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Determination of the Geothermal Potential with Soil Gas (Sniffing) in Altınoluk (NW-Turkey)

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ABSTRACT

The importance of geothermal energy is growing due to environmental concerns. Geothermal energy is increasingly being utilized all over the world due to its low emissions, renewability, and low investment cost.

Soil gases have been used as an exploration tool for geothermal energy (Tonami, 1970; Finlayson, 1992; Corozza et al., 1993; Cardellini et al., 2003; Werner and Cardellini, 2006). A soil gas survey has been carried out in Altinoluk, Turkey. ^{222}Rn, CO_2, CH_4, and N_2O, concentrations were determined in 250 samples. The distribution of $\delta^{13}C$ isotope and N_2O gases allows one to distinguish between bacterial and geothermal gases. A first evaluation of the ^{222}Rn ($KbBq/m^3$) and CO_2 concentrations was carried out in an area of tectonic activity, and anomalous emissions of soil gases in the particular points were considered. Further evaluation, which included the isotopic composition of $\delta^{13}C$ in CO_2 and other soil gases, indicated geothermal activity.

Consequently, this case history covers a successful application of the "sniffing" technique to investigate geothermal potential.

1. INTRODUCTION

Surface prospecting is the oldest method used to detect natural resources. Some gases (^{222}Rn, CO_2, CH_4, N_2O) commonly emanate from the subsurface, leading to large scale gas transfer through heterogeneous soils. In these areas, gases escape preferentially either through faults, cracks and fissures or through thermal groundwater systems (Werner and Cardellini, 2006). Recent studies have shown that emissions of gases (especially CO_2) can be very high indeed in active hydrothermal regions. This survey delineates the soil gas levels related to geothermal potential.

The aim of this study is to investigate the geothermal resources with the assistance of geochemistry (sniffing) and field geology. Gas migration along a fault surface could indicate geothermal potential underground. The measurement of the soil gases (CO_2, CH_4, N_2O and ^{222}Rn) could be applied to the assessment of geothermal resources.

For this purpose, gas compositions were measured on site using an infrared analyzer. Gas samples were also collected from the soil surface in gas tight containers for analysis of their isotopic compositions.

2. GEOLOGICAL BACKGROUND

The study area is located to the west of the Edremit in NW Anatolia. The Aegean region is tectonically active during the extensional tectonic regime, and volcanism, which was dominant in the early Miocene, began to attenuate in the Middle Miocene up to now. In this region of the westernmost part of Turkey, geothermal energy resources are prominent. The study area is located near the southern base of the Kazdagları and the north coast of the Edremit Bay. The Basin is positioned above the detachment faults that were responsible for the exposition of a methamorphic massif. Tectonic activity during the Paleozoic and Mesozoic in the Altinoluk region had a major effect on the structural evolution of the basin. Granitic magma, accompanied by calc-alkaline volcanism, reached the surface in the Late Oligocene. The methamorphic rocks were extended in the lower plate of Kazdag detachment. The study area is covered by Quaternary-aged alluvium.

2.1 Methods

Soil gases were measured at 250 locations within a 20 km^2 area of Altinoluk. Measurement distances varied between 30 and 70 m. Soil gas measurements were conducted using an Infrared gas analyzer. The method consisted of a special probe connected to a portable Infrared spectrophotometer, (accuracy ≅%2) that was inserted into the soil to a depth of 80 cm. After 5 minutes of cleaning, the concentrations of gases reached a constant value. The Markus 10 is a portable instrument for determining the radon content in the soil. A pumping time of about 30 seconds was chosen to ensure that all fresh air in the system was pumped out. After the pumping phase, the measuring phase began. Radon gases were measured with the same probe after the gas analyses for each point.

2.2 Conclusions

Several locations of geothermal potential were explored in this region. The closest geothermal field (Gure) was found to be ~3 km to the west and consists of the same geological sequences. Comparison of the concentration of gases and radon measurements with Gure gas concentrations suggested that gas concentrations (including radon) were highest near areas of geothermal activity. Radon and soil gas concentrations were spatially variable across the study area and were generally highest in thermal areas such as Gure that were used for calibrations.

The soil gas (sniffing) survey in the study area confirmed the conclusions of previous studies of geothermal systems, with the important implication that the highest soil gas emissions could be used in undeveloped geothermal systems.

