Newberry Geothermal Energy

A Research Observatory for a Sustainable Future

Newberry Geothermal Energy

Establishment of the Frontier Observatory for Research in Geothermal Energy (FORGE) at Newberry Volcano, Oregon

Appendix I

Sample and Core Curation Plan

April 27, 2016

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Abbreviations and Acronyms

°C	degree(s) Celsius
°F	degree(s) Fahrenheit
CAB	Curatorial Advisory Board
DMP	Data Management Platform
DOE/NETL	U.S. Department of Energy National Energy Technology Laboratory
DOGAMI	(Oregon's) Department of Geology and Mineral Industries
EPSG	European Petroleum Survey Group
FORGE	Frontier Observatory for Research in Geothermal Energy
ft^2	square foot(feet)
ft^3	cubic foot(feet)
GSR	Geological Sample Repository
GTO	Geothermal Technologies Office
m	meter(s)
mm	millimeter(s)
NEWGEN	Newberry Geothermal Energy
NGDS	National Geothermal Data System
ORS	Oregon Revised Statutes
OSU	Oregon State University
PI	Principal Investigator
SRS	spatial reference system
STAT	Science and Analysis Team
WFS	Web Feature Service
XRF	X-ray fluorescence
UTM	Universal Transverse Mercator

Appendix I

Sample and Core Curation Plan

I.1 Summary

Newberry Geothermal Energy (NEWGEN) proposes a comprehensive Sample and Core Curation Plan to support the establishment and management of a dedicated Enhanced Geothermal Systems field laboratory at the Newberry Volcano Frontier Observatory for Research in Geothermal Energy (FORGE). By implementing the Sample and Core Curation Plan, NEWGEN will preserve and curate physical samples during the lifetime of FORGE and beyond. The plan also establishes processes for equitably distributing the samples to FORGE participants and other interested entities.

I.2 Introduction

This Sample and Core Curation Plan provides mechanisms for sample handling and characterization, cataloging and discovery of the physical samples, and accessing sample metadata through web services. The curation process includes the physical samples, capture of metadata in a digital format, and development of searchable schema through the NEWGEN FORGE Data Management Platform (DMP) Metadata Association Tool described in Appendix F, Data Dissemination and Intellectual Property Management Plan. The Sample and Core Curation Plan includes a strategy for permanent sample and core storage and preservation beyond the life of NEWGEN FORGE. Activities associated with sample and core curation and management will commence during Phase 2C when drilling is initiated.

I.3 Background

The NEWGEN FORGE approach to curation of physical samples and cores builds on extensive experience and an existing Geological Sample Repository (GSR) at Oregon State University (OSU) in Corvallis, Oregon. The OSU GSR was established with funding from the National Science Foundation in 1972 for curation of marine samples and cores. The collection of samples has steadily expanded since then. In 2010, the repository began curating frozen gas hydrate samples from the U.S. Department of Energy National Energy Technology Laboratory (DOE/NETL). By the end of 2011, with the merger of OSU's College of Ocean and Atmospheric Sciences and the Department of Geosciences to form the current College of Earth, Ocean and Atmospheric Sciences, curatorial responsibilities were extended to land-based geologic samples. At present, the existing GSR contains more than 16,290 m of core material from 6,200 cores, 10,025 rock samples, 2,200 deep-sea manganese nodules, 1,644 sediment trap samples, 693 marine plankton tow samples, and other materials, including lake sediments and drill cores (Figure I.1). More than 27,000 samples have been distributed over the last 3 years, and more than 175,000 since 1972. The current facility includes 41,000 ft^3 of refrigerated space, 1,100 ft^3 of -25ºC freezer space, and more than 5,500 ft^3 of shelved, interior rock storage space. OSU is currently considering an expansion of an additional 15,000 ft^2 of storage, sample staging and preparation space, and laboratory space.

The GSR houses a full suite of analytical laboratory equipment for characterizing rock cores and cuttings including the following:

- a containerized GEOTEK MSCL-S multi-sensor track that provides gamma-ray attenuation bulk density, loop magnetic susceptibility, P-wave velocity, and electrical resistivity
- a GEOTEK XZ system that provides line scan camera photography and point-source magnetic susceptibility

- an ITRAX X-ray fluorescence (XRF) Scanner capable of split core and u-channel measurement at 0.2 mm resolution
- core splitters including portable vibrating saw core splitter
- rock and band saws
- freeze dryer (Virtus) and freeze dryer (LabConco)
- electronic and manual balances
- automated label maker
- Beckman Coulter LS 13 320 laser diffraction particle size analyzer
- microscopes (petrographic with digital camera, binocular)
- Hitachi LCD projector
- photography station (Norman flash photography strobe lighting system)
- Epson Perfection V750 PRO scanner.

