

# **Borehole Data For Geoscience Information Resources**

## **CONTRIBUTIONS TO THE NATIONAL GEOTHERMAL DATA SYSTEM**

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A brief overview on how to link data, obtain Identifiers, a look at the actual data and templates, and how to get your borehole data online.



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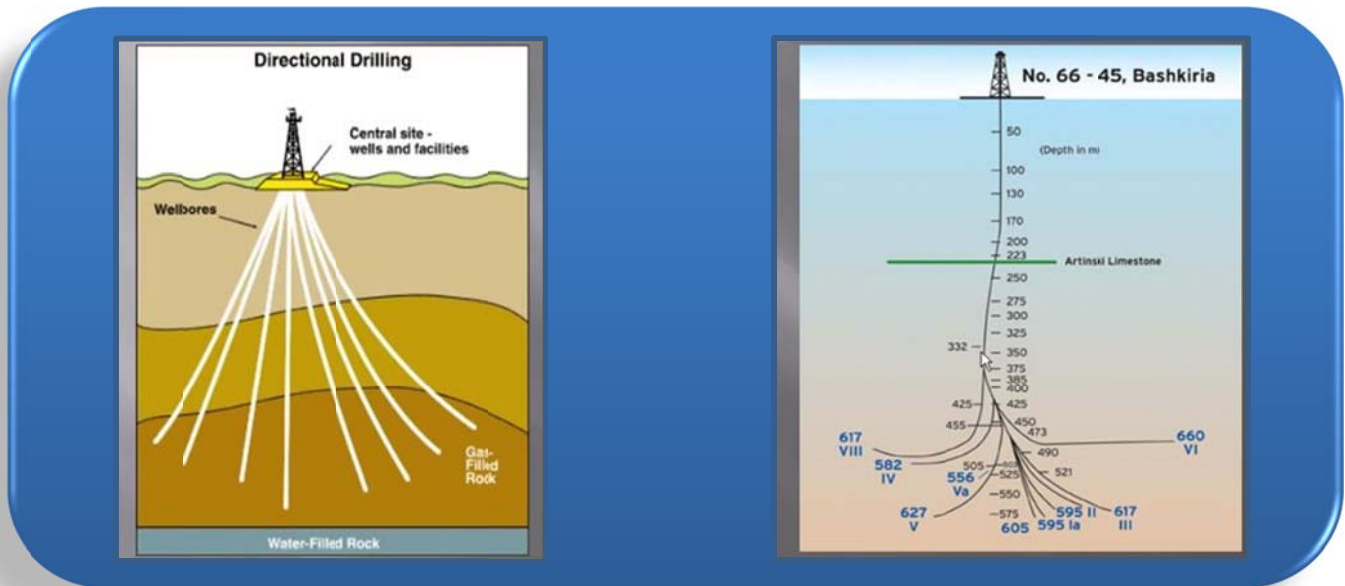
## Wells, Wellbores, Boreholes

A **well** is a facility intended to extract or inject fluid into the earth.

A **borehole** is a shaft bored into the earth, characteristically with a diameter much smaller than its length.

- Some boreholes are wells; most wellbores are drilled boreholes.

A **wellbore** is an individual drilled path from the well origin to a terminal point in the subsurface.



**Simple wells** are single boreholes with only one wellbore. Most of the data you will be collecting will focus on simple wells. The well origin and the borehole collar will be identical. With complicated wells, where you have multiple wellbores, the collar will be somewhere in the subsurface. For any given well, you may have multiple records, logs or drill dates that need to be accounted for. When dealing with water wells and simple wells, we generally assume they are vertical with one borehole.

**Mineral exploration and engineering** will deal with boreholes that are not intended for injection or extraction of fluids from the subsurface. They are designed to obtain research information, and mineral exploration boreholes are generally directional.

- The data being collected from a well will be associated with a single wellbore segments.

In a **simple well**, when you come across wells with a deviated hole, or sidetracks, and multiple wellbores, then you will need to know which wellbore the log is associated with, and exactly at what depth the temperature was measured. The data is associated with a particular wellbore.

We deal with **Logs** that come in many forms, such as standard e-logs.



**Temperature measurements** may be made with the single intention as a water temperature measurement, or more commonly a bottom hole temperature. The bottom hole temperature is the maximum temperature recorded on a logging tool during a log run, that are usually assumed to have been at the bottom of the hole.

