



Dissolved gas geochemical signatures of the ground waters related to the 2011 El Hierro magmatic reactivation

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El Hierro Island is the south westernmost and the youngest island of the Canary archipelago (<1.2 My). Since 16 July, an anomalous seismicity at El Hierro Island was recorded by IGN seismic network. After the occurrence of more than 10,000 seismic events, volcanic tremor was recorded since 05:15 on October 10, by all of the seismic stations on the island, with highest amplitudes recorded in the southernmost station. During the afternoon of 12 October a large light-green coloured area was observed in the sea to the south of La Restinga village (at the southernmost part of El Hierro island), suggesting the existence of a submarine eruption. Since October 12, frequent episodes of, turbulent gas emission and foaming, and the appearance of steamy lava fragments has been observed on the sea surface. Instituto Volcanológico de Canarias (INVOLCAN) started a hydrogeochemical program on August 2011 in order to evaluate the temporal evolution of dissolved gases on four different observation points (vertical and horizontal wells) of El Hierro. Three wells are located on the north of the island (where the seismic activity occurred at the beginning of the volcano-seismic unrest) and one horizontal well (gallery) in the south. At each observation point the concentration of dissolved helium, CO₂, N₂, O₂ and Ar and the isotopic composition of He, C-CO₂ and Ar have been measured three times per week. Significant increases on the dissolved gases content, mainly on CO₂ and He/CO₂ ratio, have been measured at all the observation points prior to the increasing of released seismic energy. Isotopic composition of dissolved helium, measured as 3He/4He ratio, showed an significant increase (from 1-3 RA up to 7.2 RA, being RA the isotopic 3He/4He ratio on air) at all the observation points 20 days before the occurrence of the submarine eruption and these relatively high 3He/4He values have been maintained along the volcanic unrest period. The isotopic composition of CO₂ has showed also significant changes in relation to the release of seismic energy. The results observed on this dissolved gases study have been tremendously beneficial on the volcanic surveillance tools to study and forecast the evolution of the seismic-volcanic crisis.