-accessible directories (web sites, repositories)
 - Web Map Services provide data portrayals suitable for map-based web mash-ups
 - Web Feature Services use standard, documented data schema to enable data integration by clients
- Standardized metadata is key component for discovering available resources
 - Describe individually accessible documents or file-based data products
 - Describe data services with sufficient information to enable software clients to connect transparently
- Interchange formats and content models developed by AZGS and reviewed by the GDSDPWG for interoperable data delivery
 - 20 completed content models with interchange formats established
 - Scanned documents organized in online linked document repositories
- Data made accessible online through web-accessible data providers. Hubs (AZ, NV, IL, KY) available for backup or providing service. All hubs operational and serving data in FY 2011
- AASG nodes and hubs linked with the DOE GDR, OpenEI, and other NGDS nodes.
 - Site visits to NREL
 - Technical Collaboration and Review visits with Boise State Univ (NGDS Design-Build team)



Key Activities – 2012-2013

- Coordinate with the IGSN on recording and cataloging geoscience samples
- Finish metadata scrub of current AASG catalog (enhancing initial metadata records and permitting updates by the content provider to existing metadata records); geologic map (contact, faults, geologic units) content model
- Finalize geologic map content models (contact, faults, geologic units)
- Release www.StateGeothermalData.org access portal v1.0 (currently in BETA shown on slide 16), demonstrate catalog harvesting capabilities
- Hub workshop in preparation for YR-3 data and system backup
- Coordinate industry review of datasets and system
- Collect statements of work (SOWs) from subrecipients for YR-3
- SAB meeting June, 2012, in Austin, TX to review YR-2 Deliverables and YR-3 SOWs
- Project technical lead workshop at ESIP/DataOne meeting on network sustainability
- Draft written sustainability plan by Fall 2012
- Release tutorials on developing user interfaces and client side applications

Key Activities – Project Duration

- Continue digitizing data, cataloging, and developing metadata records
- All data to be made accessible online, hosted by providers or in cloud via the hubs
- Network operations to provide distributed backup, facilitate data transfer
- Facilitating third-party data or service providers to be full system participants
- Sustainable business model plan



Prototype functional system with nationwide data online

- Mechanisms in place for accepting and tracking data submissions
- Preliminary user access developed on both server and client side

Key Results:

	FY2011	FY2012
Target/Milestone	National distributed network of geothermal relevant data prototype functional and in production mode	Comprehensive data production; enhanced user access; collect majority of new field data; and provide a sustainability plan for the network
Results	Presented functional system with search capabilities at GSA and GRC/GEA in October of 2011	Enhanced user access(9/2012); new field data (12/2012); sustainability plan (9/2012)



Supplemental Slide 1:

Supplemental funding for new data acquisition

Drilling Projects	Funding Provided
Idaho*	\$457,662.80
Nevada*	\$504,201.80
Oregon*	\$526,803.80
Utah*	\$516,294.80
Washington	\$648,878.80
Non Drilling Projects	Funding Provided
Arizona	\$179,976.00
Colorado	\$174,763.00
Indiana	\$69,975.00
Maine	\$49,912.00
Massachusetts	\$74,839.00
New Jersey	\$49,989.00
New Mexico	\$200,000.00
Oklahoma	\$20,000.00
Pennsylvania	\$83,425.00
Vermont	\$78,870.00
West Virginia	\$42,858.00

**Total Awarded:
\$3,678,449.00**

* Members of the Great Basin Drilling Consortium, awarded \$1,000,000.00 for drilling services split equally among members