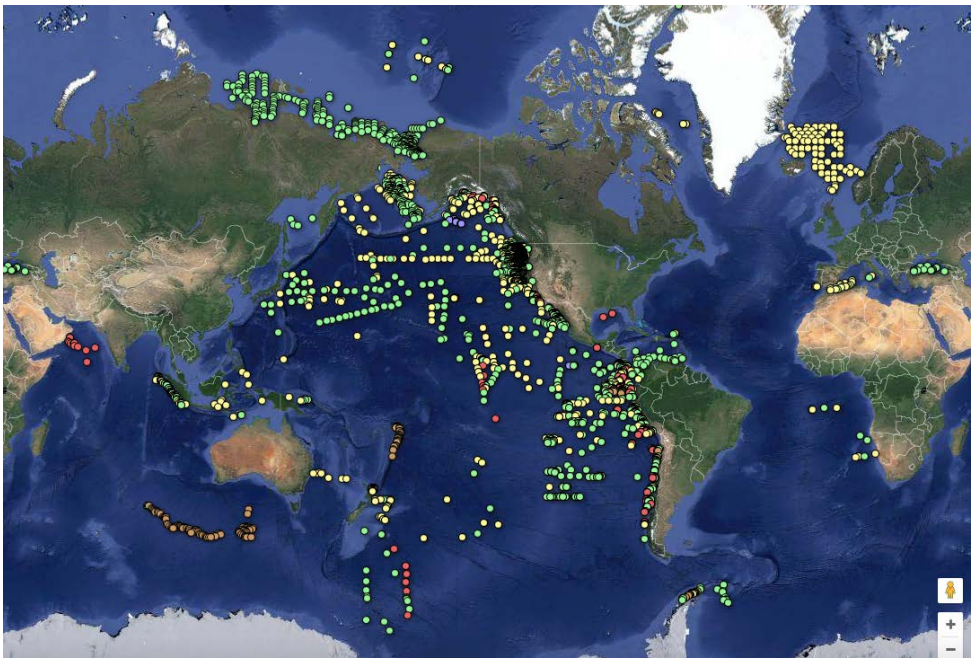

Figure I.1. Current holdings of all sample types of OSU's GSR.

Geologic exploration and discovery data generated over the past 40 years from Newberry Volcano and the surrounding region have resulted in an extensive collection of cores and cuttings. This collection is currently stored and curated by the State of Oregon Mineral Land Regulation and Reclamation Program at the Oregon Department of Geology and Mineral Industries (DOGAMI) facility in Albany, Oregon, and at the University of Utah Institute for Energy and Geoscience core laboratory. Within the state of Oregon, DOGAMI regulates the drilling of wells for the discovery and production of high-temperature geothermal resources (greater than 250°F), an authority first given to the agency by the Oregon Geothermal Resources Act of 1971 (O.L. 1971, Ch. 776). The Oregon Revised Statutes (ORS) 522, Geothermal Resources Section 522.275 delegates the authority for administering geothermal resources statutes to the State Geologist, and ORS Section 522.355(6) requires the operators of geothermal wells to provide representative drill cuttings and, when obtained, core samples to DOGAMI, whereas under ORS

Section 522.365(2) such materials may be exempt from disclosure for a period of up to 4 years, unless the operator gives approval to release the data. This statute will ensure access for first use of the samples and cores by the NEWGEN FORGE performers of research and development.

In 2015, DOGAMI's geothermal well cuttings and cores were transferred from their storage facility in Albany, Oregon, to the College of Earth, Ocean and Atmospheric Sciences GSR at OSU in Corvallis. A Memorandum of Understanding between DOGAMI and OSU transferred curatorial oversight of these materials to OSU (Attachment I.1). New cores, cuttings, and fluid samples that will be generated by the NEWGEN FORGE project also will be stored and curated in the GSR. OSU is committed to continued curation of NEWGEN FORGE physical samples as well as those generated by previous geothermal exploration at Newberry Volcano after the conclusion of FORGE. A Letter of Commitment from OSU for continued curation is attached to this plan (Attachment I.2).

Drill cuttings within the NEWGEN FORGE site were obtained in 2008 from deep exploration wells NWG 55-29 and NWG 46-16 (Figure I.2). Representative cuttings from 2008 wells have been transferred to OSU's GSR in Corvallis. During Phase 2C of the NEWGEN FORGE project, access will be provided to these existing samples through the Geothermal Data Repository using the NEWGEN FORGE DMP. Additional cores, cuttings, and hand samples from Newberry Volcano, and from the caldera (GEO N-1, N-2, N-3, N-4, N-4a, and N-5 wells; Santa Fe NC-01, and 72-3 wells; CE NB-3, 4, and 7 wells) are currently stored at the University of Utah Institute for Energy and Geoscience.

I.4 NEWGEN FORGE Sample Repository

The NEWGEN FORGE Sample Repository will be a distinct section of OSU's GSR with access to the facilities and capabilities listed above. It is anticipated that the NEWGEN will generate a significant volume of new physical samples (cores, cuttings, water samples). To accommodate the large volume of samples, low-cost commercially leased space close to the GSR may be secured for Phases 2C and 3 (included in the project budget) and will serve as an annex for the NEWGEN FORGE Sample Repository. The location and cost of this space will be determined during Phase 2A infrastructure assessment. Analysis of physical samples for essential characterization (as described previously) will take place in the main OSU GSR facilities (see Attachment I.2 at the end of this plan).

At the conclusion of the NEWGEN FORGE project, OSU will continue long-term curation of the samples at no additional cost to DOE. The OSU Vice-President for Research has provided a Letter of Commitment to Curate Samples, which is attached to this plan. In the letter, OSU confirmed that it is committing to the long-term curation and distribution of physical samples from the NEWGEN FORGE after the conclusion of the FORGE program, and that it will maintain a database of publicly discoverable metadata to facilitate distribution of these samples. This commitment extends to existing physical samples as well as samples obtained under NEWGEN FORGE funding.

