GL01929

DRILL SAMPLE COLLECTION AND CURATION POLICY FOR THE CASCADES DEEP THERMAL GRADIENT DRILLING PROGRAM

Introduction

Core and cuttings recovered during exploration drilling are an important resource for research and evaluation of the geothermal potential. When the cost of drilling is considered, it is evident that the core and cuttings are an expensive and valuable product of the exploration effort. Lithologic samples are the first products recovered from a drill hole and the possibility that the hole may be lost before wireline logs are run or fluid samples are collected further indicates the value of the core and cuttings recovered.

The Cascades Deep Thermal Gradient Drilling Program is a combined effort of industry and public agenices in a potential resource area where subsurface data, particularly in the public domain, are very limited. The data gained through this program will be of value to industry, public agenices and private researchers. It is therefore the purpose of this drill sample collection and curation policy to provide procedures for sample handling that will ensure preservation and equitable distribution of sample for the maximum benefit of the program. Sample handling procedures must be uniform enough to protect sample integrity and reasonable enough for well site personnel to follow without undue extra work.

Well-Site Core Handling

The core will be transferred from the core barrel either to the core trough or directly into core boxes if a core trough is not available. Care will be taken during handling to ensure that all pieces of core remain in their original orientation and sequence. Directly after removal of core from the core barrel, all core pieces with length equal to or greater than core diameter will be marked with an arrow pointing downhole using a grease pencil

or permanent felt tip marker (Fig. 1). If the core needs to be washed this will be done while it is in the core trough. When the core is placed in the core box, a wooden block labeled with the bottom depth of the core run will be placed at the end of the core from that run. If a core run did not directly follow the previous core run because of rotary drilling or other non-coring operations, a wooden block labeled with the beginning depth of the core run will be placed at the top of the run such that beginning and ending depth of each run will be indicated. All core will be placed in core boxes following a uniform system: with the box orientation label on the left, the box will be filled from upper left to lower right (Fig. 1). The label on each core box will be completely filled out using care to ensure that lettering is easily legible, as large as practical and done with an appropriate permanent marker. The drilling crew will be responsible for marking orientation arrows on the core, placing the depth labeled blocks at the top and bottom of each core run, and labeling core boxes unless the well-site geologist does these duties personally.

Drill Cuttings Sampling

Drill cuttings samples will be collected from any intervals which are rotary drilled or drilled with a core plug bit. Cuttings will be collected at 10-foot intervals from the shaker table or if a shaker table is not being used, caught from the blooie line with a bucket and/or screen device. Samples will not be taken from a drain ditch or catchment where contamination from surface materials or earlier cuttings may occur. DOE will require 1 kilogram of sample for each 10-foot interval. Drilling mud will be rinsed from the cuttings if needed and the samples placed in bags labeled with hole name and drilling depth. Proper and timely collection of drill cuttings samples is the responsibility of the drilling crew. Bagging and labeling of the sample bags

are also the responsibilities of the drilling crew unless the drill site geologist assumes this task while logging the samples.

Logging of Core and Cuttings

Whenever a geologist is present, the samples (core or cuttings) will be logged on site or at a nearby convenient operations base prior to sample splitting or transfer to curation facilities. Responsibility for the initial sample logging will be coordinated between the operating company and Department of Energy, Idaho Office (DOE) or their representative. On-site sample logging is important for several reasons: 1) the log will provide a data base upon which drilling and well-test decisions can be made; 2) the on-site log will be made before any sample split or sampling by collaborating investigators; 3) the on-site log will be made prior to possible sample degradation due to sample drying, disaggregation due to drying and pressure release, oxidation, vibration during transport, possible loss or damage during transport and storage; 4) the on-site log will provide a data base for interpreting wireline logs and for subsequent detailed studies of the rocks drilled; and, 5) on-site logging provides the best opportunity for the geologist to interface with the drilling crew to note any drilling operations or conditions which may affect the quality of sample recovery and reasons for sample loss.

Core and cuttings should be logged on a standard form (see Appendix for our example), previously approved by the operating company and DOE, which provides both uniformity of format and flexibility to facilitate different lithologies drilled. All involved companies, government agencies and collaborating investigators, who request a copy of the field log, will receive a copy in a timely manner consistent with DOE's policies on release of data.