**Rock and water samples** include core, cuttings, fluid samples etc. that come from various locations in the wellbore.

**Engineering** boreholes may be used during highway construction or when constructing foundations, this however is not our focus. Completions of these wells differ and borehole size may vary from small to large.

Other data generally associated with the well and not the wellbore in particular, is the production data and injection data. With some of the more complicated wells, you might have different production data from different well bores.



## **Data Online, Identifiers, and Linked Data**

When dealing with a data system, the linkage between various data items is important.

Linkage is important because when talking about a particular well, that well may be associated with cuttings, temperature measurements, fluid samples, geochemistry from the fluid samples and more. So there will be many relationships between different data items. The idea is to be able to link those items together in the data system.

The way to bind all this data in the information system is to have reliable identifiers and a consistent way of using them. The **Identifier** is a string that is unique to your resource (well).

**API** – For most gas and oil wells, and most geothermal wells depending on the state, wells have API numbers. An API well number or API number is a "unique, permanent, numeric identifier" assigned to each well drilled for oil and gas in the United States. The API number is one of many industry standards established by the American Petroleum Institute. The state issues API numbers based on the regulations in that state. API's are more commonly used and understood.

**URI** – (Uniform Resource Identifier) is a string that identifies a resource. Resource in these terms being something we are interested in and want to identify and link with other information which may be an individual well log, an individual well, an individual wellbore, or a particular sample.

**HTTP URI's** – Hypertext Transfer Protocol (HTTP) is a common scheme used on the web to identify web pages. This identifier might identify anything in the world, a person, a well, a rock, that you can't send over a wire. The URI will be a representation for what the identifier identifies.

- **Minting URI's**

A URI is a Uniform Resource Identifier, the URI describes the mechanism used to access the resource, the specific computer that the resource is housed in and the specific name of the resource on the computer. In many cases, they will have to be made up unless there is some visible identifier scheme already in place.

One of the conventions being promoted in the information system for URI's is adding prefixes. Prefixes are used to identify the authority.

**Prefixes** will help identify what kind of identifier it is and who assigned it. They are also both globally unique, and unique to the organization. This helps not having to worry about the numbers after.

**Using Existing Identifier.** API numbers for wells or for individual wellbores are commonly used because the API system is set up to identify down to individual wellbores in a great amount of detail.



**Add Prefix to Identify Authority.** Prefixes may look like some of these examples

azogcc: (Arizona Oil and Gas Commission)

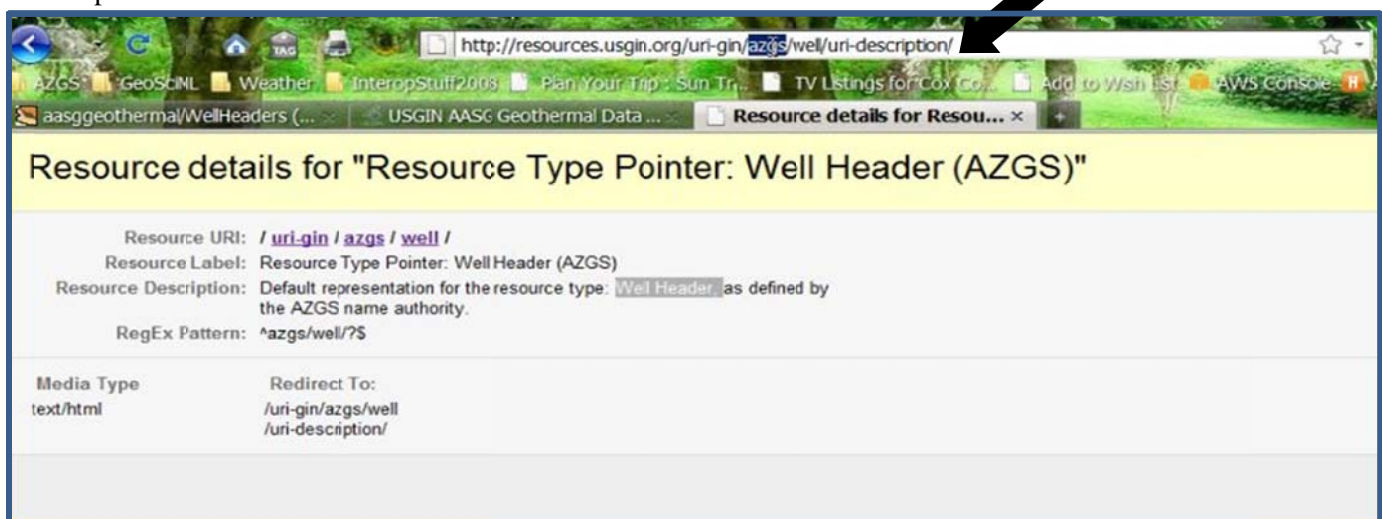
api: (American Petroleum Industry)

