

Display Name	Entity Internal Name	Implementation		
Active fault	ActiveFaultTrace	Feature class		
Geologic feature representing an active fault. Default geometry is line representing outcrop trace on ground surface, in WGS 84 decimal degrees. Binding between earthquakes and faults is from earthquake hypocenter observation feature to fault.				
Attributes:				
(GeologicStructureTraceFeature)	Geologic structure trace feature	String	1	This feature is an extension of geologic structure feature, so include all properties from that feature type.
time since last movement	data object	Geologic age	0..1	time in ka (thousands of years) with uncertainty, since last event
slip rate	data object	Number with uncertainty	0..1	have to distinguish horizontal or vertical only slip rate, separation, from actual vector magnitude. Time interval for rate calculation is important component. Value is quantity with uncertainty.
slip accumulation interval	data object	Geologic time interval	0..1	time period of averaging for slip rate calculation. Required if slip rate reported.
date of most recent event	string	1	1	If earthquakes are associated with fault date of most recent event.
recurrence interval	data object	0..1	1	estimated average time between slip events on fault.
total slip	data object	0..1	1	vector (trend, plunge, magnitude) linking piercing points on opposite sides of fault, with uncertainty.
USGS active fault category	string	0..1	1	term from USGS fault category scheme

Well log	BoreholeLogCoverage	1-D coverage	a coverage that reports some physical observation at regularly spaced intervals along a borehole trace. Use for well logs, probably a web coverage service. Discrete coverage is collection of depth/value/ units tuples. If served as SOS, present properties available as offerings.	
Attributes:				
BoreholeURI	string	Reference	1	Link to borehole from which coverage is recorded. The borehole record contains information of borehole geometry, operator, TD, etc.
Property	string	Number with uncertainty and units	1	Temperature reported for each depth in log. Consider average temperature to best represent what is measured at each point. Uncertainty on temperature measurement is reported for log as a whole, not on a point by point basis?? (m, value, valueUnits)
(IDLog)	SWE Record	SimpleFeatureContent	1	point location where log acquired; typically borehole collar or well origin x, y
(StandardObservationProperties)	SimpleFeatureContent	1	1	
ObservationLocation	point feature	1	1	

borehole	BoreholePoint	Feature class	Feature that represents a well or borehole. Point location is well origin or borehole collar. Includes attributes for surface elevation of collar, PLSS and geographic coordinate locations of collar. Use GeoSciML borehole model as starting point. Use for simple well and complex well origin point as well. If multiple boreholes (well bore segments) are associated with a well, these should be represented	
Attributes:				
(StandardFeatureProperties)	SimpleFeatureContent	1	1	
Longitude	string	Number with uncertainty	1	longitude of collar location
Latitude	string	Number with uncertainty	1	latitude of collar location
PLSS location	Formatted string	0..1	0..1	string indicating public land grid or legal description of borehole collar location. Need conventions for syntax to make usable for search
Total depth	string	Number with uncertainty and units	0..1	depth of the bottom of the borehole, in m below elevation reported for borehole collar.
CollarDatum	category	Units	0..1	controlled vocabulary to indicate if collar location, which is used as reference elevation from which depth in borehole is measured, is at ground surface, Kelly bushing, or some other vertical reference point
Collar elevation	string	Length	0..1	Elevation of collar reference point above sea level. Include datum to indicate if is KB, ground surface, or other. Use meters for interoperability
UnitsOfMeasure uomURI	Text			
LeadOwner Operator	string	Formatted string	0..1	semicolon delimited list of bit diameters used, starting at collar, to end of hole. Single value if borehole is all same diameter
Bit diameters	string	Formatted string	0..1	semicolon delimited list of bit diameters used, starting at collar, to end of hole. Single value if borehole is all same diameter
CompletionInfo	LongText			