The lithologic log will include project name, well name or number, location, well-head elevation, geologist and date logged. For each core run, the

box number, depth in feet and tenths of core recovered, and recovery will be recorded (Fig. 2). Next the lithology will be described followed by fractures, joints, faults and alteration if present. Lithologic descriptions are best given by rock unit which may be thicker or thinner than coring runs. The depth of upper and lower contacts (unit interval) will be stated, followed by a one- to two-word lithologic name, then a description of the unit in appropriate detail. Additional comments may be added for each core run after the unit description for thick but variable units. Lithologic descriptions will be observations rather than interpretations. Core size or bit type, drilling fluid and lost circulation material will be noted as it affects the sample's condition. Cuttings samples for intervals not cored will be logged in the same manner with cuttings and bit type noted. Also depth of all significant drilling operations or events such as setting casing, loss of fluids or bit change will be noted on the core log at the drilling depth that these occur.

Although field lithologic classifications are hand-sample names which may be found to be incorrect by later petrographic or chemical study, they will provide the basis for sample selection and contact depth picks for later, more detailed studies.

Sample Split and Sample Cutting

No sample splits or selected sampling of the core and/or cuttings will be done by any party prior to completion of lithologic logging. After logging, the core will be split and/or selected samples taken by the involved entities and collaborating investigators as agreed upon by the operating company and DOE or their agent(s) for the particular well. Appropriate and timely sample splits and sample selection will be the responsibility of the operating company's site personnel and the project manager or agent for DOE or their

delegated representatives. Any samples cut on the drill site after logging will be noted on the field lithologic log and a block of wood or note with the sample interval and entity taking the sample will be placed in the core box in place of the sample taken. After the sample split between the operating company, DOE or their agent and any other involved agencies (i.e. state geologic survey), the curation and sample availability of the DOE split will be the responsibility of DOE or their agent.

Water and Gas Samples

Water and/or gas samples may be collected during drilling or at the completion of a well as agreed upon by the operating company and DOE. Such factors as hole condition and cost may require on site geologist to make final decisions concerning water and gas sample collection. Sample collection, on-site analysis and treatment of samples for proper preservation will be the responsibility of the authorized DOE representative or collaborating investigator. Instructions for fluid sampling are the topic of a separate memorandum.