azgs: (Arizona Geological Survey)

**USGIN Dereferencing.** In order for these identifiers to be useful there has to be some way to dereference them. There needs to be some means in order to get items over the web and onto the internet that tells you what that identifier is meant to represent.

A dereferencing service has been set up through USGIN. This is a rule based redirection to a server. This server allows you to define different kinds of resources.

Example:



The authority is azgs (**AZGS**) – for this you may add different prefixes or other path segments, for other states that want to use this method.

We define using regular expressions so this dereferencing service will parse other URL's coming in. Using other regular expression patterns we can figure out how to rewrite those and redirect the requests to a useful place where you will get information back.

How you make the http useful is by utilizing the existing, very durable, widely tested and used infrastructure for dereferencing identifiers, known as the web. By having the domain name, the registers and domain name servers all over, the URI or http URI that uses a known host, will be dereferenced and return with something useful.

## **The Boundaries between Metadata and Data**

If there is a file that can be retrieved on the web, then it should have a metadata record. Any kind of information resource that is in a file can be used to create a metadata record, publish it online and make it accessible.

**Well logs** – Ideally for well logs, the standard would be to have a metadata record for each file that has a scanned or imaged log.



**Permit Files** – Similar to well logs, permit files may also have a variety of scanned documents, with each document having a metadata record.

**Spreadsheets** – If you have a well log that's been digitized and it is in a spreadsheet- the easiest way to make the document accessible online would be to treat the spreadsheet as a document, put it into a repository, and create a metadata record for it.

**Individual records** – The idea is to set up individual records that can be retrieved as services. An example would be with the wells themselves—we use a well header to represent each well. In doing this we can make the well available “over the wires” through a well feature service that has a feature or a database record for each well. This is the done when you retrieve links, you also get information related to that well. The well feature (service) will have URL's that would links to and identify all the logs having their own metadata records.

## The Templates

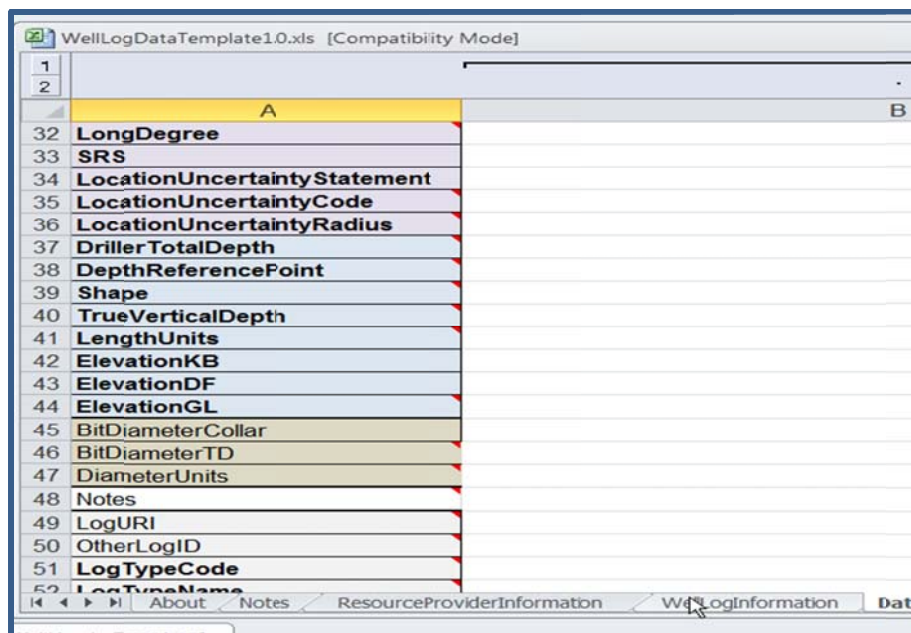
**Well Headers:** Will have one record per well, allow for multiple wellbores, represent each location as a feature and include association from well to all related data.

