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Chemical and isotopic characterization of rainfall at Stromboli volcano (Aeolian Islands): a necessary step to define hydrological models of circulating fluids and a possible tool for geochemical investigation of volcanic activity

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Stromboli (Aeolian Archipelago) is an open-conduit volcano characterized by frequent explosive activity (every 20-30 minutes). The last effusive activity occurred during 2002-2003. In order to define the geochemical fluids circulation model of Stromboli Island the chemical and isotopic composition of meteoric recharge plays a fundamental role. To reach this aim a rain gauges network (6 sites) was installed on December 2003 and monthly sampled. Deuterium and oxygen isotopic ratios show a large seasonal variability that strongly reflect air temperature. Even though the investigated area is few kilometres wide and the maximum altitude value is 924 m a.s.l., the altitude effect can be appreciated. Also deuterium excess, computed as d = (δD – 8*δ^{18}O), shows a positive correlation with the altitude, suggesting that it can be used as an additional isotopic tool in evaluating the mean recharge altitude of the local aquifer. Coastal sites, not isotopically affected by local features, indicate that the mean weighted deuterium excess values of the area is $\approx$ 14 per mil. This value could be reasonably extended to all the Aeolian Islands. Based on the dissolved ions content (SO_4^{--}, Cl^-, F^-, Na^+, K^+, Ca^{++}, Mg^{++}), at least three different sources could be distinguished: sea aerosol, volcanic gases and pyroclastic products. Coastal sites mainly reflect the expected sea aerosol composition, while summit sites are often changed significantly by volcanic activity. As a result of dissolution of acid gases in the falling drops, the pH values of the rainwater collected in the neighbourhood of the crater, ranging in the interval 3.3-6, are usually two units lower than those of

the distal sites (5.0-7.1). Moreover rainwaters collected at 300 m a.s.l, about 1.5 kilometres far from the craters, show S/Cl, Cl/F and S/F molar ratios compatible with those measured in the plume by diffusive tubes. Taking into account that the rising of new undegassed magma causes a change in the molar ratios, as a consequence of the different solubilities of sulphur, chlorine and fluorine in melts, the chemical composition of precipitation could provide an additional information for the monitoring of the volcanic activity. Finally, where explosions produce relevant amount of ashes, the weathering of pyroclastic products inside the rain gauge, favoured by low pH values, has to be taken into account as a possible source of dissolved ions.