THE POTENTIAL GEOTHERMAL ENERGY OF WARM SPRINGS ON THE ISLAND OF EUBEA, GREECE

CONSTANTIN N. GARAGOUNIS

National Technical University, Department of Mineralogy-Petrography-Geology, 42 October 28th Street, Athens, Greece

Revised MS. received 1 October 1975

Abstract. A description is given of the potential of the thermal mineral springs at Edipsos, Greece.

L’énergie géothermique potentielle des sources chaudes situées sur l’île d’Eubea, en Grèce


It is unnecessary to reiterate the advantages of utilizing geothermal resources: more competent authors have done so. While Greece’s neighbours have realized the possibilities of this new energy supply and are already exploiting it successfully, Greece has only recently started exploring these resources, but the author hopes export of this type of energy will be possible in the future.

As outlined by the Austrian Ronner (1974), youthful Tertiary and Quarternary volcanism is particularly indicative of a prospective heat supply from the subsurface. A survey of Tertiary and Quarternary volcanoes in Greece provides evidence that there should be no lack of geothermal resources in this country.

Lardarelle-Monte Amiata, the rich geothermal fields of Italy, are located in a recent fault zone and similar extensive fault zones are found in Greece (Aubouin and Guernet, 1963; Galanopoulos, 1967). Furthermore, Greece is a classical area of seismic activity, and minor earth quakes have always been considered characteristic of geothermal fields. Thus the whole of Greece, especially the eastern part and the so-called Volcanic Arc of Islands, seems very promising and warrants geothermal exploration. The Volcanic Arc of Islands is tectonically related to an area in Turkey where units for the effective production of geothermal power have already been installed.

The author’s main research has been devoted to the thermal mineral springs in the area to the north of the Gulf of Eubea and the Malic Gulf. In this area, the main source of heat comes from the Pliocene volcano of the islands of the Lichades and its secondary craters near the health resort of Kammena Vourla. There, hot springs rise at six sites containing a mixture of various ratios of sea and karstic groundwater.

Evidence from $^{14}$C determinations indicate that the fresh water component of these springs originates mainly, and at Edipsos almost entirely, from very old karstic waters, with an age in the range of 15-20 000 years, strongly suggesting that this fresh water originates from deep karstic reservoirs which do not have a ready outlet and are normally sealed off.

The term *deep karst* is defined by hydrogeologists as a karstic mass existing at depth or below sea level. This seems to be the case in the research area. Deep karstic waters characteristically show only minor seasonal variations of temperature and outflow with only limited circulation of short-term storage (Apel, 1972). Furthermore, deep karstic water contains very little tritium. According to research by the Federal Research Institute of Hanover,
springs waters in general are relatively poor in tritium. The Edipsos springs contain less than 2.5 T.U., indicating that the mean age of the rain they are derived from is over a century old. In other words, the main fresh water component of the springs in the research area, and especially of Edipsos, most probably originates from a deep karstic water reservoir.

$^{13}$C determinations give evidence of the influence which the volcanoes exercise on spring waters. According to Fricke (1970), freely circulating $\mathrm{CO}_2$ in mineral waters can be classified as a 'classic juvenile component', and all the springs in the area under consideration, including the hot Damaria Spring which has a temperature of $83^\circ\mathrm{C}$, contain such $\mathrm{CO}_2$. There is a strong possibility, however, that no primary genetic connection exists with the volcanic centre, and that instead the carbon dioxide is formed by the influence of heat from the youthful volcanoes upon other media, i.e. the rocks or groundwater (Fricke and Michael, 1970).

According to the present research, other characteristics of these springs, viz. their high temperature, their radon and uranium contents and the presence of hydrogen sulphide, are all likely to be due to the volcanic influence. Unfortunately, it would not be feasible to become involved in a detailed discussion of these factors at this point.

It is the author's opinion that extensive and possibly partially connected karstic water reservoirs exist underneath the northern part of the Gulf of Eubea and its marginal areas, and that they are affected and heated by volcanoes. These reservoirs are sealed from the surface by a Neogene stratum of varying thickness, the most compact part of which may lie between the two fields of the Thermopyles and Koniavitous springs. The same type of stratum was found near Gialtra, on the opposite side of the Eubean Gulf.

Edipsos would appear to be the most favourable location for a trial borehole. There, hot waters are rising along the tectonic faults in the old crystalline Teledrion Mountains. They include the Damaria Spring which has a temperature of $83^\circ\mathrm{C}$ and a marine water content of 25 per cent as indicated by chemical analyses.

Should we succeed in drilling to a depth where thermally heated karstic water occurs and there is no access of colder sea water, it should be possible to tap very high temperatures. An additional factor to be considered is the vastly reduced geothermal gradient in volcanic areas. Recently, a Sinter block, 1-m thick, threatened to block the outlet of the Damaria Spring and had to be removed. Prior to removal, a temperature of $73^\circ\mathrm{C}$ was measured, whereas afterwards it rose to $83^\circ\mathrm{C}$. It is doubtful that the same low geothermal gradient would exist throughout the whole area of Edipsos, but is is believed that it is safe to assume that sufficient hot water would issue, as a result of drilling to a minimum depth of 300 m.

An important advantage of the proposal is that there does not appear to be any risk of exhausting the energy resources found near Edipsos. In parallel cases, American scientists have proposed the artificial recharge of geothermal fields with water. In the case of Edipsos, nature herself seems to have taken care of the exigency: there are very strong indications that a close hydraulic connection is maintained between the karstic body in the Lichas Mountains and the springs of Edipsos. In fact this may well be the case for the entire, extensive geothermal field in the north of Eubea.

To conclude: within the area which was prospected, the outflow of the numerous thermal springs found near the borders of this territory, provides evidence for the existence of a vast geothermal field. In those territories of Greece where no thermal springs are evident but where the existence of youthful volcanoes is a fact, new methods could be employed to detect potential locations for development. These methods were tested last year, on the Island of Lesbos, by geologists and geophysicists of the Technical University of Clausthal-Zellerfeld, and of the Geological Survey of the GFR, Hanover (as per verbal information of Prof. Dr Peter Kromberger, TU Clausthal).

These methods include, firstly thermal infrared scan from the air, which gives topographical heat impressions similar to aerial photographs, and secondly the rapid and reliable measurement of ground temperatures by portable infrared radiometers, which identifies any
heat anomalies in ground temperatures, thus giving evidence of areas suitable for further prospecting.

REFERENCES


Fricke (1970)

Fricke and Michael (1970)