**Well Log:** Will have each log represented by a document, one metadata record per log, and digitized log data can be a coverage service.

**Temperature Observations:** Are to collect the temperature measurement information and the borehole information. This may have more flexibility depending on where in the borehole the temperature is being recorded. There should be one row in the template for each temperature observation which is later implemented as a temperature observation service.

**Well Log Template:** The Well Log Template is for additional information about the logs. It will greatly resemble the well header Template in every way, with the addition of more values.

- In the picture bellow, the **bold** means the data in that value is required, just as the values highlighted pink in the Well Header Template.
- The well log template will generate have similar output to the well header template.



	A	B
32	<b>LongDegree</b>	
33	<b>SRS</b>	
34	<b>LocationUncertaintyStatement</b>	
35	<b>LocationUncertaintyCode</b>	
36	<b>LocationUncertaintyRadius</b>	
37	<b>DrillerTotalDepth</b>	
38	<b>DepthReferencePoint</b>	
39	<b>Shape</b>	
40	<b>TrueVerticalDepth</b>	
41	<b>LengthUnits</b>	
42	<b>ElevationKB</b>	
43	<b>ElevationDF</b>	
44	<b>ElevationGL</b>	
45	<b>BitDiameterCollar</b>	
46	<b>BitDiameterTD</b>	
47	<b>DiameterUnits</b>	
48	<b>Notes</b>	
49	<b>LogURI</b>	
50	<b>OtherLogID</b>	
51	<b>LogTypeCode</b>	
52	<b>LogTypeName</b>	





### Well Header Template:

- The spreadsheet is set up so that there will be one row for each well.

	HeaderURI	WellName
1		
2		Bozo 1 OilCompany. This row contains example data for reference only.
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

- The minimum amount of data allowed is highlighted in pink, this means that the highlighted pink values are required.

A	B	C	D	T	U	V	W	X
HeaderURI	WellName	APINo	OtherID	Production	Producing Interval	ReleaseDate	County	State
	Bozo 1 OilCompany. This row contains example data for reference only.	42-501-20130-03-00	azogcc:04-004   USGSMRD:26498-5673	show	Mission		Pima	AZ

- When hovering over the headers with your mouse, there will be comments describing the value

[illegible]



	A	B	C	D
	title	description	publication_date	originator_conti _org_name
1	Scanned Gamma Ray-Neutron Log (Whipstock 1) for Arkla Exploration 12 New Mexico-Arizona Land	Tiff image file, scanned with Neuralog scanner. Originator organization is the name of the company that ran the log where that is available. Logged by McCullough. Formation at TD is Permian Supai. Publication data is drilling ended date from Permit files.	1965-05-04T12:00	McCullough
2	Scanned Graphic Lithologic Log for Premco Western 1-10 Federal	Tiff image file, scanned with Neuralog scanner. Proposed hole dia 7.875". Originator organization is the name of the company that ran the log where that is available. Logged by Samples examined by O. Clair Adams. Formation at TD is Permian Toroweap. Publication data is drilling ended date from Permit files.	1997-12-25T12:00	Samples examined by O. Clair Adams
3	Scanned Induction Electrical Log for Duval 25 Santa Fe	Tiff image file, scanned with Neuralog scanner. No C.D. use. Mud sample from flow line. RMF * @ BHT. * BHT too low to measure. Originator organization is the name of the company that ran the log where that is available. Includes log run 1. Logged by Schlumberger.	1964-03-22T12:00	Schlumberger

- After obtaining the URI, using the dereferencing system, place the http URI into the browser and you will receive an XML Well Header metadata record. This is almost identical to the spreadsheet, as you can see the values are the same. This is created by the Web Feature service, the web feature for the well header ( where the log was obtained from).

his XML file does not appear to have any style information associated with it. The document tree is shown below.

