Geophysical Research Abstracts
Vol. 14, EGU2012-9454-1, 2012
EGU General Assembly 2012

Geochemical monitoring network at El Hierro (Canary Islands) before and during 2011 submarine eruption

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Since 17 July 2011 an important increase in the number of seismic events located in El Hierro (Canary Islands, Spain) was detected by the seismic network of the Instituto Geográfico Nacional (I.G.N.). This increment was interpreted as a precursory signal of a potential eruption, which in fact took place three months later (10th October 2011). In order to improve and complete the volcano monitoring network several geochemical parameters were measured since the beginning of the anomalous seismic activity.

Measurements of CO_2 diffuse flux through the soil were carried out in the major part of the island: the central zone, El Golfo (northern area) and the zone delimitated by the western rift. More than 450 measurements were accomplished during July, August, and September 2011. Analysis of the data revealed the existence of a spatial anomaly with relative high CO_2 diffuse flux in the southwest part of the El Golfo area, close to the zone where the anomalous seismicity was located. This abnormal flux, almost aligned with the western limit of the seismic swarm, was not detected again in measurements accomplished on September in the same area.

Between July and August, four geochemical stations were installed in three sub-horizontal galleries and in one well. Air and soil temperature were measured in all galleries and air 222Rn concentration was determined in the four stations. Two of the galleries were also equipped with a sensor in order to obtain measurements of CO_2 concentration in the air. The sampling period for each parameter was established in ten minutes. Anomalous high 222Rn concentrations were detected in the station located in the well, apparently related to increases in the seismic accumulated energy and the GPS deformation rates.

Taking into account the location of the earthquake epicentres and in order to study the evolution over the time of some physicochemical parameters of groundwater, four wells in the El Golfo area were regularly sampled since July 2011. Temperature, pH, electric conductivity and total dissolved solids were periodically measured. Water samples were also collected in order to determine major and trace elements. In situ measurements did not show any significant changes that could be related directly to the volcanic-seismic activity. However, the highest water temperature and the lowest pH value were obtained in the well located closer to the zone where the maximum values of CO_2 diffuse flux were detected.

Water samples were also taken on the stain generated by the submarine eruption and the nearby area since the beginning of the eruptive process. Chemical analysis revealed that seawater directly affected by the volcanic emissions, experimented an important increase in the concentration of several heavy metals.