STUDY OF A GEOTHERMAL FIELD IN THE ASAL ACTIVE VOLCANIC RIFT ZONE (FRENCH TERRITORY OF AFARS AND ISSAS, EAST AFRICA)

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The Asal rift, located 80 km west of Djibouti, is one of the active "rifts-in-rift" structures of the Afar depression, a transition between the Gulf of Aden and the Red Sea ridges (Fig. 1).

Attention was drawn to this zone because of the presence of a graben structure, and of geochemical particularities of various hot springs. Two wells were drilled on the S-W margin of the rift, at locations chosen mainly from geological considerations. The first hole reached a hot water geothermal reservoir, the second, one kilometer away, was dry.

Both wells found, from top to bottom, a recent basaltic series, then a thick rhyolitic volcanic series, and finally an old tectonic, tilted, basaltic series, where the reservoir is located. The first well was drilled to a depth of 1130 m, where heavy mud losses occurred, while the second well reached 1550 m. An important normal fault appears to separate the two wells.

The first well, which had to be induced into production by air-lift, was used for extensive well testing.

Permeability information was obtained prior to production by injection of cold water. Although the bottom hole pressure was perturbated by thermal effects from mixing within the tubing of injection and reservoir water, analysis could be performed with the semi-log straight line method, and yield a kh value of 2 darcymeters. Buildup and drawdown tests were also performed, but provided unusual pressure responses (Fig. 2). Although the reservoir was expected to be fractured, no fracture effect was apparent on a log-log plot. Pressure at the bottom of the well stabilized rather abruptly within 10 minutes after the beginning of either a buildup or drawdown test, which might indicate the existence of a recharge boundary nearby.

Numerous temperature and pressure logs were run in the well, before and during production (Fig. 3). These indicated initial conditions of 253°C and 77 kg/cm^2 at 1050 m, which was the maximum depth reached with the Kuster recorder. Pressure and temperature logs during production clearly showed the existence of a flashing front within the wellbore.

The well production rate was varied by means of pipes of different diameters at the wellhead. Sampling of the geothermal fluid at the wellhead failed to provide reasonable values of flow rate and enthalpy. These were obtained by comparison with theoretical results from a numerical model provided by M. Nathenson (Fig. 4). Although the flow system at the Asal field seemed to be different from that considered in the model, agreement between measured and computed values was very good. It was concluded that the maximum

production of the well was of the order of 135 t/hr, with 20% steam at the wellhead. This, with a wellhead temperature of 170°C could provide 1 or 2 MW of electric power.

Chemical analyses of the geothermal fluid indicated very high salt content, of the order of 190 g/l, which was also found to increase with production time. This, and other evidences, might indicate the existence of an active convection cell.

interpretation of the various data collected on the field is continuing, and results will be made available in the near future.

Reference

M. Nathenson, "Flashing flow in hot water geothermal wells." Jour. Res. U.S. Geological Survey, Vol. 2, No. 6, Nov-Dec. 1974, p. 743.