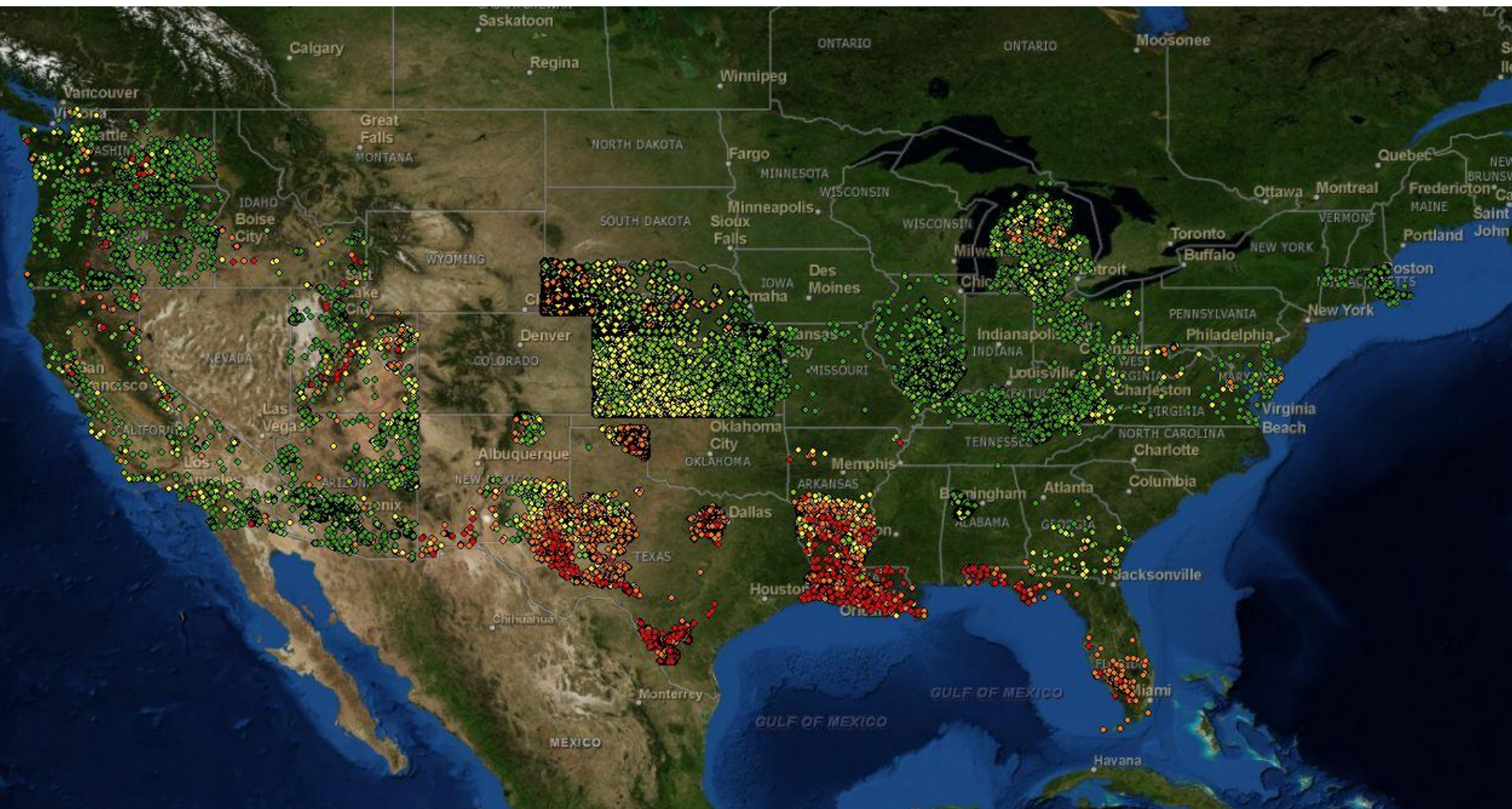
Supplemental Slide 2: Top 15 Funded States

State	Funding Provided
Washington	\$1,249,146
Nevada	\$1,070,639
Utah	\$966,834
Oregon	\$958,847
Idaho	\$873,562
Texas	\$743,481
Colorado	\$617,021
New Mexico	\$605,483
Kentucky	\$585,977
Massachusetts	\$515,901
Illinois	\$507,809
Hawaii	\$499,951
Montana	\$401,009
Indiana	\$378,499
Wisconsin	\$329,135