Borehole temperature measurement	BoreholeTemperatureObservation	Feature class	Feature class for borehole that has associated temperature data. Part of thermal well description. Use for measurements that may or may not be at the bottom of a borehole. Use in situations where there are only one or a few measurements in a borehole, not a continuous log-like series. Geochemical thermometry is associated with a water sample (keyed to a borehole), or perhaps just to a borehole--different kind of observation.	
Attributes:				
BoreholeURI	string	Reference	1	identifier for borehole in which measurement made
Temperature	string	Number with uncertainty and units	0..1	temperature measured at a particular time and depth, with no attempt to average or determine if is time varying
TemperatureType	string	Number with uncertainty	0..1	Indicate if this is a maximum temperature recorded during a log run, or temperature measured by sensor at a particular depth.
TimeSinceCirculation	float	1	1	Time since circulation, in decimal hours. Use -99 if value is not available. Observation notes should record any details on how this time was estimated.
HoleDiameter	float	0..1	0..1	diameter at measurement location, expressed as decimal number
MeasureDepth	string	Number with uncertainty and units	1	Report depth at which temperature is reported. For max temperature reported by log, assume is bottom hole
BoreholeFluid	string	1	1	fluid in borehole at time of measurement
FluidResistivity	string	0..1	0..1	ohm.m "at" temperature.
FluidDensity	string	0..1	0..1	pounds per gallon assumed.
FluidPh	0..1	0..1	0..1	
FluidViscosity	in seconds, result from standard mud logging viscosity test			
ObservationLocation	point feature	1	1	x,y location at which observation plots in a map
(StandardObservationProperties)	SimpleFeatureContent	Category	1	collection of standard properties associated with an observation

Crustal Strain rate	CrustalStressObservation	Feature class	One of a family of observation services. In short run these may be specific to data type, but in long run a more generic observation service may be better if generic clients are developed that connect to an ogc/ISO observation service	
Attributes:				
(StandardObservationProperties)	SimpleFeatureContent	1	1	attributes to characterize the observation
MeanStress	Float	0..1	0..1	
MaxStress	Float	0..1	0..1	
MinStress	Float	0..1	0..1	
StressRecord	SWE Record	0..1	0..1	
ObservationLocation	point feature	1	1	x,y point location for plotting the observation

dike, vein, or marker bed	DikeVeinMarkerTraceGeologicFeature	Feature class	Line mapped feature that has an associated geologic unit description.	
Attributes:				
(StandardFeatureProperties)	SimpleFeatureContent	1	1	
FeatureType	string	1	1	controlled vocabulary term specifying the kind of feature
PositionAccuracy	float	1	1	half width of band of uncertainty along mapped trace. -99 if unknown
ObservationMethod	string	1	1	explanation of how feature was located
FeatureTrace	line feature	1	1	linear geometry of feature. GML encoding will include Spatial Reference System specification (SRS)

Document object	Document	metadata record	Product is metadata for document accessible online	
Attributes:				

Drill stem test	DrillStemTestObservation	Feature class	Associated with borehole, has top, bottom coordinates of interval, geologic formation, pressure, flow data? Operator,	
Attributes:				
BoreholeURI	string	Reference	1	Identifier that provides link to borehole where DST was obtained, and that defines the CRS for locating the tested interval
Pressure	string	Number with uncertainty and units	1	measured pressure
Temperature	string	0..1	0..1	Temperature of observed fluids; should this be range, peak, average?
Geologic formation	category	Category	1	Name of tested unit
IntervalBottom	string	Number with uncertainty and units	1	bottom of tested interval
IntervalTop	string	Number with uncertainty and units	1	top of tested interval
DateTime	string	Date	1	Date and time test was completed
DST operator	string	Person	1	person responsible for DST operation
Testing company	string	Organization	0..1	company that conducted DST
(StandardObservationProperties)	SimpleFeatureContent	1	1	
ObservationLocation	point feature	1	1	x,y location for plotting observation site on a map

