Online, Interactive Assessment of Geothermal Energy Potential in the U.S.A.*

Lee Allison¹, Stephen M. Richard¹, Ryan J. Clark¹, Kim Patten¹, Diane Love¹, Celia Coleman¹, Genhan Chen¹, Jordan Matti¹, Janel Day¹, Esty Pape¹, and Leah Musil¹

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Abstract

Geothermal-relevant geosciences data from all 50 states (www.stategeothermaldata.org), federal agencies, national labs, and academic centers are being digitized and linked in a distributed network via the U.S. Department of Energy-funded National Geothermal Data System (NGDS) to foster geothermal energy exploration and development through use of interactive online 'mashups,' data integration, and applications. Emphasis is first to make as much information as possible accessible, with a long range goal to make data interoperable through standardized services and interchange formats.

An initial set of thirty geoscience data content models are in use or under development to define standardized interchange format: aqueous chemistry, borehole temperature data, direct use feature, drill stem test, earthquake hypocenter, fault feature, geologic contact feature, geologic unit feature, thermal/hot spring description, metadata, quaternary fault, volcanic vent description, well header feature, borehole lithology log, crustal stress, gravity, heat flow/temperature gradient, permeability, and feature description data like developed geothermal systems, geologic unit geothermal properties, permeability, production data, rock alteration description, rock chemistry, and thermal conductivity.

Map services are also being developed for isopach maps, aquifer temperature maps, and several states are working on geothermal resource overview maps. Content models are developed preferentially from existing community use in order to encourage widespread adoption and promulgate minimum metadata quality standards. Geoscience data and maps from NGDS participating institutions (USGS, Southern Methodist University, Boise State University Geothermal Data Coalition) are being supplemented with extensive land management and land use resources from the Western Regional Partnership (15 federal agencies and 5 Western states) to provide access to a comprehensive, holistic set of data critical to geothermal energy

development. As of September 2011, we have over 34,000 records registered in the system catalog, and 234,942 data resources online, along with scores of Web services to deliver integrated data to the desktop for free downloading or online use. The data exchange mechanism is built on the U.S. Geoscience Information Network (USGIN, http://lab.usgin.org) protocols and standards developed as a partnership of the Association of American State Geologists and U.S. Geological Survey.

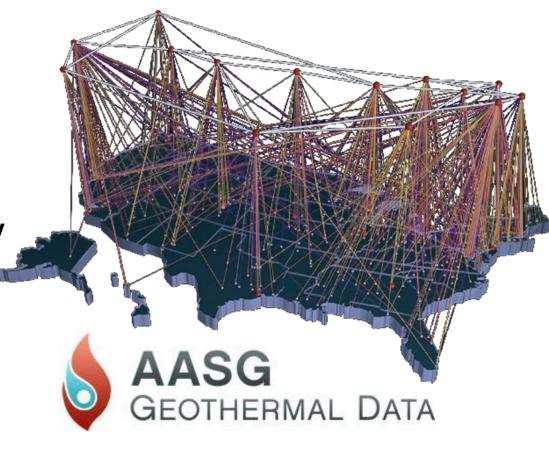
Online, interactive assessment of geothermal energy potential in the U.S.

www.stategeothermaldata.org

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Arizona Geological Survey





NGDS: The Challenge of Data



1,000s of databases 1,000s of collections 80,000+ geologic maps

Selected data resources in State Geological Surveys 3.5 million wells – oil & gas, water 195,000 well logs 50,000 geothermal wells 750,000 BHT's 6 Tb existing digital data >75,000 scanned publications & maps 2.5 million feet of core

600,000 sample logs



STATE GEOTHERMAL DATA

USGIN: data integration framework



Distributed
Web-based
Interoperable
Open source
Community of Practice

Separation of roles:

- Data Producer
 - Manage data content
- Data Provider
 - Server performance
 - Archive and backup
 - Service implementation, schema mapping
- Data Consumer
 - Find resources
 - Extract useful information
 - User interface