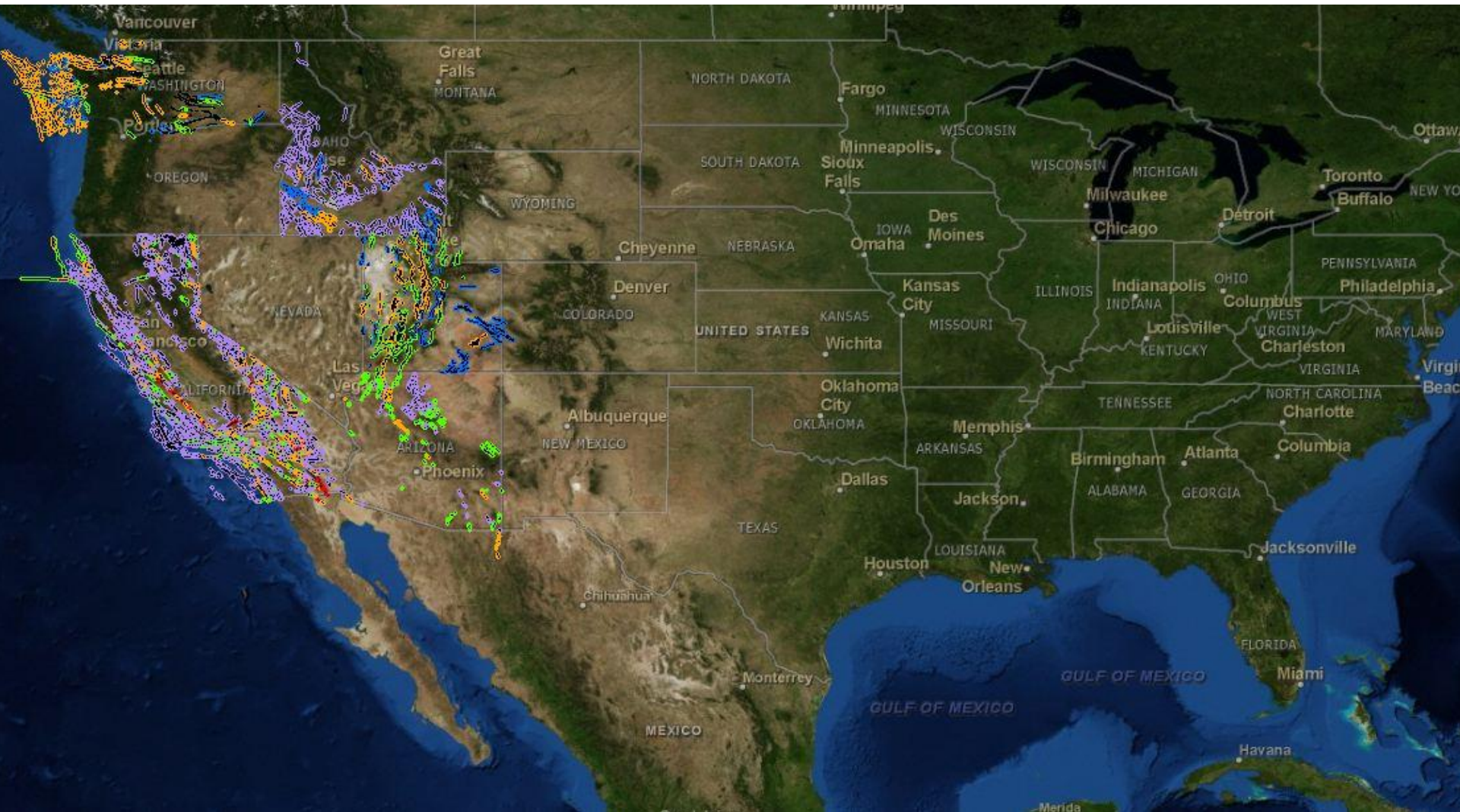
***AZ & CA data collection is part of the AZGS award and is not included in this summary**



Supplemental Slide 3: Current Nationwide Borehole Temperatures



Supplemental Slide 4: Current Active Faults





Supplemental Slide 5: Additional Functionality of the Data Contribution Map

Where to access
the map

HOME ABOUT DATA CONTRIBUTION **PROGRESS** NEWS FORUMS MEDIA MEMBERS

Home » Progress » Interactive Data Contribution Map

Interactive Data Contribution Map www.stategeothermaldata.org

Use this map to: Compare Progress Across All States | View Datasets Anticipated and Available from a Specific State | View Detailed Information About a Specific State's Datasets

Temperature
Rock & Heat Flow
Chemistry
Water
Well Logs
Map Data
Metadata & Documents
Recent Tectonics
Other

Data Contribution Status
Online
In Progress
n/a

About this map

- Select a state report - Go

Map permits a user to track nationwide data contributions at a glance.

Legend and navigation; select one of the categories to view nationwide contributions