Sismo-vulcanic crises at Fogo volcano, São Miguel (Azores, Portugal): volcanic lakes monitoring

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Azores archipelago is located in the north Atlantic Ocean between the latitudes of 37°N to 40°N and the longitudes of 25°W to 31°W. The islands of the Azores archipelago represent the emerged portion of the Azores plateau, which is defined by the 2000 meters bathymetry line. This area is located nearby the triple junction between the American, the Eurasian Plate and the African Plates, according to a complex geodynamic setting. The archipelago is made by nine volcanic islands, which are divided in three geographical groups. The island of São Miguel, where an important seismic-volcanic activity occurs is located in the eastern group. This island has an area of 746.5 km^2, and has about 54The geology of São Miguel is dominated by three active trachytic volcanic centres, namely the Sete Cidades, Fogo (Água de Pau) and Furnas central volcanoes. In the areas between these central volcanoes, monogenetic eruptions have occurred typically forming cinder cones. The central volcano of Água do Pau is a polygenetic edifice, composed by pyroclastic deposits and intercalated lavas flows. The so-called Fogo lake is located in the bottom of the summit caldera, and presents a surface area of 5.06 km^2 and a maximum depth of 26 m. The Congro lake is located about 4.9 km toward east from Fogo lake and is emplaced in the interior of a maar (s.l) On the onset of seismo-volcanic crisis, in the end of 2002, an increment of the seismic activity with the present of seismic swarms has occurred in the central part of São Miguel island. Between May and October of 2005 it was registered an increase of the energy released. In the 20th and 21th of September 2005, events with magnitudes of 3.9 and 4.3 respectively were registered and in the residential areas, in the vicinity of the epicentral zone, the seismic activity attained am intensity of VI/VII in the Modificate Mercalli scale. The area with a higher concentration of epicentres corresponds to the volcanic Complex of Fogo-Congro. In order to integrate the monitoring network developed by the Centre of Volcanology and Evaluation of

Risk Assessment, 4 lakes were selected (Sete Cidades lake, Fogo lake, Congro lake and Furnas lake). Several geochemical profiles were made in these lakes, to characterise water composition along the water column and to evaluate the possibility of volcanic contamination. The sampling campaigns were more focused on the Fogo and Congro lakes because these two lakes were inside the epicentral seismic area. Water samples mainly belong to the Na-Cl to Na-HCO$_3$ types and can be classified as fresh waters, due to the low mineralization. The pH presents a large range of values, and generally decreases with depth. Waters are characterized by low total CO$_2$ contents and presents an higher concentration in depth, namely in the summer period, when density stratification occurs. The water samples from Congro lake present a slight concentration increase, of same species, when compared with the water chemistry of Fogo lake. Along the seismo-volcanic crisis period, the analysed parameters shown a similar behaviour along the water column, for the period of summer and winter, with the exception of the free and total CO$_2$, electrical conductivity and bicarbonate. This variation, namely for the CO$_2$, suggests that the seismic activity triggers the degasification of the gas trapped in the sediments of the Fogo lake bottom. This phenomenon has actually occurred in the Congro lake in the 20th September 2005. However, significative changes in the analysed parameters, namely CO$_2$, sulphate and chloride, are not observable. Therefore, the possible release of magmatic volatiles associated with the onset of the crisis has not affected water composition on these lakes.