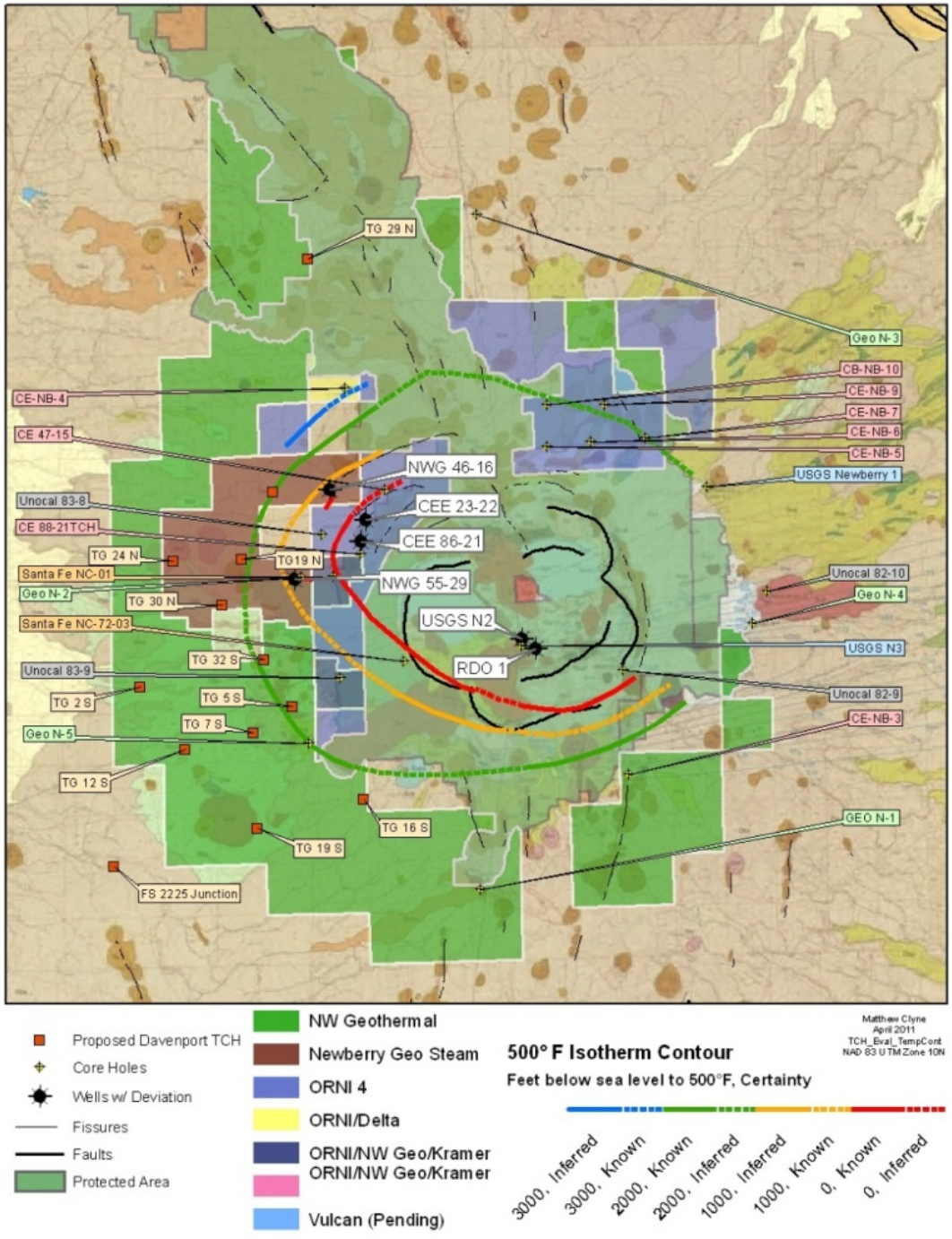

Figure I.2. Location of temperature coreholes and geothermal exploration wells at Newberry Volcano with inferred contours showing the depth to the 260°C (500°F) isotherm from an internal CalEnergy report.

I.5 NEWGEN Sample Curation and Preservation

I.5.1 Collection

Collection and processing of physical samples at the drill pads will be the responsibility of the NEWGEN **Director of Research and Operations**. The **Deputy Director of Site Operations** will oversee physical sample collection, including populating an electronic Physical Sample Log report, scribing the marks of record for cores (including the position in the well [depth] and orientation of the core sections) in their inner barrels, and packaging cores, cuttings, and fluids for shipment to the NEWGEN FORGE Sample Repository. Core will be sectioned into standard lengths for transportation and storage.

Physical samples from the NEWGEN FORGE site (cores, cuttings, and fluid samples) will be processed at the drill pad in a temporary facility such as an onsite storage container for transportation to the GSR for more complete sample description, analysis, preservation if necessary, and curation. Once packed for transportation to the NEWGEN FORGE Sample Repository, responsibility for the samples transfers to the **Director of Geosciences** or a designated **Curator** (appointed by the **Director of Geosciences**), who will arrange transport of the samples to the NEWGEN FORGE Sample Repository, 160 mi by road from the NEWGEN FORGE site. Once the samples arrive at the NEWGEN FORGE Sample Repository, they will be accepted into inventory and processed to generate standardized sample descriptions. The Physical Sample Log will capture all of the sample collection, processing and preservation data that will be accessible through the NEWGEN FORGE DMP Data-Metadata Association Tools. Web-based interfaces (and automation mechanisms) will help acquire and associate metadata with electronic data content and physical samples. These software tools will be designed to identify and construct data assets that comply with GDR Tier 3 information content requirements.