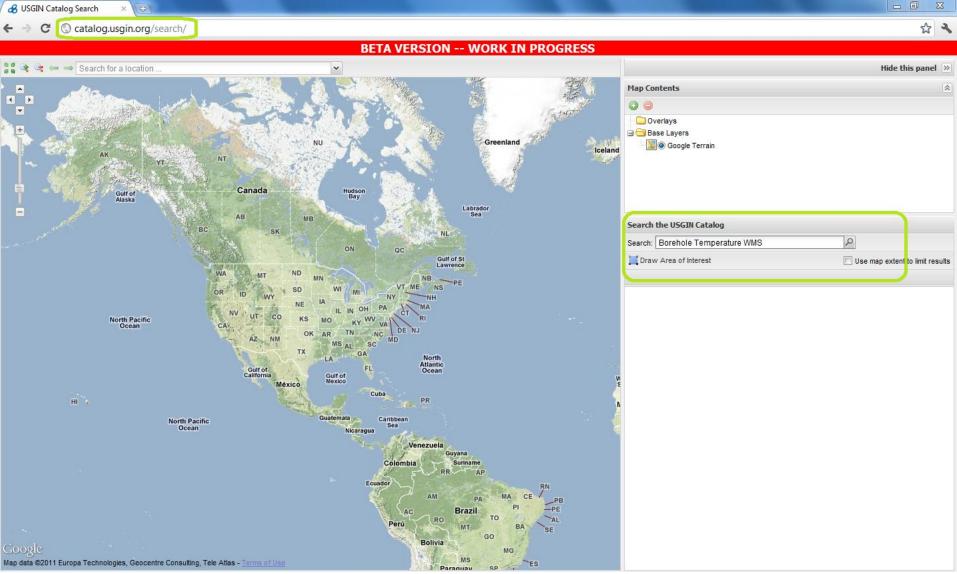


Geothermal Data System

- Discover via the Catalog
- Access via the Web
- Explore using Applications



Catalog search – Borehole Temperatures



Borehole Temperature search results



B USGIN Catalog Search C C catalog.usgin.org/search/ 2 3 ← → BETA VERSION -- WORK IN PROGRESS 👒 👒 🖚 🔿 Search for a location Hide this panel >> \$ Map Contents -4 F 00 -G Overlays Search Result Footprints Greenland Base Layers Iceland Soogle Terrain Canada Hudson Gulf of Bav Alaska Labrador Sea AB Search the USGIN Catalog SK NL 2 Search: Borehole Temperature WMS ON Gulf of St Draw Area of Interest Use map extent to limit results Lawrence WA ND MT Search Results (29450) NB PE NS ME SD OR Kentucky Borehole Temperature WMS NE NN Abstract Maximum temperatures recorded on borehole geophysical logs usually from drilled oil UT and gas wells in Kentucky. Ocean OK AR 📲 Zoom To 🔒 Lock 🔇 Remove 🞇 Add to Map 🌘 Add to ArcMap 🔍 Details AZ NM GA California Borehole Temperatures, AASG Geothermal WMS FL Gulf of alifornia Gulf of Borehole Temperatures for wells througout the state of Calfornia Mexico México 📲 Zoom To 🛛 Lock 区 Remove 🗽 Add to Map 🍙 Add to ArcMap 🔍 Details Cuba HI 2 West Virginia Borehole Temperatures, AASG Geothermal WMS Guatemala North Pacific Caribbean Sea Borehole Temperatures throughout the state of West Virginia Ocean Nicaragua 📲 Zoom To 🛛 Lock 🔇 Remove 💹 Add to Map 🎑 Add to ArcMap 🔍 Details Venezuela Guyana Suriname Colombia AASG Geothermal Data Borehole Temperature Observation template v1.0 AP This spreadsheet indicates the content requested for temperature measurement data Ecuador obtained from boreholes for the AASG geothermal data project. Typcially bottomhole AM temperatures are recorded from log headers, and this information will be provided through a PA PB borehole temperature observation service. The HeaderURI for a particular borehole (well for -PE Brazil AC simple wells) is the cross-referencing link (foreign key) used to associate the header record, RO 10 Perú well logs, temperature measurements, and other information from a particular borehole. MT 60 📲 Zoom To 🛗 Lock 区 Remove 👃 Download 🔍 Details Bolivia MS K Showing 1 - 10 of 29450 results Map data @2011 Europa Technologies, Geocentre Consulting, Tele Atlas - Terms of Use