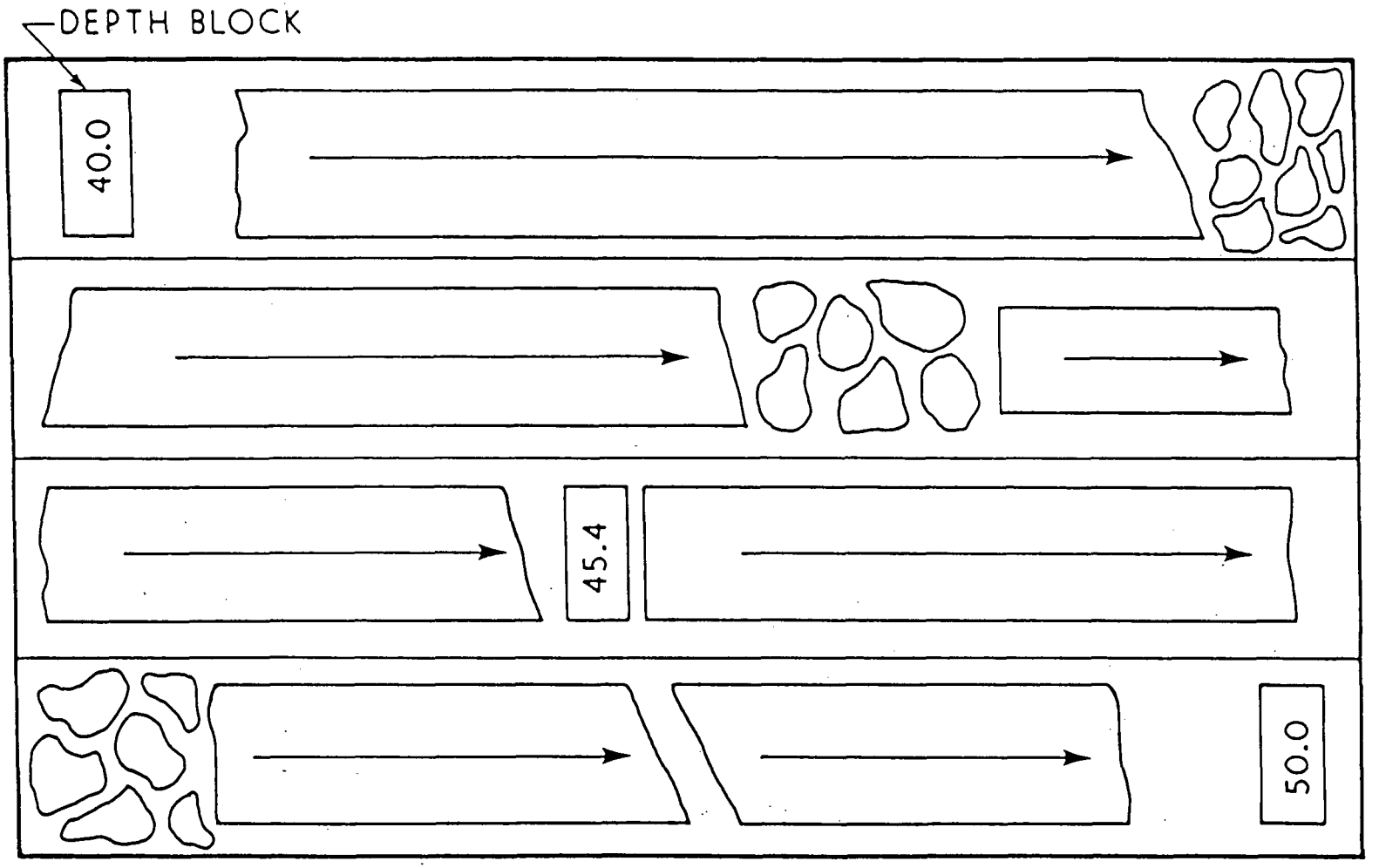

Figure 1. Core box is filled from upper left corner with depth blocks at the end of each run and arrows pointing downhole on core pieces.

CORE LOG

PROJECT _____ WELL NUMBER _____ LOCATION _____

WELL HEAD ELEV. _____ LOGGED BY _____ DATE _____ PAGE _____

BOX #	Depth	Recovery	Graphic Symbol	LITHOLOGIC DESCRIPTION	Fractures & Alteration	Drilling Information