I.5.2 Physical Samples

Cores

Cores will be extracted from boreholes and sectioned into standard lengths, retaining their positions within inner barrels that will be used to transport and store the cores. The barrels will be scribed with a well identification number, a unique core section identification number, and the orientation and position of that section within the well. At the time the cores are collected, a digital Physical Sample Acquisition Log will be initiated. The core barrels will be boxed, labeled, and prepared for transportation to the NEWGEN FORGE Sample Repository.

I.5.3 Drill Cuttings

Drill cuttings will be separated from drilling fluid and made available for mud logging, a subcontracted task under the supervision of the **Deputy Director of Site Operations**. Drill cuttings will be labeled and barcoded for position in the borehole, assigned a unique cutting identification number, boxed, and prepared for transportation to the NEWGEN FORGE Sample Repository. At the time the cuttings are collected, a digital Physical Sample Acquisition Log will be initiated.

I.5.4 Fluids

Fluid samples may be obtained from downhole reservoir fluid samplers, from the wellhead and well test separator, from water wells, from surface water in nearby areas such as Paulina Creek to the south, or Pauline Lake and East Lake to the east in the volcano’s caldera. Samples may be presented for curation in conventional sample bottles of the type used by oil field services companies (e.g., multi-chamber

assemblies designed to depressurize the sample for shipping but to retain exsolved gases and to allow for subsequent re-pressurization), in pressurized gas-tight sample bottles, in gas sample bottles, or in zero pressure sample containers.

Fluid sample collection will be done under the supervision of the **Deputy Director of Site Operations**, who will assign a unique fluid sample identification number to each sample, label/barcode each container, and complete the digital Physical Sample Acquisition Log. Some fluid samples may require refrigeration or cryogenic handling, which will be done onsite. The fluid samples will then be boxed and prepared for transportation to the NEWGEN FORGE Sample Repository.

I.5.5 Digital Metadata

GDR Tier 3 Metadata

Metadata associated with physical samples (cores, cuttings, and fluid samples) will be described using a GDR Tier 3 schema that will be linked to the electronic Physical Sample Log. Standardized metadata attributes for these structured data sets are still under development/revision for physical samples (currently in review by the Geothermal Data System Development and Population Technical Working Group of the National Geothermal Data System (NGDS) Architecture Design, Testing, and Implementation Project); no XML schema yet exists for this content model, but the current 2013 V0.8 content model for physical samples contains a rich set of descriptor fields found at http://schemas.usgin.org/models/#physicalsample. The subset of **required** fields in that schema appears in Table I.1 (in yellow) along with a subset of optional fields that will be populated at the time of sample collection (in white; other optional fields from the schema may be added in future).

Not all of the sample metadata fields will be populated at the drill pad; a number of the fields will be completed during sample characterization at the NEWGEN FORGE Sample Repository. By building the NEWGEN FORGE Sample Repository's Physical Sample Logs as an extension of the NEWGEN FORGE DMP's Resource Management and Metadata Association tools, GDR Tier 3 metadata may be augmented and edited at each stage of the curation and characterization process. At the conclusion of this process, automatic synchronization between Tier 3 physical sample data and GDR will be supported by the NEWGEN FORGE Transfer Tool. The transfer tool will greatly automate the construction and pre-verification of the comma separated value-based metadata files that would accompany electronic data content (or references to physical samples). As stated in the data management plan, the ability to programmatically transfer metadata to the GDR via an application programmer's interface will be explored.

Table I.1. GDR Tier 3 standardized metadata attributes for physical samples (cores, cuttings and fluid samples).

NAME	DESCRIPTION
SpecimenURI (string)	Unique identifier for sample; should include protocol prefix with known meaning, delimited by a ':' (colon), e.g., igsn:24623570 or http://resources.usgin.org/uri-gin/AZGS/sample/24623570.
SpecimenLabel (string)	Short text string to identify/characterize the samples used in this observation; may include one or more sample names as provided by the sample collector or analyzing laboratory.
SpecimenDescription (string)	Free text description of sample, including size, weight, quality, lithology, locality, etc.