Zoom to and add to map - KY BHTs

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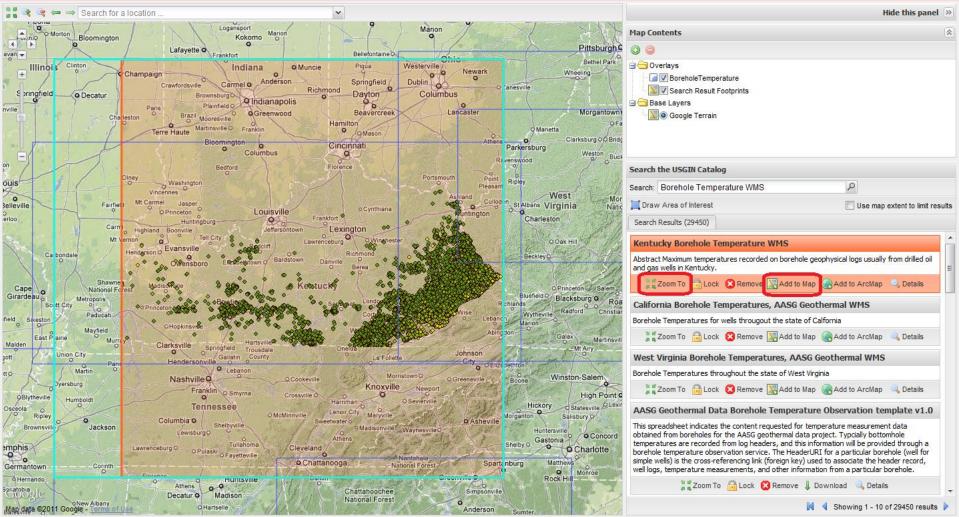
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BETA VERSION -- WORK IN PROGRESS



Zoom to and add to map - CA BHTs



