

The Evolution of Geochemical monitoring on active volcanoes: Case Studies from the Aeolian Islands

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The geochemical surveillance of an active volcano aims at recognizing possible signals related to changes of volcanic activity. In fact, as a consequence of magma rising inside the plumbing system and/or refilling of new batches, volatiles dissolved into it are progressively released as a function of their relative solubility. Approaching the surface, these fluids, discharged during magma degassing, may interact with shallow aquifers and/or may be released along the main volcano-tectonic structures.

The first step in the framework of the geochemical investigation of a volcanic system aimed at a surveillance activity is the chemical and isotopic characterization of fluids and for then putting forward a geochemical model; inside of this geochemical model it is possible to interpret the observed changes in any single investigated parameter. The geochemical approach is to identify the following topics:

i) The main End-Members involved in the studied system; ii) Possible type and degree of interaction processes, Water-Rock and Gas-Water; iv) Mixing among the individuate End-Members; v) Chemical and isotopic characterization of a possible hydrothermal system; vi) Formulation of a geochemical model; vii) Choice of sites and useful geochemical parameters able to give us information about changes of volcanic activity. Then, we can start the continuous and discontinuous geochemical monitoring program.

The Aeolian Archipelago (Italy) is characterized by the presence of several active volcanoes with different volcanic activity: a) Vulcano Island with solphataric activity, last eruption occurred in 1888; b) Stromboli Island, with strombolian activity, last eruptions occurred in 2002-2003, 2007 and in 2014; c) Panarea Island, undersea degassing, last massive submarine gas output occurred in November 2002.

The Aeolian active volcanoes represents a real unique and natural laboratory where the geochemical scientists worked for more of twenty years producing a lot of geochemical data. Moreover, advanced geochemical continuous monitoring systems was installed in the active volcanoes (like Vulcano and Stromboli Islands) to measure extensive parameters (Soil CO₂ and Plume SO₂ fluxes) and intensive parameters like High-Temperatures fumaroles and characteristic chemical species ratios (like C/S).

Here, we present a review of acquired geochemical data, interpretative models and installed monitoring networks.