Extrait du BULLETIN VOLCANOLOGIQUE
Organe de l'ASSOCIATION DE VOLCANOLOGIE
de l'Union géodésique et géophysique internationale
Tome XXVII - 1964

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NAPOLI
STABILIMENTO TIPOGRAFICO FRANCESCO GIANNINI & FIGLI
Via Cisterna dell'Olio
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U. S. Geological Survey, Menlo Park, California

Abstract (1)

A well drilled for geothermal power near Salton Sea in Imperial Valley, Calif., is 5,232 feet deep; it is the deepest well in the world (1962) in a high-temperature hot spring area. In the lower half of the hole temperatures are too high to measure with available equipment, but are at loast 270° C, and may be as much as 370° C. For comparison, maximum temperature heretofore reported at depth (1962) for hot spring areas is 295° C.

The well taps a very saline brine of Na-Ca-K-Cl type (about 185,000 ppm Cl) with exceptionally high potassium, and with the highest content of minor alkali elements known for natural waters; Fe, Mn, Zn, Pb, Cu, Ag, and some other metals are also exceptionally high. This brine may be connate, but present evidence favors a source in the magma chamber at depth that supplied late Quaternary rhyolite domes of the area (2). If the latter is correct, the brine is an undiluted magmatic water that is residual from the separation of a more volatile phase high in CO_2, H_2S, and with some alkali halides. Elsewhere, the hypothesized volatile phase may account for near-surface hot spring activity of most thermal areas of volcanic association. The residual brine of high salinity may ordinarily remain relatively deep in the volcanic systems because of high specific gravity and low content of volatiles, seldom appearing at the surface except in a greatly diluted form.

The hot springs of Arima, Japan, may be a rare example of this type of magmatic water discharging at the surface in moderate concentration (Cl as much as 42,000 ppm). Independent evidence from fluid inclusions in minerals of high-temperature base-metal deposits also favors the existence of magmatic water high in Na, Ca, and Cl, and low in CO_2 and other volatile components.

During a three-month production test several tons of material precipitated in the horizontal discharge pipe from the well. Amorphous silica with iron and manganese, and bornite are the dominant recognized components. This material contains the astonishingly high contents of about 20 percent copper, 2 percent silver, and notable sulfur, arsenic, bismuth, lead, antimony, and some other minor elements. Total quantities of all elements in the original whole brine are not yet known, but calculated amounts corresponding to 1 to 3 ppm of copper

(1) For I.U.G.G.-I.A.V. meeting, Berkeley, California, August, 1963, Symposium on Post-Eruptive Processes in Regions of Active Volcanism.

(2) See note added in proof.

and 0.1 to 0.3 ppm of silver were precipitated from the brine to form the pipe deposits. The brine, therefore, may be man's first sample of an « active » ore solution.

Equally fascinating to many geologists is the possibility that in the lower part of the hole temperatures are so high and pressures are sufficient for young sedimentary rocks to be undergoing transformation into rocks with mineral assemblages of the greenschist facies of metamorphism. Drill cores from 4,400 to 5,000 feet in depth contain chlorite, albite, K-feldspar, epidote, mica, and quartz, with some indication of increase in metamorphic grade downward. Regional geological and geophysical studies favor a depth of about 20,000 feet to pre-Tertiary basement rocks in the general area. A shallow basement or local upfaulting of old metamorphic rocks are not likely possibilities for the thermal area.

Discussion

G. C. FACCA: The Imperial Valley deep well does not have the record of depth, as stated by Mr White. In 1962, Larderello Co. (Italy) drilled a geothermal well 2,850 m deep.

I would ask Mr White for as many details as possible about the lithologic logs of the Salton Sea wells and their economic value and utilization.

D. H. WHITE: Drill cuttings indicate fine-grained clastic sediments with persistent clastic quartz, clay minerals, K-feldspar, plagioclase, calcite and dolomite. In the thermal environment, metamorphic and hydrothermal mineral changes have occurred that will be reported upon in detail at a later date. Economic aspects have not been released for publication.

J. HEALY: Taking into account the suggested magmatic origin of the brine, and the metamorphic features,would the speaker be prepared to suggest a depth for the magmatic body? Could the brine be of mixed origin, perhaps a triple mixture?

D. E. WHITE: The depth of the hypothesized magma body has not yet been determined. The brine can be of mixed origin, with waters and mineral components from two or more sources.

Note added in proof

Later studies are confirming the metamorphic and hydrothermal effects, and the high metal contents of the brine, but do *not* support the hypothesized magmatic origin of the water and most of the dissolved constituents. The very high temperature and heat flow demand a large magma chamber at relatively shallow depth.