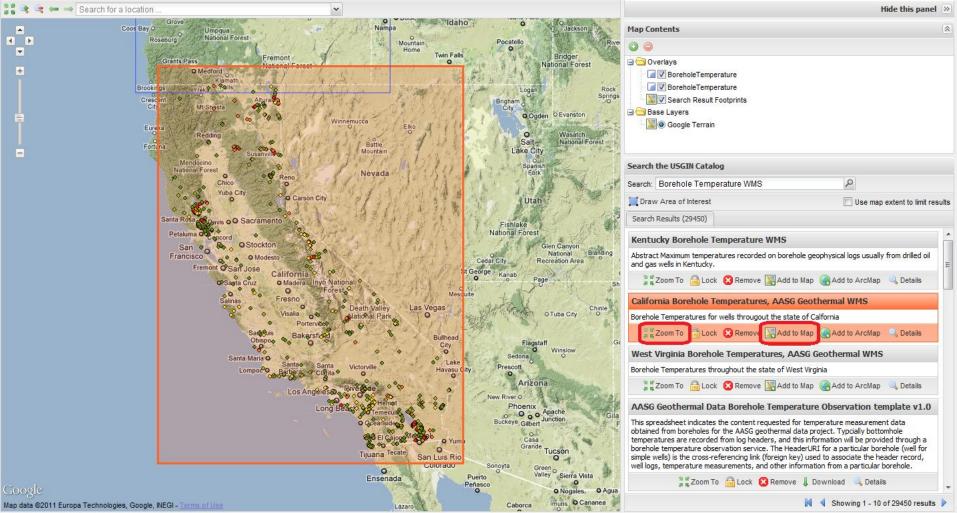
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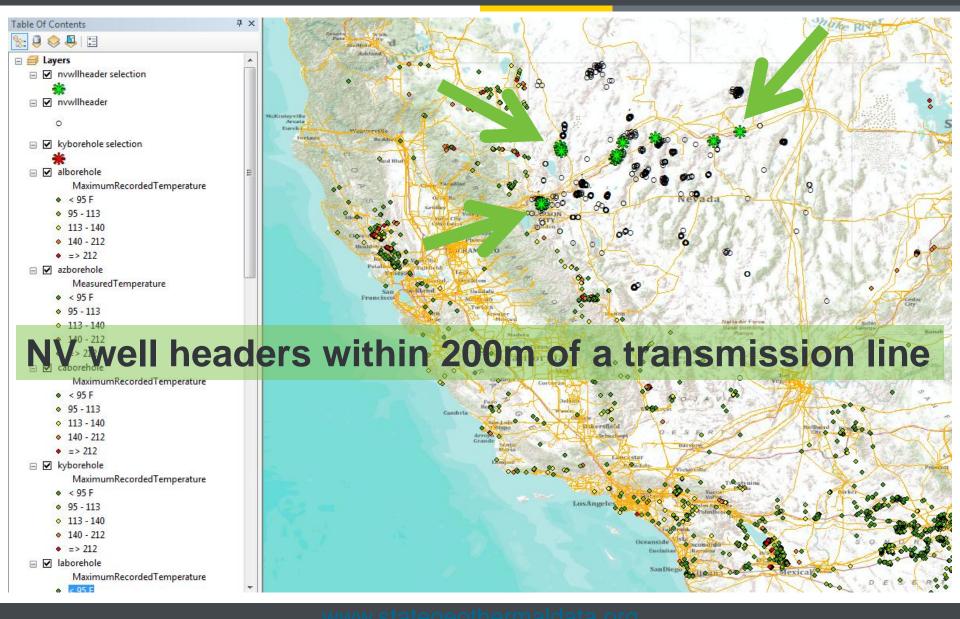
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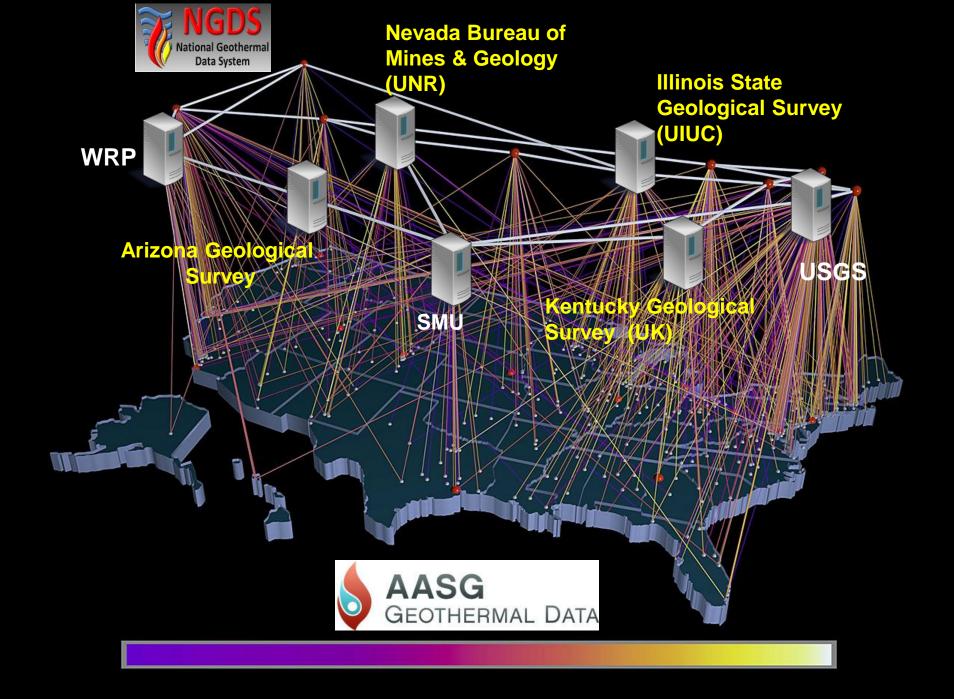