Figure 2

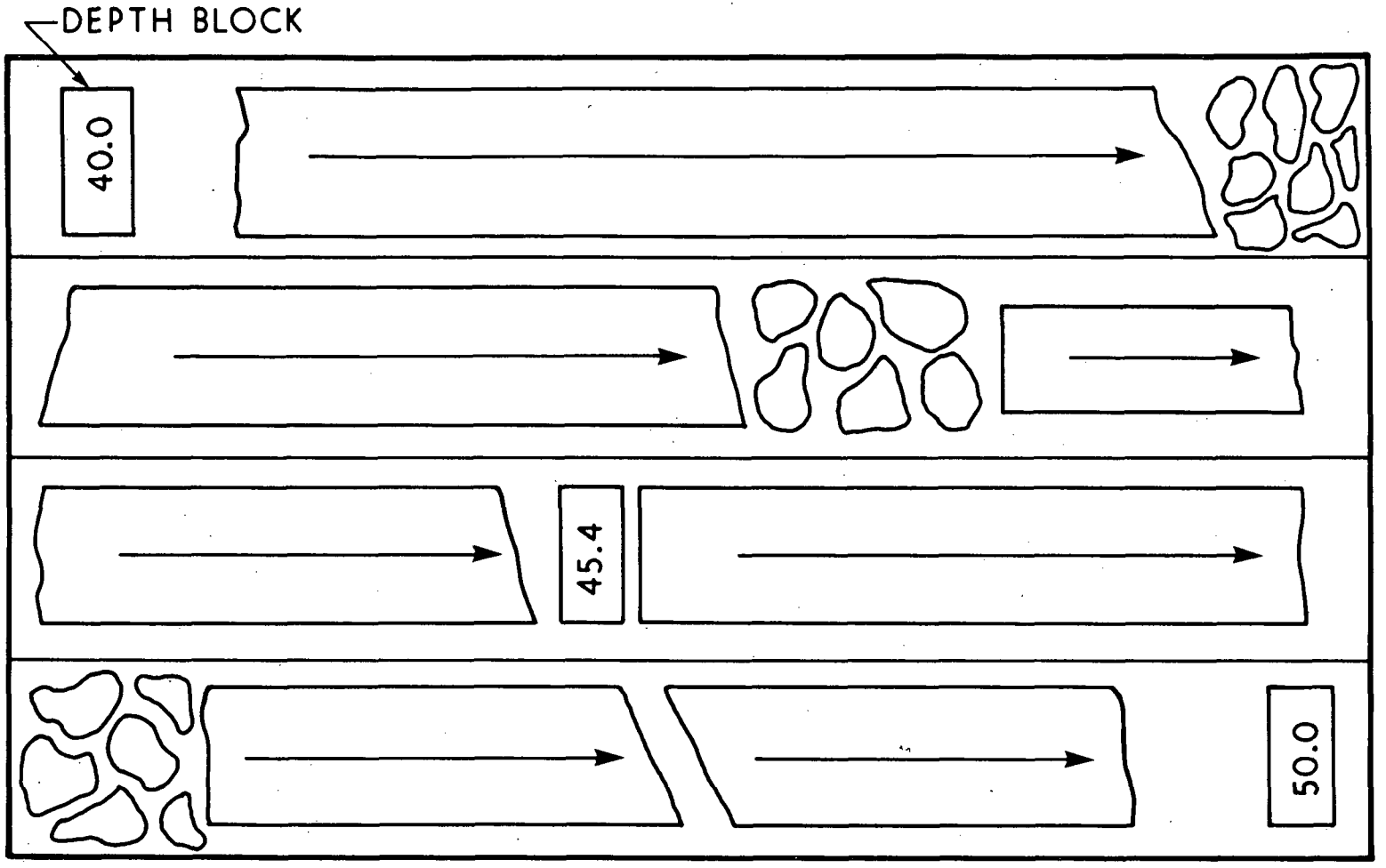

Figure 1. Core box is filled from upper left corner with depth blocks at the end of each run and arrows pointing downhole on core pieces.

VOLCANO MODEL

Research Problems and Objectives

It is evident from available literature and the U. S. Geological Survey's Cascades Geothermal Workshop (Menlo Park, May 22-23) that a concise model of the feeder system of a Cascades stratovolcano is lacking, particularly as structures and lithologies relate to geophysical properties and hydrothermal systems. To formulate a volcano model the distribution and character of dikes, plugs and large intrusions in the volcanic pile and underlying rocks should be determined. The density, magnetic susceptibility, permeability and alteration of these intrusions and the rocks between intrusions should be determined to relate the model to geophysical data and geothermal system models. Also, the mineralization, fluid inclusions and structures should be studied to determine temperature, depth, chemistry and plumbing of associated hydrothermal systems.

Data Collection

A regional study of deeply eroded volcanoes and exposed vents and intrusions in the High Cascades, such as Mount Jefferson, Mount Washington, older volcanic centers around Lassen Peak, and in the Western Cascades will be carried out to develop a general model of volcanic structures at different levels. During field examination the size, distribution, alteration and magnetic susceptibility of intrusions will be studied. The jointing, fracturing, faulting and alteration along these structures will be studied to determine the control they provided for circulating fluids. Samples will be collected for study of alteration minerals, vein minerals, and fluid inclusions to determine temperature, depth and chemistry of thermal fluids.

Data Synthesis and Model Formulation

The data gained from the regional study will be integrated with the drilling program results, published studies of volcanic vent in other areas and the data from studies of Cascades volcanoes to develop a volcano model which will correlate geology with the geophysical characteristics and provide a framework for geothermal systems. The model will attempt to define the typical structure, composition, density, alteration and permeability of a stratovolcano at several levels under the cone. The model will be useful in interpreting data from a specific volcano and formulating a geothermal exploration strategy.