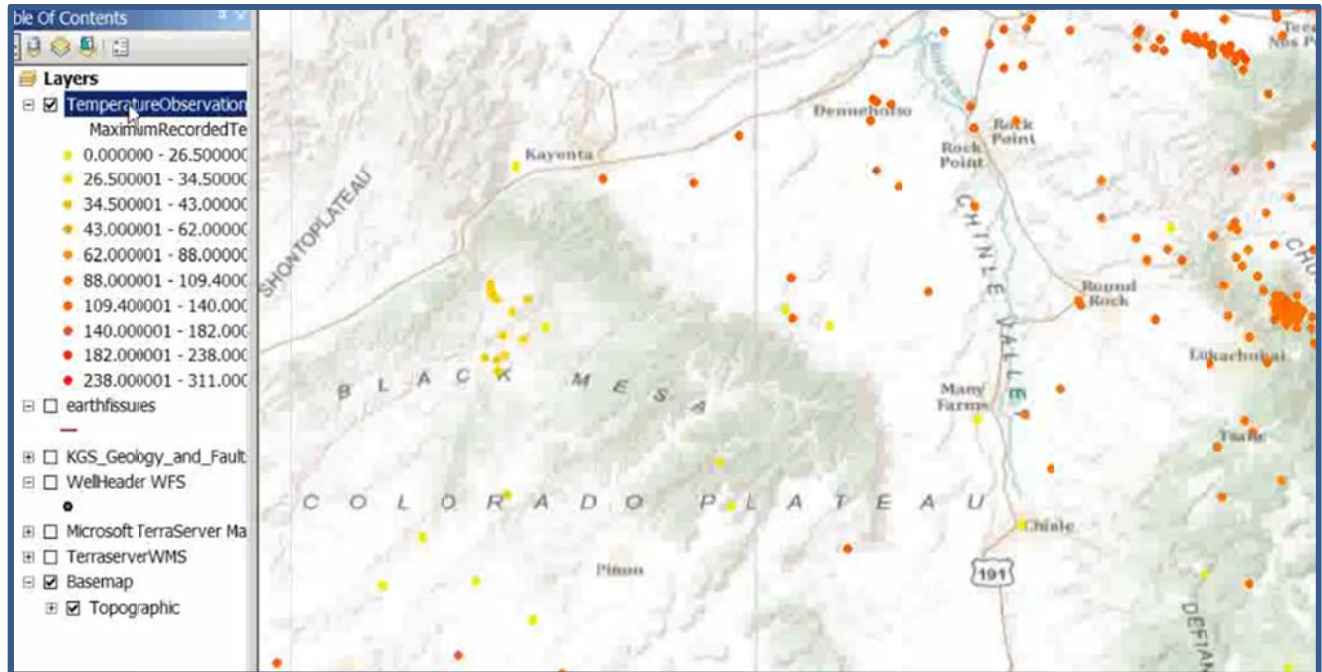
```
<wfs:FeatureCollection xmlns:schemaLocation="http://stategeothermaldata.org/uri-gin/aasg/xmlschema/simplefeatures/ http://services.  
MapServer/WFSServer?request=DescribeFeatureType%26version=1.1.0%26typename=WellHeader http://www.opengis.net/wfs htt  
- <gml:boundedBy>  
  - <gml:Envelope srsName="urn:ogc:def:crs:EPSG:6.9:4326">  
    <gml:lowerCorner>31.37012743400004 -114.8031822019999</gml:lowerCorner>  
    <gml:upperCorner>36.997997144000067 -109.0493863559999</gml:upperCorner>  
  </gml:Envelope>  
</gml:boundedBy>  
- <gml:featureMember>  
  - <aasg:WellHeader gml:id="T2_850">  
    <aasg:ID>850</aasg:ID>  
    + <aasg:HeaderURI></aasg:HeaderURI>  
    <aasg:WellName>Arkla Exploration 12 New Mexico-Arizona Land</aasg:WellName>  
    <aasg:APINo>02-017-00262</aasg:APINo>  
    <aasg:OtherID>AZOGCC:09-18</aasg:OtherID>  
    <aasg:OtherName>  
    <aasg:Operator>Arkla Exploration</aasg:Operator>  
    <aasg:MineralOwner>New Mexico-Arizona Land</aasg:MineralOwner>  
    <aasg:LeaseName>New Mexico-Arizona Land</aasg:LeaseName>  
    <aasg:SpudDate>1965-04-26T00:00:00</aasg:SpudDate>  
    <aasg:EndedDrillingDate>1965-05-04T00:00:00</aasg:EndedDrillingDate>  
    <aasg:WellType>O&Gexplor</aasg:WellType>  
    <aasg>Status>Unknown</aasg>Status>  
    <aasg:CommodityOfInterest>Information</aasg:CommodityOfInterest>  
    <aasg>StatusDate>2010-11-01T00:00:00</aasg>StatusDate>  
    <aasg:Function>stratigraphic test</aasg:Function>  
    <aasg:Production>not applicable</aasg:Production>  
    <aasg:County>NAVAJO</aasg:County>  
    <aasg:State>Arizona</aasg:State>  
    <aasg:Field>Wildcat</aasg:Field>
```