Earthquake epicenter	EarthquakeEpicenterObservation	Feature class	Epicenter is location determined based on complex analysis of seismic waveforms, thus each epicenter is the result of an observation. Observation service would return individual determination or collection of determinations. Feature service might return collection of surface projection	
Attributes:				
Magnitude	float	1	1	magnitude of earthquake
MagnitudeUncertainty	float	0..1	0..1	standard error on magnitude determination
Time	data object	Date	1	Calendar date, clock time for event. Julian date, GMT time?
hypocenter location	data object	georeferenced point 3D	1	X, Y, Z location of hypocenter in Earth
location uncertainty	string	Length	0..1	
(StandardObservationProperties)	SimpleFeatureContent	1	1	

flooded mine feature	FloodedMineFeature	Feature class	features representing water-filled mine workings, either subsurface or surface. Coal mines in Indiana. Of interest as a water source. Delineate as polygons	
Attributes:				
(StandardFeatureProperties)	SimpleFeatureContent	1	1	
MineURI	string	1	1	identifier for mine, e.g. from Indiana Coal mine information system
SurfaceOrSubsurface	string	1	1	flag for surface or underground workings
Shape	polygon feature	1	1	polygon shape that locates the mine extent

Fluid chemistry	FluidCompositionObservation	Feature class	an observation that characterizes the fluid composition of a sample or fluid unit. (a fluid unit is analogous to a geologic unit--fluid associated with some particular part of the earth, typically an aquifer or surface water body). Need to study EarthChem and CIAHSI to determine best approaches to dealing with variety of analytes. Need to distinguish simple observation which is analysis of one sample, from composite observation that may integrate results from multiple samples to characterize spatial or temporal variation.	
Attributes:				
SampleID	string	Reference	0..1	identifier for sample from the original collector if observation is from a single sample (Observation type = simple)
SampleURI	string	1	1	identifier for the sample, link provides access to complete information about the sample.
SamplingFeatureURI	string	0..1	0..1	identifier for sampling feature. Typically this will identify a well or borehole from which a sample was collected
Sample type	category	Category	0..1	kind of sample analyzed.

Observation type	category	Category	1	category to characterize scope of observation and procedure--e.g. simple, average, range, peak, mode
(CompositionRecord)	SWE record	Component result	1	analyte, measured concentration (Units, magnitude, value), metadata tuple
(StandardObservationProperties)	SimpleFeatureContent	1	1	
ObservationLocation	string	1	1	point location for sample from which composition was determined. This is x,y surface location for surface projection of sample location for subsurface samples.

Geothermometer observation	GeochemicalThermometerObservation	Feature class	Temperature estimation based on geochemical analysis of fluid constituents. May need different scheme for each system to make flat file, or if can consistently define method, analyte, concentration, uncertainty, anal procedure, calculated tmax, tavg, current T or something like that.	
Attributes:				
ElevationDatum	decimal	0..1	0..1	surface elevation relative to sea level for depths, MSL for topographic elevation
Elevation	decimal	0..1	0..1	elevation of sample location; depth in borehole is reported -0 with Elevation datum as surface elevation of well origin.
ResultTemperature	decimal	1	1	calculated temperature result for geothermometer
ResultUncertainty	decimal	1	1	uncertainty for calculated temperature
UncertaintyEstType	category	1	1	term from controlled vocabulary for uncertainty determination method
ThermometerType	category	1	1	term from controlled vocabulary for geochemical thermometer system used to estimate temperature
SampleURI	string	1	1	identifier for analyzed sample; information for sample should be accessible using this URI via a sample feature service. Ideally this is an http URI that will dereference using standard web architecture
(AnalysisRecord)	SWE record	1	1	a structured data list for reporting more complex analytical results; types for these need to be defined; experts need to determine if a binding can be made between thermometer type and analysis record structure.
(StandardObservationProperties)	SimpleFeatureContent	1	1	
ObservationLocation	point feature	1	1	x, y location to plot observation location