Exploring the Data in our Application – Well Headers in Nevada using ArcGIS

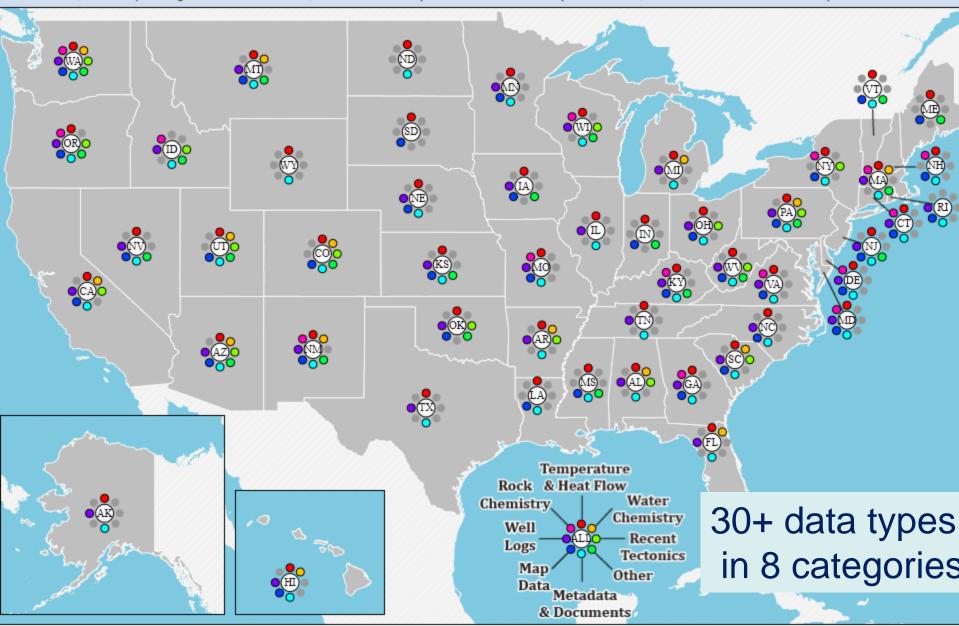


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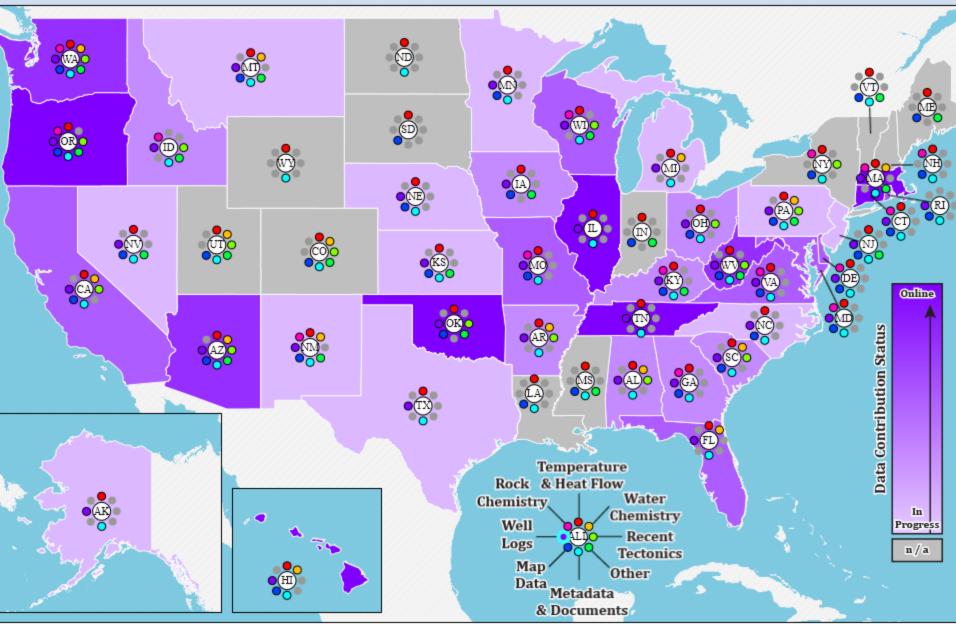
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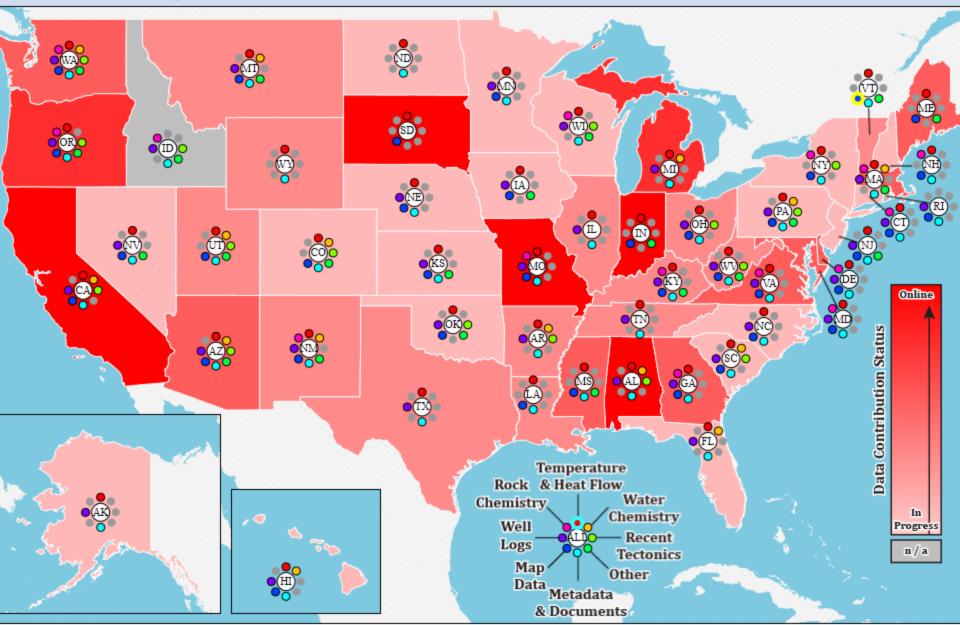