Table I.1. (contd)

NAME	DESCRIPTION
ParentSpecimenURI (string)	Identifier for a specimen from which this specimen was subsampled; e.g., if a piece from a registered core is registered as a separate sample, this would be the identifier for the core.
GeologicUnitName (string)	Name of geologic unit that was sampled. Include hierarchy of names if the unit is part of a higher-ranking geologic unit, e.g., Group name/Formation name, or Formation/Member, or Group/Formation. Spell out unit names in full.
SamplingFeatureURI (string)	Unique Identifier for the particular site (station) or well where the sample(s) came from. For wells, this might be the Header URI or API number used in other metadata files. If unavailable, state “missing.” SamplingFeature is a concept that represents the feature that accesses the part of the Earth from which the sample came, e.g., outcrop, borehole, dredge haul.
MaterialClass (string)	Category from simple material classification scheme; e.g., rock, sediment, aqueous liquid, other liquid, gas, biological material.
LithologyTerms (string)	Description of the lithology of surface geology or geologic column for well interval; e.g., granite, sandstone, limestone, arkose, schist. Recommend using CGI simple lithology vocabulary. Use to account for EarthChem Material, EarthChem Type, EarthChem Composition, alluvium, 36-40': gravels; etc.
RockName (string)	Free text name for lithology category of sample; e.g., biotite-hornblende granite, lithofeldspathic sandstone, calcareous arkose, biotite schist.
SpecimenCollector (string)	Free text specification of person, organization, affiliation, address, etc. for party that originally collected specimen. Include contact information if available.
DateCollected (dateTime)	Date for the record (date on which observation, measurement, or test was made or specimen was collected). Day, month, and year must be specified; Excel will display using ISO 8601 date and time (yyyy-mm-ddT:hh:mm) format. If only the year is known, enter month and day as 'Jan. 1', (or '1/1/', or '1-1-', or 'January 1,'). All dates will be converted to yyyy-mm-ddThh:mm.
CollectionMethod (string)	Coring, blasting, dredging, etc.
SpecimenType (string)	Term to describe the type of specimen. Use term from list of specimen types. If the specimen type collected is not present on this list, add the specimen type to the list in the example column.
CurrentCurationLocation (string)	Free text name of institutiion, museum, or repository where the sample is currently stored.
SpecimenCuration (string)	Other information about specimen curation-previous history of curation; contact information for person who should be contacted for information about or access to the sample.
CuratorURI (string)	Identifier for the party that currently has stewardship of the specimen. Ideally an http URI that will dereference to a standard CI_ResponsibleParty type representation of the party.
AccessConstraint (string)	Text specification of constraints on access to this sample description. Might include a date when information becomes public, and term like: public, private, sandbox, for use by sample catalog system.

Table I.1. (contd)

NAME	DESCRIPTION
County (string)	Required. County name. If unknown or not applicable use “missing.” If offshore, specify “offshore” in this field.
State (string)	Required. State name without abbreviations. If unknown or not applicable use “missing.” For offshore locations, specify the governing or nearest state and list the county as “offshore.”
LocationKeyword (string)	Additional information or more geographic names associated with sample collection location; if multiple names supplied, delimit with pipe “|”character, e.g., Arizona | La Paz County | Harquahala Mountains | Browns Canyon.
UTM_E (double)	UTM (Universal Transverse Mercator) easting coordinate as decimal number.
UTM_N (double)	UTM northing coordinate as decimal number.
UTMZone (string)	The datum and UTM zone for the reported coordinates. Datums for most locations should be NAD27 or NAD83.
LatDegree (double)	Latitude coordinate for the surface location of the feature (use center point for areas); values should be provided with at least 4 significant digits for sufficient precision (7 decimal places is recommended by the U.S. Geological Survey (USGS) (OFR 02-463, p. 6). Use decimal degrees.
LongDegree (double)	Longitude coordinate for the surface location of the feature (use center point for areas); values should be provided with at least 4 significant digits for sufficient precision (7 decimal places is recommended by the USGS (OFR 02-463, p. 6). Use decimal degrees.
SRS (string)	The spatial reference system (SRS). It is recommended that an European Petroleum Survey Group (EPSG) code be used to identify the SRS used to specify the location. If an EPSG code is used, identify it as such with the prefix “EPSG:” For common EPSG codes, see the Data Valid Terms tab. EPSG:4326 is the identifier for WGS84, and should be the text in this field. EPSG codes can be dereferenced by putting the code in this URL (replace 4326) http://spatialreference.org/ref/epsg/4326/.
LocationUncertaintyStatement (string)	Information about how the original location was determined, e.g.: 1:250,000 map, gps unit, Google Earth, PLSS Conversion, Spatial Datum Conversion, e.g., NAD27 to WGS84.
LocationDescription (string)	Free text description of the sample location, the specific place where your sample was collected, method used to determine the location of the sample, e.g., GPS, DVL, or relation to parent sample.
VerticalExtentMax_m (double)	Maximum elevation at which a sample was collected (in meters). Use negative values for depth below sea level. Minimum elevation if a range is provided for the elevation/depth below sea level. “678.5”; “-4536” (= 4536 meters depth below sea level).
VerticalExtentMin_m (double)	Minimum elevation at which a sample was collected (in meters). Use negative values for depth below sea level. Minimum elevation if a range is provided for the elevation/depth below sea level. “678.5”; “-4536” (= 4536 meters depth below sea level).