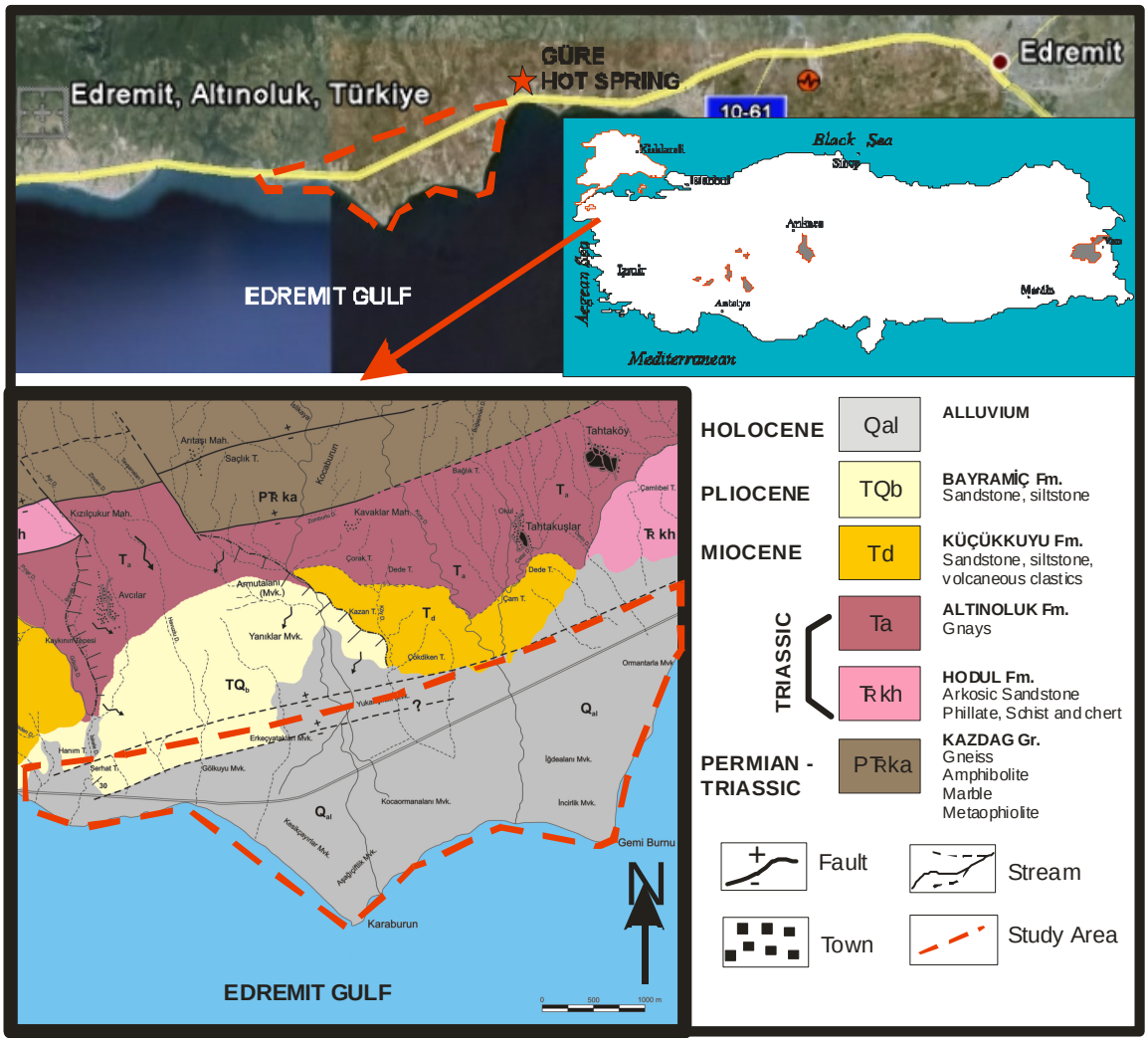

Figure 1: Simplified geological map of the study area and location of measured area

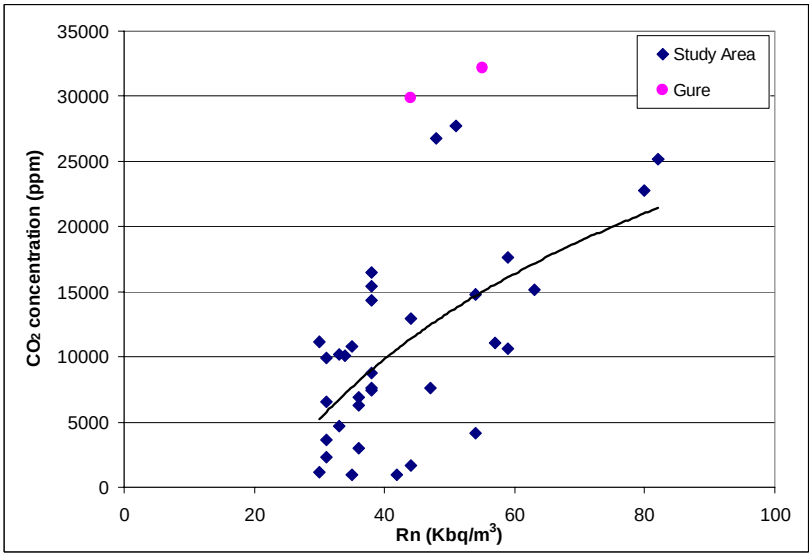

Figure 2: Correlation between measured values of radon and CO_2 concentrations

REFERENCES

Cardellini, C., Chiodini, G, Frondini, F., Granieri, D., Lewicki, J., Peruzzi, L.: Accumulation chamber measurements of methane fluxes: application to volcanic-geothermal areas and landfills, Applied Geochem **18**, (2003), 45-54.

Corozza, E., Magro, G., Cecarelli, A., Pieri, S. and Rossi, U.: Oil gas survey in the gothermal area of Bolsena

Lake (Vulsini Mts., Central Italy), *Geothermics* **22**, (1993), 201-214.

Finlayson, J. B.: A soil gas survey over rotorua geothermal field Rotorua, New Zealand, *Geothermics* **21**, (1992), 181-195.

Tonami, F.: Geochemical methods of exploration for geothermal energy, *Geothermics* **2**, (1970), 492-515.

Werner, C., and Cardellini, C.: Comparison of Carbondioxide Emissions with Fluid Upflow, Chemistry and Geologic Structures at the Rotorua Geothermal system, New Zealand, *Geothermics* **35**, (2006),221-238.