Contact, fault, fold	GeologicStructureTraceFeature	Feature class	A line mapped feature that has an associated geologic structure description; use for faults of any age, fold hing surface traces, traces of joints,	
Attributes:				
(StandardFeatureProperties)	SimpleFeatureContent	1	1	collection of standard properties carried by any feature
FeatureType	category	1	1	term from controlled vocabulary classifying kind of feature
GeologicHistory	string	1	1	Text specifying age of feature
YoungerAgeURI	1	1	1	URI for younger age bound for genesis of structure
OlderAgeURI	1	1	1	URI for older age bound for genesis of structure
FeatureTrace	line feature	1	1	linear geometry for outcrop trace of feature

Lithology log interval	GeologicUnitIntervalFeature	Feature class	segments of a linear sampling feature (borehole, measured section) with geologic unit description for each interval. Use borehole as root element, sampling frame provides geometry, mapped intervals are intervals along trace with 3-D geometry (borehole collar x,y, depth as z or convert to actual elevation z?). Include simple borehole URI. Have to follow URI (make http URI to enable resolution), then simple geologic unit inline content with http URI to access full GeoSciML Geologic unit.	
Attributes:				
(SimpleGeologicUnit)	SimpleFeatureContent	1	1	content for simple geologic unit description
BoreholeURI	http URI	1	1	identifier for borehole from which interval is described.
Interval type	category	Category	1	Classification for kinds of interval location reference schemes and kind of associated description.
upper bounding coordinate	string	Number with uncertainty and units	1	Top of borehole interval, or coordinate of stratigraphic upper boundary of interval in a measured section
lower bounding coordinate	string	Number with uncertainty and units	1	bottom of borehole interval, or coordinated of stratigraphic lower boundary of interval in a measured section

Map unit polygon	GeologicUnitPolygonFeature	Feature class	Mapped feature, with geologic unit description, part of a Geologic Map. Use GeoSciML portrayal scheme. Recommend using NGMDB Lite syntax for Lithology, geologicHistory, and otherProperties	
Attributes:				
Rank	olderEventAgeURI	http URI	1	olderEventAgeURI
DominantLithologyURI	LongText	1	1	metadatumURI
Source	LongText	1	1	otherProperties
ObservationMethod	LongText	1	1	ObservationMethod
Lithology	specificationURI	Text	1	symbol
Description	Label	1	1	Description
Label	youngerEventAgeURI	1	1	Label
GeologicHistory	1	1	1	youngerEventAgeURI
Name	1	1	1	GeologicHistory
LocationText	1	1	1	Name
FeatureURI	1	1	1	LocationText
Description	1	1	1	FeatureURI

geothermal facility	GeothermalFacilityFeature	Feature class	facilities with geothermal heating/cooling installation, power generation, or other geothermal application installed. Production record is (startDate, endDate, commodity, quantity, units)	
Attributes:				
MetadataURI	http URI	1	1	ProductionRecord
Label	SWE record	1	1	FacilityType
Source	1	1	1	Owner
SpecificationURI	http URI	1	1	Operator
ProductionRecord	SWE record	1	1	Function
FacilityType	1	1	1	Name
Owner	1	1	1	LocationText
Operator	1	1	1	FeatureURI
Function	1	1	1	Description
Name	1	1	1	
LocationText	1	1	1	
FeatureURI	1	1	1	
Description	1	1	1	

Geothermal system	GeothermalSystemFeature	Feature class	Feature representing a geothermal system. Has polygon representing projection of system to earth surface, production data, associated operators, some sort of classification for geothermal category, development status, peak temperature, estimated heat available...	
Attributes:				
(StandardFeatureProperties)	SimpleFeatureContent	1	1	
DepthTop	float	1	1	Vertical depth from surface to top of reservoir
DepthBottom	float	1	1	Vertical depth from surface to bottom of reservoir
DepthDatum	float	1	1	Surface elevation that depth is measured from
ReservoirVolume	float	1	1	
LengthUnits	category	1	1	term from controlled vocabulary, specifies length units used for depth and volume
ReservoirEnergy	float	1	1	
EstimationMethod	string	1	1	method used to estimate reservoir energy
EnergyUnits	category	1	1	term from controlled vocabulary, specifies length units used for reservoir energy
Shape	polygon feature	1	1	polygon delineating extent of feature projected to earth surface