OtherID	Other AP
AzgsPer:04-004   USGSMRD:26498-	If no API authority colon...



## ArcMap:

- This is an example of an ArcMap project, the small dots to the side are temperature observations. The temperatures are indicated in the box to the left.



- This is a shape file with the well header logs in ArcMap, here you can see the list of URI's as well. This is where the prefixes in dereferencing come into play.

The screenshot shows the ArcMap application window. The title bar reads "catalogtesting.mxd - ArcMap - ArcInfo". The menu bar includes File, Edit, View, Bookmarks, Insert, Selection, Geoprocessing, Customize, Windows, and Help. Below the menu bar are several toolbars. The main map area displays a topographic map of the Denneyholso area, with orange dots representing temperature observations. The dots are clustered in the upper right portion of the map. The map scale is indicated as 1:1,000,000. The Table of Contents on the left shows a layer named "TemperatureObservations" with a sub-layer "MaximumRecordedTemperature". Below the map, a data table is displayed, showing a list of observations with columns for OBJECTID, RecordSeriesNo, ObservationURI, WellNameOrSiteID, APINo, and WellHeaderURI. The table contains 19 rows of data, with the first row having OBJECTID 906 and RecordSeriesNo 907. The last row has OBJECTID 911 and RecordSeriesNo 912. The status bar at the bottom indicates "0 out of 1992 Selected".

OBJECTID *	RecordSeriesNo	ObservationURI	WellNameOrSiteID	APINo	WellHeaderURI
906	907	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0907	AZ1110	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:649886
894	895	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0895	AZ1098	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZ MO34:4647113.8
895	896	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0896	AZ1099	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:617813
896	897	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0897	AZ1100	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACPM32:2769111.6
897	898	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0898	AZ1100	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:617807
898	899	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0899	AZ1101	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZ AP34:5500109.30
899	900	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0900	AZ1102	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZNA34:5581109.92
900	901	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0901	AZ1104	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZ AP34:5650109.15
901	902	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0902	AZ1105	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:617788
902	903	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0903	AZ1106	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:627281
903	904	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0904	AZ1107	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZ MO34:6667113.9
917	918	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0918	AZ1122	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZ MO34:9350113.6
905	906	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0906	AZ1111	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:626414
891	892	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0892	AZ1094	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZ AP34:3792109.15
907	908	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0908	AZ1111	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:600391
908	909	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0909	AZ1112	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZ MO34:8147114.1
909	910	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0910	AZ1113	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:614296
910	911	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0911	AZ1114	<Null>	http://resources.usgin.org/uri-gin/azgs/well/AZ MO34:8756114.1
911	912	http://resources.usgin.org/uri-gin/azgs/obs/bhtemp/0912	AZ1115	<Null>	http://resources.usgin.org/uri-gin/azgs/well/ACWR55:613578



- Well header Feature Service (WFS WellHeader) in ArcMap which closely resembles the shape file.

Table

## Finding Metadata in the Catalog

Finding metadata in the catalog should only be slightly different from application to application. In this example, we are using the USGIN Geportal site.

- <http://catalog.usgin.org/geoportal/catalog/main/home.page>

After clicking the link above you will arrive at the home page for the USGIN Geportal. To start searching metadata records you can either type in the desired search criteria on the home page search box, or you may click the tab next to HOME that's says "search"



USGIN AASG Geothermal Data Metadata Search

HOME SEARCH BROWSE

You can simply...

Starting point to locate resources in the US Geoscience Information Network:

Search

What is this site?...