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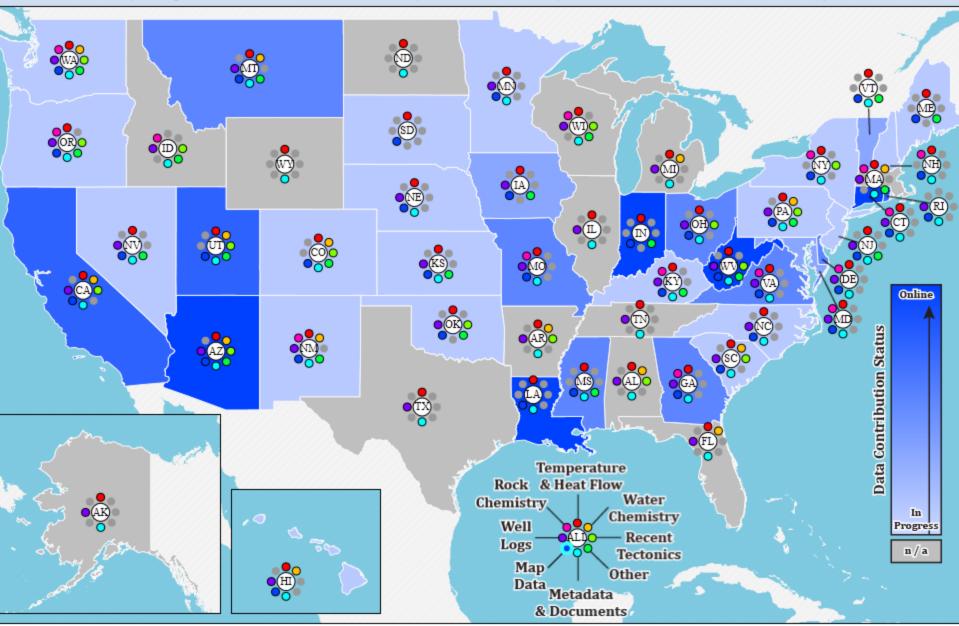
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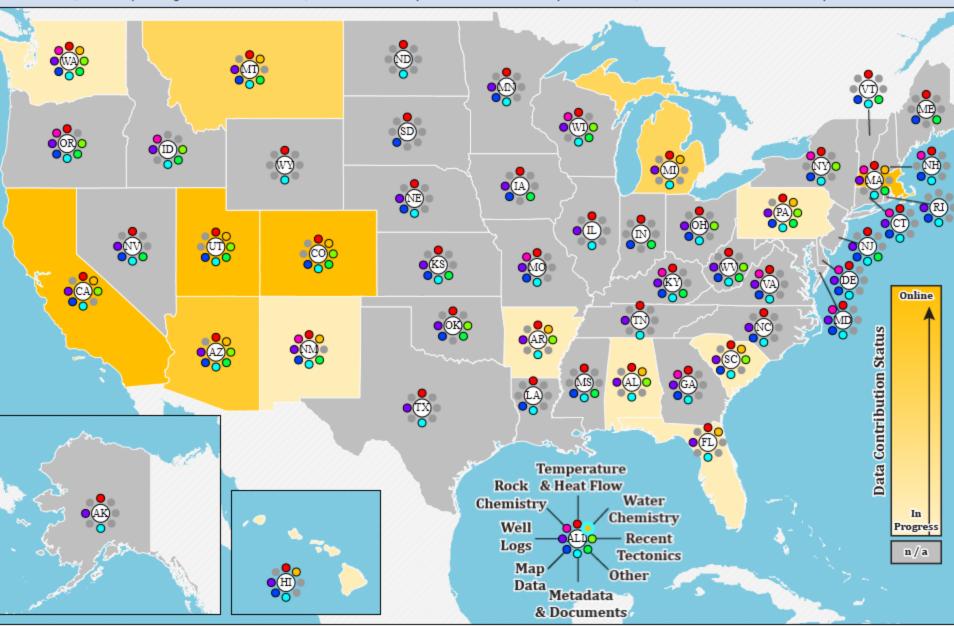
Temperature & Heat Flow



Map Data



Water Chemistry



Coming to your desktopa U.S. geothermal data system