GeologicUnit	GeothermalUnitSimpleFeature	Feature class	Observation that summarizes properties for geologic unit; focus on properties of interest for Geothermal energy	
Attributes:				
Shape	polygon feature	1	1	polygon delineating extent of feature
(StandardFeatureProperties)	SimpleFeatureProperties	1	1	
Lithology	ThermalConductivity	Permeability	Porosity	ObservationMethod

Heat flow	HeatFlowObservation	Feature class	basic data and result for heat flow measurement	
Attributes:				
ThermalConductivity	HeatFlow	(StandardObservationProperties)	GradientIntervalDepthBottom	GradientIntervalDepthTop

Hot spring	HotSpringFeature	Feature class	point feature representing a hot spring, a kind of Water source feature	
Attributes:				
Owner	string	Formatted string	0..1	Township range location for hot spring
temperature	data object	Number with uncertainty	0..1	Temperature of water from hot spring. For now consider that will be average temperature, peak temperature or temperature range are other possible properties.
flow	data object	Number with uncertainty	0..1	Average volume of water per unit of time. Has units and uncertainty
(StandardFeatureProperties)	string	String	1	Include information on how temperature and flow rate are measured, reference for original data

metadata	MetadataRecord	metadata record	information describing some resource, its provenance, quality, and how to access the resource	
Attributes:				

physical property (soft typed)	PhysicalPropertyObservation	Feature class	generic observation for single result observation of a physical property, e.g thermal conductivity	
Attributes:				

Co-produced fluid feature	ProducedFluidObservation	Feature class	A borehole collar feature for a well other than a specifically thermal water well, with flow rate and temperature data. May want to have only one borehole water source feature? With produced fluid composition property? Need some kind of parameter for water/other fluid ratio...	
Attributes:				
Units	EndInterval	FluidType	(StandardObservationProperties)	Volume
StartInterval	1	1	1	1

Whole rock radiogenic element analysis	RadiogenicElementObservation	Feature class	Analytical data for U, Th, and K associated with a rock sample; may include calculated radiogenic heat production. Probably should consider an SOS offering type for a trace element chemistry service.	
Attributes:				
SampleURI	(composition)	SWE record	1	1

SampleID	(StandardObservationProperties)	SimpleFeatureContent	1	1
AnalysisType	ResourceAssessmentRegion Feature	Feature class	Features that carry attributes specifying suitability of an area for some resource development base on some criteria. Methodology should be includes as procedure on each feature, along with source of analysis (who, when, why, where done), and assessment results for the feature. Might be represented as a 2-D coverage.	

Resource suitability	ResourceAssessmentRegion Feature	Feature class	Features that carry attributes specifying suitability of an area for some resource development base on some criteria. Methodology should be includes as procedure on each feature, along with source of analysis (who, when, why, where done), and assessment results for the feature. Might be represented as a 2-D coverage.	
Attributes:				
(StandardFeatureProperties)	AssessmentCategory	Confidence	AssessmentScheme	1
Sample	SampleFeature	Feature class	Feature class for representing samples. Each has a sampled feature, curation location, Sample Location	
Attributes:				
SampleURI	CollectorSampleID	SampleLabel	SampleFeatureName	SampleFeatureURI
CollectionLong	CollectionLat	CollectionName	SamplingProcedure	ParentSampleURI

Area coverage	SingleAttributeAreaCoverage	2-D raster coverage	an X,Y grid with associated data value for each point. What kind of data specified might vary. Have to explore WCS for these.	
Attributes:				