Login - registered user login

Register - register as a new user

About - more information about USGIN

Feedback - send us some feedback.



\*The actual search page will give you more options to narrow down your search.

Starting point to locate resources in the US  
Geoscience Information Network:

After typing in the search criteria you choose, click search and items matching your search will be on the right side of the page

USGIN Association of American State Geologists

## USGIN AASG Geothermal Data Metadata Search

HOME SEARCH BROWSE


### Search


Records shown from: This Site  
Click here to select different site or configure search.

**Additional Options**  
**Clear**

WHERE


☒ Anywhere ☐ Intersecting ☐ Fully within





 esri®


Results 1-10 of 133 record(s) [1](#) [2](#) [3](#) [4](#) [5](#) [>](#) [Last](#)


☐ Expand results [Zoom To Results](#) [Zoom To Searched Area](#)


 **Scanned Temperature Log with other log traces of the EMBRY, WENDALL, well no: 1, API: 16085002690000**  
B&W Tiff image file scanned from paper copies in KGS O&G archive. Ky Permit no: 33435; KGS record no: 8856; Status of well: Abandoned & plugged; Formation at TD: Sellersburg Ls. Publication date is reported completion date.  
[Open](#) [Preview](#) [Details](#) [Metadata](#) [Zoom To](#)


 **Scanned Temperature Log of the YORK ESTATE, well no: 21, API: 16061007060000**

 **Scanned Temperature Log of the JOHNSON, DENVILLE, well no: 1, API: 16061000100000**

 **Scanned Temperature Log of the JOHNSON, DENVILLE, well no: 1, API: 16061000100000**

 **Scanned SPECIAL Log with other log traces of the EQUITABLE (DENVIL JOHNSON), well no: 2, API: 16061000110000**

 **Scanned SPECIAL Log with other log traces of the EQUITABLE (DENVIL JOHNSON), well no: 2, API: 16061000110000**

 **Scanned Temperature Log with other log traces of the LYLE, JOHN S, well no: 1, API: )**



After skimming through the items, find one that you wish to view and then click on the title for the metadata record. After doing so, a row of options will appear: Open, Preview, Details, Metadata, and Zoom To. These are all ways to view the metadata record.

- By clicking Open, the resource for the current metadata record will open for you to view.
- By clicking “preview” you will receive a preview to either the location on a map, or the resource associated with the metadata record.
- By clicking “details,” you will be taken to the metadata details page. This will include the metadata content.

Organization: Operator: FOSSIL PETROLEUM CORP

Resource  
Title: Scanned Temperature Log with other log traces of the EMBRY, WENDALL, well no: 1, API: 16085002690000

Reference  
Date: 1979-01-23T00:00:00-07:00

Abstract: B&W Tiff image file scanned from paper copies in KGS O&G archive. Ky Permit no: 33435; KGS record no: 8856;  
Status of well: Abandoned & plugged; Formation at TD: Sellersburg Ls. Publication date is reported completion date.

☒ Resource Details

Resource  
Language: eng

Resource  
Maintenance Completed  
Status

Lineage: Operators submit all logs when well is completed. KGS scans the logs and makes them available to the public via the web. Logs with color are scanned in color, otherwise images are B&W. This metadata record harvested from [http://repository.azgs.az.gov/resources/metadata/kentucky/usgin\\_metadata\\_10.xml](http://repository.azgs.az.gov/resources/metadata/kentucky/usgin_metadata_10.xml), and transformed to USGIN ISO19139 profile using iso-19115-to usgin\_19115.xslt version 1.0

Quality Operators submit all logs when well is completed. KGS scans the logs and makes them available to the public summary: via the web. Logs with color are scanned in color, otherwise images are B&W. This metadata record harvested from [http://repository.azgs.az.gov/resources/metadata/kentucky/usgin\\_metadata\\_10.xml](http://repository.azgs.az.gov/resources/metadata/kentucky/usgin_metadata_10.xml), and transformed to USGIN ISO19139 profile using iso-19115-to usgin\_19115.xslt version 1.0

☒ Distribution Information

Role: Distributor

☒ Access

☒ Online

- By clicking “metadata,” you will be reviewing the XML for the metadata record.
- By clicking “Zoom to,” you will zoom in on the map, to the set location for the resource.