Table I.1. (contd)

NAME	DESCRIPTION
DatumElevation_m (string)	The point of reference against which elevation measurements are made. Best practice: use mean sea level as datum.
CollectionActivityName (string)	Free text name that should uniquely identify the collection activity (cruise, project, etc.) for human readers.
SourceCitation (string)	Mandatory. Short text explanation of source of information defining this feature or record; may be author-date type citation, well log, report, data files etc., but should include some indication of how digital data originated. If unpublished data, provide researcher name, date and research institution for proper citation. Separate multiple citations with pipe "|" character.
SourceCitationURI (string)	Identifier, DOI or other URI, for the cited source. Ideally an http URI that may be dereferenced to produce a representation of the original source document.
Registrant (string)	Free text specification of party that originally registered sample; may be name or organization, with or without contact information.
UpdateDate (dateTime)	Date of last time line of data was updated or corrected by the service provider.(Format: 2012-06-22T00:00).
RelatedResources (string)	This may be one to many http links to resources (logs, pictures or other documents if available online. Should be an http://address (URL)) related to the observation described in each record. Delimit multiple values with the pipe "|" character.
Notes (string)	Any additional information to be provided, including description and other data not captured by the template, details about collection method, contact information for related parties (original collector, project Principal Investigator, collection platform or launch, etc.
Shape (PointPropertyType)	Added by GIS for WFS service; this element appears in the xml output, but is generated during service deployment from the latitude and longitude; therefore, it does not appear in the template.

I.5.6 Storage and Sample Description

Upon arrival at the NEWGEN FORGE Sample Repository, all samples will be inventoried, entered into the NEWGEN GSR inventory database, and uploaded to the NEWGEN FORGE DMP as part of the Resource Management subsystem.

Cores

Cores will be slabbed (cut in half longitudinally), half placed into archival storage within the repository, and the other half available for subsample selection and distribution.

Samples and cores will be characterized and described using line scan photography and point-source magnetic susceptibility, XRF analysis, bulk density, P-wave velocity and electrical resistivity. The metadata associated with core data assets will be assimilated into the NEWGEN FORGE DMP using web-based data asset uploaders and synchronized with GDR, following established Tier 3 data schema. Data interfaces will help streamline the acquisition of metadata by identifying what information can be acquired through automation and what information will need to be manually provided.

Cuttings

Representative samples of cuttings will be characterized using optical microscopy and XRF analysis. Similar to the core data, cutting data assets will be described and assimilated into the NEWGEN FORGE DMP using expanded data asset uploaders and synchronized with the GDR, following established Tier 3 data schema.

Fluid Samples

Fluid samples will be retained in refrigerated storage where appropriate, and made available for subsampling and distribution. Chemical analysis of fluids (liquids and gases) will be completed as requested and the data assimilated in the NEWGEN FORGE DMP using fluid sample data asset uploaders and synchronized with the GDR, following established Tier 3 data schema for aqueous geochemical analyses.

I.5.7 Preservation

Maintaining control of the inventory in the NEWGEN FORGE Sample Repository is critical to success. Retrieval of all sample types will be facilitated through the use of a digital inventory control system that is keyed into a sample indexed barcode associated with each sample unit, as described below. All samples will be checked in and out through an inventory control system that is integrated with the NEWGEN FORGE DMP. This will ensure that the integrity of the archived samples and cores can be maintained, shipment and storage can be tracked, and the loss of samples prevented.

Cuttings will be preserved by storage in the NEWGEN FORGE Sample Repository in indexed and barcoded trays on labeled storage racks. The trays will be labeled to represent discrete downhole depth sections. Split core samples will stored in the repository in split inner barrels, in indexed trays holding multiple core sections, on indexed shelves. Fluid samples will be individually labeled, barcoded, and preserved by storage in the secure repository in original sample bottles where feasible, on indexed and barcoded trays and indexed shelves, or where required, placed in refrigerated storage. In all cases, half of all curated cutting and fluid samples are to be preserved for archival storage, and half made available for distribution.

While the working half of the core sections is available for sampling to facilitate the scientific objectives of those seeking core samples, the archive half is intended to remain a pristine archive of the material recovered. The nondestructive analyses will be done using the archive half (e.g., magnetic susceptibility, gamma-ray density, line scan images, XRF scans, computerized tomography scans, etc.) leaving it as a permanent record.

If the working half of the cores becomes depleted, decisions regarding distribution of the archived core will be made by the Curatorial Advisory Board (CAB; Section I.5.8.1 below) about whether the proposed science and sampling plan justifies sampling of the archive half of the core.

I.5.8 Process for Fair Distribution of Samples

Physical samples (cores, cuttings, fluid samples) from the NEWGEN FORGE Sample Repository will be made available to interested entities through a request system. Scientific investigators will be able to identify samples to request using the available metadata including descriptions of samples and derived products such as detailed sample analyses. Interested scientific investigators will request samples using a series of web forms that will appear as linked URLs accessible through the GDR. Materials for educational purposes and museum displays may also be available in limited quantities.

Physical sample discovery will be enabled by metadata adhering to GDR Tier 3 data schema for physical samples, and initial descriptions of those samples will be searchable through the GDR and other NGDS nodes. These will be updated frequently through the NEWGEN FORGE DMP. The use of GDR Tier 3 data schema facilitates discovery of sample materials using a range of web-based tools available through the NGDS and other linked nodes, including georeferenced (map-based) data discovery.

