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Physico-chemical changes of the ground waters related to the 2011 El Hierro magmatic reactivation

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The island of El Hierro (278 Km2), is the smallest, the southwesternmost and the youngest island ([U+F07E] 1.12 My) of the Canarian archipelago. The main geological characteristics of El Hierro consist on the presence of three convergent ridges of volcanic cones on a truncated trihedron shape and giant landslides between the three rift zones, being the most recent El Golfo on the northwest flank of the island. On July 2011 an anomalous seismic activity at Hierro Island started and suggested the initial stage of a volcanic unrest in the volcanic system. On October 10, after the occurrence of more than 10,000 earthquakes, a submarine eruption started. Evidences of this submarine volcanic eruption were visible on the sea surface to the south of La Restinga village, at the south of the island, in the form of large light-green coloured area, turbulent gas emission and the appearance of steamy volcanic fragments three days later.

As part of its volcanic surveillance activities, the Instituto Volcanologico de Canarias (INVOLCAN) started a hydrogeochemical monitoring program on August 2011 in order to evaluate the temporal evolution of several physico-chemical parameters of the ground water system of El Hierro. Four observation sites were selected: three wells on the north of the island, where the seismic activity was located at the beginning of the volcano-seismic unrest (SIMO, FRON and PADO) and one horizontal well (gallery) in the south (TACO). Ground water sampling is being regularly collected, three times per week, at each observation site, and in-situ measurements of pH, conductivity and temperature measurements are performed. After 6 month of monitoring, no significant changes have been observed on pH and temperature measurements from all the observation sites. However, clear sharp decrease of conductivity was observed at SIMO on October 10 when the seismic tremor started. In addition, the strongest conductivity decrease pattern was observed later on at SIMO and PADO on November 4; one week earlier of the largest seismic event registered during this volcanic crisis on November 11 (M = 4.6). This observed physico-chemical changes in the ground water system might be explained as a result of the changes on the strain/stress field due to the seismic activity enhancing mixing of water bodies with different conductivities.