イタリア・エトナ火山の地下水流動系に関する地球化学的・同位体的研究

Geochemical and isotopic study of the groundwater flow system of Mt. Etna volcano (Italy)

 # Carmelo Bellia,[1], 安原 正也[1], 風早 康平[1]

Carmelo Bellia[1], Masaya Yasuhara[1], Kohei Kazahaya[2]

[1] 地調

[1] Geol. Surv. J., [2] Geol. Surv. Japan

This paper describes the early findings of an isotopic and geochemical study undertaken in the Southern and Eastern regions of Mt. Etna volcano (Sicily) in order to define: a) the groundwater flow system; b) the aquifer's recharge areas and; c) the interconnection between aquifers and fluids from subducted origin.

During the first investigation campaign, started in winter 1999, a total of 43 water samples were collected (respectively 21 from bores, 13 f rom springs, 3 from rivers and 6 from mud volcanoes). For each sample in situ readings of pH, electrical conductivity and temperature were taken. Concentrations of major ions, d13C, dD, d18O and bicarbonate content were subsequently determined.

Etnean waters possess a marked bicarbonate alkaline chemistry which reflects the alkaline composition of the volcanic rocks. Along the coast a chlorine-sulphate alkaline composition prevails, probably due to some partial mixing phenomena with seawater. Other distinctive characteristics of these waters are: very high TDS, Mg usually higher than Ca and Na+Mg >Ca+K.

EC between 1000 uS and 2000 uS is most common in the groundwater of the Southernmost flank of Mt Etna. EC between 500 uS and 1000 uS, instead, characterises the Eastern flank with an anomalous peak of 1330 uS at Pozzillo. EC lower than 500 uS is usually found in waters at altitude approximately above 600m a.s.l.

Analysis of dD and d18O indicates that all the waters sampled are of meteoric origin and seems to exclude any interaction with deeper magmatic fluids.

The dD-d18O distribution, relatively at the Southern sector of Mt Etna, is consistent with the line defined by the relation dD =8 d18O +22 for Mediterranean precipitation waters (Gat & Carmi, 1970).

However, this is not true for the Eastern sector, which shows a trend that departs considerably from the mentioned line, suggesting that weights and distribution of the stable isotopes, in the Eastern flank, are ruled by more complex hydrological processes.

Moreover, dD and d18O data indicate that waters become isotopically lighter going from East to West according to the main direction of the wind, which blows, during the raining season, along an East-West axis. They also become lighter with increasing the altitude and with decreasing the distance from the summit.

Two areas characterized by a diffuse degassing of CO2 of magmatic origin, leaking into groundwater, have been identified by analysis of d13C and PCO2: the first and more important, is located in the Southern region of the volcano and stretches from the town of Adrano to the town of Misterbianco and the second, smaller, is located in the Eastern region surrounding the town of Pozzillo.

d13C content varies broadly from the anomalous low -14 per mil proximate the town of Giarre, to the quite high 2.3 per mil recorded at Paterno' in waters nearby the mud volcanoes.

High microbiological activity is thought to be responsible for such a d13C depleted groundwaters.

Three mud volcanoes located around the town of Paterno', discharge CO2 rich gases and Na-Cl brines with EC ranging between 60000 uS and 110000 uS. d13C and PCO2 values are usually very high varying respectively from 0.9 per mil to 5.3 per mil and from 1.3 bars to 2.2 bars. High "positive" stable isotopic ratio (dD ~ -12 per mil and d18O ~ 10.4 per mil seems to indicate a very deep origin of these fluids.