Interested researchers requesting access to physical samples will be required to complete a series of web forms providing the following categories of information:

- **Initial Statement of Proposed Research or Proposed Use for Teaching and Museum Display.** Each request must include an outline of the intended studies, methods, objectives, and names and addresses of collaborating investigators. Subsequent sample requests during the same investigation should include an additional statement describing study progress and stating the need for additional material. Student requests should be submitted through their academic advisors.
- **Sample Reference Information.** Specific sample identification numbers, as extracted from the Tier 3 data schema, will be required to identify the specific sample in the repository catalog. Subsample information such as specific positions within the well can be included (e.g., sample to be extracted from Well NWG 55-29; depth 2200 m).
- **Number of Samples.** Initial smaller sample requests may be used to determine if more samples will be required later. Large requests require will require justification.
- **Size of Samples.** Indicate the minimum sample weight or volume needed. Larger sample volumes must be justified.
- **Teaching and Museum Collections.** Small samples for displays may be available, within the constraints of scientific research priorities.
- **Approval of Request.** Sample requests will be forwarded to the Curator for review. The Curator will present sample requests to the CAB for consultation and approval. One of CAB's roles is to provide oversight of the sample distribution process so approvals are unbiased by the relationship (if any) between the requesting party and the NEWGEN Consortium. In cases of conflict of interest, the Curator will be recused and the NEWGEN Executive Director will substitute. Previous recipients of NEWGEN FORGE samples will be consulted if they are still studying materials that have been requested by another party. Conflicts between different investigators requesting the same samples for the same purpose will be mediated by the Curator and resolved by the CAB.
- **Sampling and Shipment.** Upon approval by the CAB, requesting parties may participate in the sampling. The samples will be released by the Curator for shipment 2 to 3 weeks after approval. There will be no cost to FORGE-funded investigators for sampling and shipping. For material requests outside of NEWGEN FORGE, the sample distribution costs (packaging, shipping) will be covered by the requesting party.

The requesting party has the following responsibilities to the repository to assure fairness in sample allocation and acknowledgement of NEWGEN FORGE and DOE:

- **Acknowledgement of Samples Received.** Upon receipt of samples, the requesting part must acknowledge receipt by email once samples arrive at their destination.
- **Cooperation in returning samples when appropriate.** When recipients have concluded their analysis of NEWGEN FORGE physical samples, if requested by the repository (e.g., if needed by another investigator), recipients will agree to return of those samples to the repository for re-use.
- **Citation.** Recipients of physical samples must acknowledge the NEWGEN FORGE Consortium and DOE's Geothermal Technologies Office (GTO) in all publications resulting from use of our samples.

Appropriate citations will be included with each shipment of samples. Sample recipients must retain the NEWGEN FORGE sample identifications in published reports, or provide a clear correspondence between their identifier and NEWGEN FORGE project.

- **Copies of Published Reports.** One copy of all published reports, or data where NEWGEN FORGE samples have been used should be sent in .pdf format via email to a designated repository address for inclusion in our records.

Curatorial Advisory Board

Overview

The Director of Geosciences, or their designee, serves as the **Designated Curator**. The Curator will work closely with the NEWGEN FORGE CAB that will be established at the beginning of Phase 2C by the NEWGEN Directorate. Oversight of CAB's operations and policies will be provided by the Science and Analysis Team.

Role

The CAB's mission is to review NEWGEN FORGE Sample Repository operations to assure fair and equitable distribution of cores, cuttings, and fluid samples to interested parties, while preserving the integrity and preservation of the physical sample archive. The CAB will have oversight of repository operations and the sample distribution process. The CAB is charged with recommending changes to operations, policies, and procedures, as required.

The NEWGEN **Executive Director**, in consultation with the Science and Analysis Team and the GTO, has the authority to require implementation of CAB's suggestions by the Curator. While CAB has primarily an advisory role, it also approves sample requests in consultation with the Curator, and it has the authority to resolve conflicts about the distribution of materials, if they arise (see Conflict Management section below).

Members

The CAB will be appointed by the NEWGEN Directorate, in consultation with GTO. Members of the CAB will be selected from leading members of the national and international research community who have expertise in geothermal sample collection and analysis, and/or archiving, distribution, and data discovery of geologic samples. The CAB will have the following members:

1. CAB Chairperson
2. CAB Vice-Chair
3. CAB Secretary
4. CAB Standing Member
5. CAB Standing Member
6. NEWGEN Geoscience Director (non-voting)
7. NEWGEN FORGE Repository staff member representative (non-voting).

With the exception of the non-voting members, all CAB members will serve for 2-year renewable terms.

Conflict Management

The CAB will have authority to make final decisions regarding distribution of NEWGEN FORGE samples if and when conflicts or differences of opinion arise among one or more sample requesters and/or the NEWGEN FORGE Curator.

Attachment 1

Memorandum of Understanding

Memorandum of Understanding
Core Curation
Frontier Observatory for Research in Geothermal Energy

This Memorandum of Understanding ("MOU") is entered into on the date of the last signature below between Oregon State University ("OSU") and Oregon Department of Geology and Mineral Industries ("DOGAMI").

The State of Oregon Mineral Land Regulation and Reclamation Program (MLRR) at the Oregon Department of Geology and Mineral Industries (DOGAMI) regulates the drilling of wells for the discovery and production of high-temperature geothermal resources (greater than 250°F), an authority first given to the agency by the Oregon Geothermal Resources Act of 1971 (O.L. 1971, Ch. 776). The Oregon Revised Statutes ORS 522, Geothermal Resources section 522.275 delegates the authority for administering Geothermal Resources statutes to the State Geologist, and ORS section 522.355(6) requires the operators of geothermal wells to provide representative drill cuttings and, when obtained, core samples to DOGAMI, whereas under ORS 522.365(2) such materials may be exempt from disclosure for a period of up to four years, unless the operator gives approval to release the data.

