



## **Forecasting the 2011 El Hierro submarine eruption (Canary Islands) on the basis of soil He degassing surveys**

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El Hierro Island is the southwesternmost and the youngest island of the Canary archipelago. 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 of the 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.

As part of the volcanic surveillance of the island, the Instituto Volcanológico de Canarias (INVOLCAN) geochemical monitoring program is carrying out diffuse helium surveys on the surface environment of El Hierro (soil atmosphere). This noble gas has been investigated because it has been considered an almost ideal geochemical indicator because it is chemically inert, physically stable, nonbiogenic, sparingly soluble in water under ambient conditions and almost non-adsorbable. At each survey, 600 sampling sites covering the whole island and following an homogeneous distribution are selected for helium measurements in the soil gases. The helium concentration gradients with respect to its value on air (5.24 ppm) allow us to estimate a pure diffusive emission rate of helium throughout the island. The first survey was carried out on the summer of 2003, when the island was on a quiescence period. At this survey, the amount of helium released by the volcanic system of El Hierro was estimated in 6 kg/d. Since the beginning of the seismic unrest, 13 helium emission surveys have been carried out. The helium emission rate has shown an excellent agreement with the evolution of the volcanic crisis of the island, reaching 30 kg/d on November 6, several days before the occurrence of the submarine eruption. A significant decrease to 13 kg/d was estimated almost 10 days after the beginning of the eruption, followed by a sudden increase to 38 kg/d several days before the largest seismic event of the volcanic crisis ( $M = 4.6$ ) occurred on November 11. The results of the soil helium surveys performed at El Hierro Island prior and during a volcanic unrest period suggest that the emission of this noble gas is strongly controlled by the volcanic activity and its presence on the surface environment responds to the changes on the gas pressure at depth produced by the ascent of magma bodies.