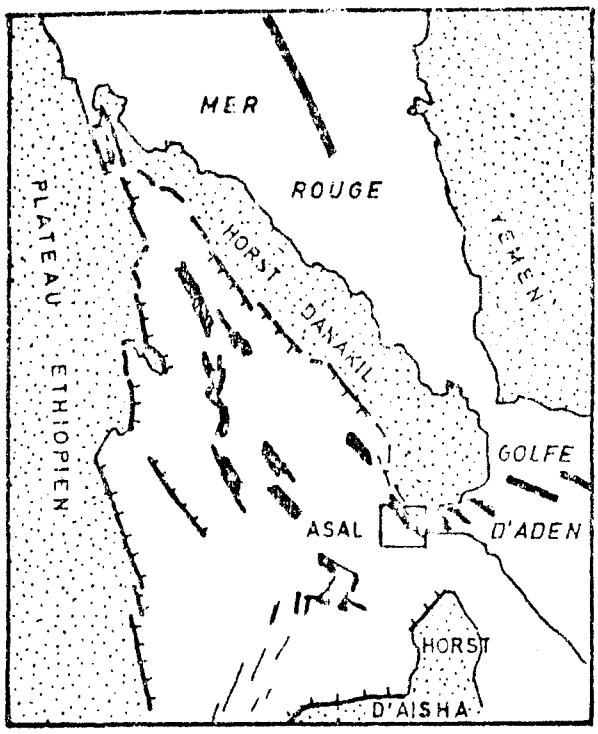

Figure 1

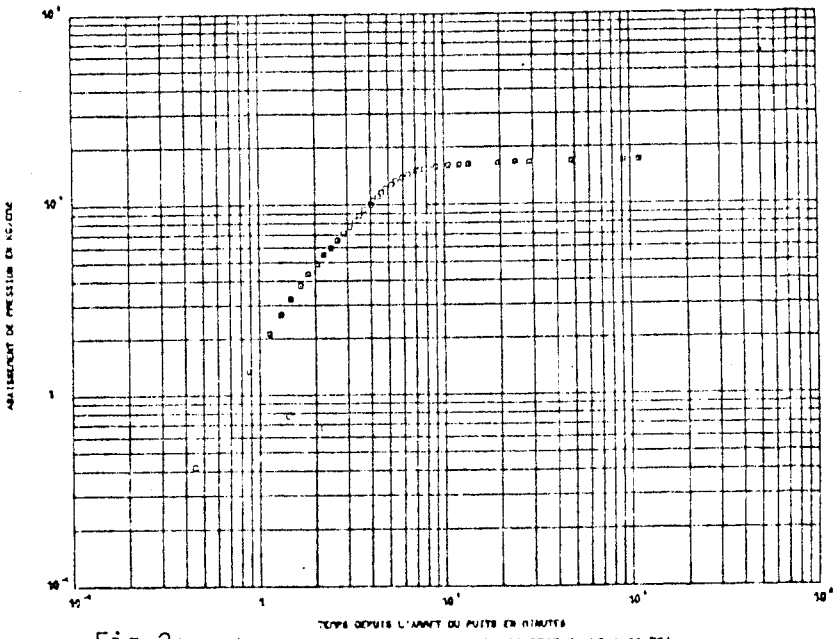

Fig 2: ESSAI DE REMONTEE EN PRESSION SUR ASAL1 (SCATIE 4e LE 1-11-75)

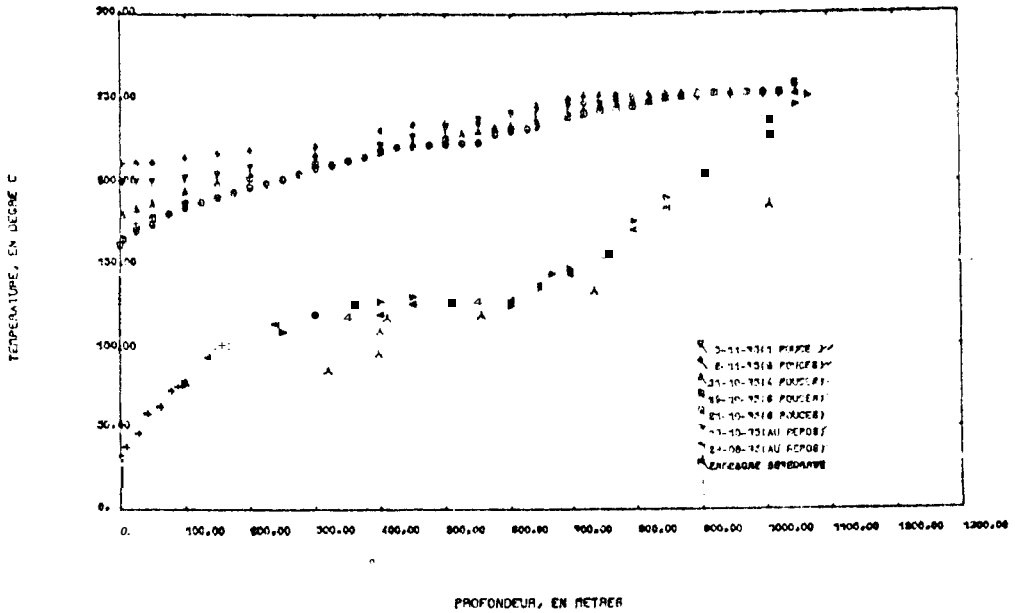

FIGURE 3 : MESURES DE TEMPERATURE DANS ASAL 1

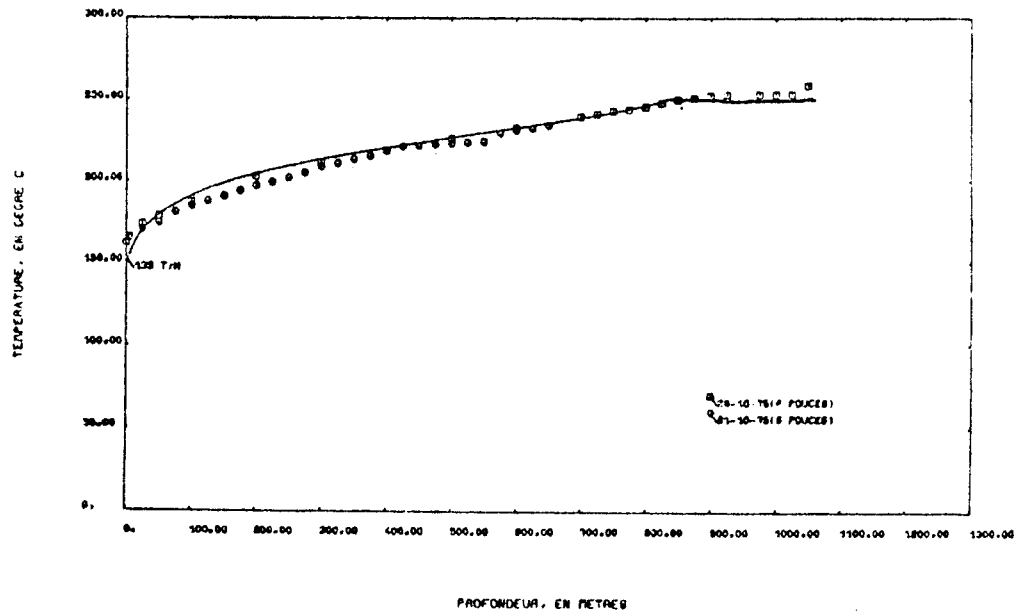

FIGURE 4 : ASAL 1-COMPARAISON ENTRE LES MESURES DANS LE PUITS ET LES PREVISIONS DU PROGRAMME WELL (KH=2 DARCYMETRES, CONDITIONS DE FOND: 250 DEG C ET 86 BARS)