Under the authority of the State Geologist, in 2015 DOGAMI's geothermal well cuttings and cores were transferred from the Albany, Oregon DOGAMI storage facility to OSU's College of Earth, Ocean and Atmospheric Sciences' (CEOAS) geological sample storage facility at OSU's main Corvallis campus. This MOU formally transfers curatorial oversight from DOGAMI to OSU for these previously transferred materials and to cores and cuttings from the west flank of Newberry Volcano that may be extracted in the course of performance of the US Department of Energy Frontier Observatory for Research in Geothermal Energy (FORGE) project on the triangular area defined by the coordinates: 43.753°N -121.328°W, 43.753°N -121.298°W, 43.723°N -121.317°W. See Figure 1 attached for a site map.

With the mutual agreement of both parties, additional cores and cuttings from elsewhere in Oregon may also be transferred from DOGAMI to OSU for curation. Curation, in this context, means storage of these materials by OSU, maintenance of whatever metadata has been provided by the driller regarding these samples, and providing for public discovery of that metadata as well as provision of a mechanism by which requests for subsamples may be submitted to OSU. Procedures and whatever fees may be necessary will be developed by OSU for the allocation and distribution of those subsamples, as well as for providing a range of analytical services for those requiring analysis of rock properties.

ACCEPTANCE:

OREGON STATE UNIVERSITY

Patricia A. Hawk

Date: 4/25/16
Name: Patricia A. Hawk
Title: Assistant Vice President for Sponsored Research and Award Administration

OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES

Date: 4-22-16
Name: Brad Avy
Title: Director and State Geologist

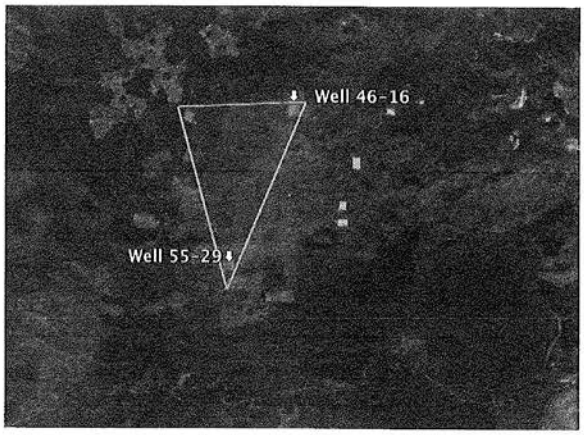

Figure 1. Location of FORGE project site on west flank of Newberry Volcano, Deschutes County, Oregon. The area of the site is bounded by three drill pads, with existing deep exploration well locations as indicated. Paulina Lake is shown on the right.

Attachment 2

Oregon State University Letter of Commitment to Curate

Cynthia Sagers, Ph.D.
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March 21, 2016

US Department of Energy
National Renewable Energy Laboratory
3610 Collins Ferry Road
Morgantown, WV 26507-0880

RE: DE-FOA-0000890 "Frontier Observatory for Research in Geothermal Energy (FORGE), Phase 2 Renewal Application" Letter of Commitment

To Whom It May Concern:

Oregon State University has taken on the responsibility of curating physical samples (rock cores, cuttings and fluids) from the Newberry FORGE site. Previously, the Oregon Department of Geology and Mineral Industries (DOGAMI) was responsible for curating representative cores and cuttings from geothermal wells in Oregon. All of DOGAMI's previous rock core and cuttings samples have been transferred to Oregon State University. Oregon State University confirms that it will commit to the long-term curating and distribution of physical samples from the Newberry FORGE site after the conclusion of the FORGE program, and that it will maintain a database of publicly discoverable metadata to facilitate distribution of these samples. This commitment extends to existing physical samples as well as samples obtained under FORGE funding.

Oregon State University currently maintains a rock core repository that contains more than 16,290 m of core material from 6,200 cores, 10,025 rock samples, 2,200 deep-sea manganese nodules, 1,644 sediment trap samples, 693 marine plankton tow samples, and other materials, including lake sediments and drill cores. More than 27,000 samples have been distributed over the last three years, and more than 175,000 since 1972. The current facility includes 41,000 CFT of refrigerated space, 1,100 CFT of -25°C freezer space, and more than 5,500 CFT of shelved, interior rock storage space, and additional expansions are being considered. The rock core repository houses a full suite of analytical laboratory equipment for characterizing rock cores and cuttings including gamma ray attenuation bulk density, loop magnetic susceptibility, P-wave velocity, electrical resistivity, line scan photography, point-source magnetic susceptibility, high-resolution XRF, core splitters, rock and band saws, microscopes, particle size analyzers and other infrastructure. A comprehensive suite of analytical services is also available for core, cutting and fluid sample characterization, including paleomagnetic, geochronologic, elemental and CT analyses through OSU's *Fee Book*.

Technical questions regarding Oregon State University's participation should be referred to Technical POC Dr. Adam Schultz at (541) 737-9832 or Adam.Schultz@oregonstate.edu. Contractual questions should be referred to Contractual POC Patricia Hawk at (541) 737-4933 or Patricia.Hawk@oregonstate.edu

Sincerely,

Cynthia Sagers, Ph.D.
Vice President for Research