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THE UTILIZATION OF VOLCANO ENERGY.

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~~HELD AT~~

HILO, HAWAII,

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RESEARCH DRILL HOLE AT THE SUMMIT OF KILAUEA VOLCANO, HAWAII

George V. Keller

ABSTRACT

An exploration hole has been drilled to a depth of 1262 m beneath the summit of Kilauea Volcano on the Island of Hawaii in order to obtain information about the potential for the occurrence of geothermal energy in a basalt environment. The hole was started at an elevation of 1102 m, and bottomed at an elevation of -160 m. Short intervals were cored, but the principal information obtained from the hole was in the form of physical measurements. The temperature profile through the hole was complicated, showing several reversals, and reached a maximum value of 137°C at the bottom. Geophysical logs indicate that rocks are fully water saturated to an elevation of about 500 m above sea level, and that the water in the rock has a salinity about equal to or slightly greater than that of sea water. This result supports the pre-drilling hypothesis that there should be a convection cell formed of warm saline water above a shallow magma chamber at Kilauea Volcano.

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Discussion of Keller Paper

Unidentified

What was the frequency of the noise you measured?

Keller

That was the total power in a bandwidth of from 1 to 10 Hertz. It's not the normal way one presents data on seismic noise.

Unidentified

Do you have spectral data on the noise? Frequency data?

Keller

This was a graduate student's study, and he is very careful and factual on the presentation of his data.

Unidentified

All the data are there?

Keller

Yes.

Kennedy

Did you get cuttings from the interval of 1060 to 1610 feet?

Keller

We did get cores. Not a lot of cores, but several from the whole interval. Well, if you want one core for every 200 meters or something like that.

Kennedy

Sure.

Higgins

On the last two slides you showed of the well logs, I notice there seems to be a correlation between washout or caliper size and density that almost looks to be in the inverse ratio. You seem to see high densities associated with washout areas rather than the inverse.

Keller

In detailed interpretation of density logs, one must be careful because this is not the scattered gamma radiation reported directly, but an analog corrected value. There is a trace on the log, which I haven't referred to, which is the magnitude of correction. You get a washout; the correction becomes too large to be made accurately, and you say that...

Higgins

You've anticipated my next question and answered the whole thing. Thank you.

Keller

Well, there's a lot of story to well logging, as you well know, but I think this was done by very competent people.

Kennedy

Can I ask a question on the interpretation of your logs? On this high-resistivity layer--you were saturated with water--did you try to pump this? Did you produce any substantial amount of water? Was water moving into it, or was it very tight?

Keller

That is a very complicated question to answer. We tried to produce water locally with a Schlumberger wire line formation tester. That is a gadget that you jam up against the wall, open a vacuum, and you have all of the hydrostatic pressure to squeeze water out of the rock. We got not one drop of water any place we tried to do this.

Kennedy

How do you interpret this? What does it mean?

Keller

Absolutely no permeability at the locations where we sealed against the formation over intervals of about a foot. There is no intergranular permeability--this is only during the bottom 2000 feet of the section.

Kennedy

What you are really saying is that the rock is really tight--that you are making no water down there.

Keller

We're making no water from short intervals where we could test.

Kennedy

Any sign of chert alteration?

Keller

Yes.

Unidentified

The porosity improves below sea level?

Keller

If you look at the logs in detail, one of the last members we drilled through was a massive flow that was some tens of feet thick, with a low porosity and very high thermal gradient. The porosity in that was only 2 percent, but beneath it, the last few feet of the hole, we were again in high-porosity rock.

Unidentified

What about permeability?

Keller

The permeability, as indicated by departure between the two resistivity logs, was nil. We never had circulation, but we felt we were losing circulation higher in the hole. We have a great deal of information on fracture permeability from the microseismogram logs, which haven't been evaluated yet.

Unidentified

What kind of water did you find in the hole?

Keller

We did not recover any water samples, despite all of our attempts. The determinations of salinity are based on the geophysical logs.

Unidentified

In the temperature profile you have shown, is the bottom temperature stabilized?

Keller

What I have shown you is a continuous temperature profile obtained 32 days after completion of drilling, at which time the temperature seems to have stabilized to within a degree of the final temperature.

Unidentified

Have you repeated these measurements?

Keller

Many times. We have 50 temperature logs as a function time. These wiggles change with time. This doesn't change the same way with time, but the small structure of the temperature profile through the permeable rocks does change every time we run a log.