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Magma ascent and eruption forecasting at Deception Island volcano (Antarctica) evidenced by δD and δ18O variations

Antonio M. Álvarez-Valero[1,2], Meritxell Aulinas[3], Adelina Geyer[4], Guillem Gisbert[5], Gabor Kereszturi[6], **Elena Núñez-Guerrero**[2], Antonio Polo-Sánchez[1], and Hirochika Sumino[7]

[1]Department of Geology, University of Salamanca, Spain (aav@usal.es)
[2]Laboratory of Stable Isotopes (NUCLEUS) - University of Salamanca, Spain
[3]Departament de Mineralogia, Petrologia i Geologia Aplicada. University of Barcelona, Marti Franques s/n, 08028 Barcelona, Spain
[4]Institute of Earth Sciences Jaume Almera, ICTJA, CSIC, Lluis Sole i Sabaris s/n, 08028 Barcelona, Spain
[5]Institute of Geosciences, IGEO, CSIC, Madrid, Spain
[6]Massey University, New Zealand
[7]Department of Basic Sciences, University of Tokyo, Japan

Geochemistry of volatiles in active volcanoes provides insights into the magmatic processes and evolution at depth, such as magma evolution and degassing, which can be implemented into volcanic hazards assessment. Deception Island is one of the most active volcanoes in Antarctica, with more than twenty explosive eruptions documented over the past two centuries. Hydrogen and oxygen isotopic variations in the volatiles trapped in the Deception Island rocks (glass and melt inclusions in phenocrysts) provide essential information on the mechanisms controlling the eruptive history in this volcanic suite. Thus, understanding the petrological and related isotopic variations in the island, has the potential to foresee the possible occurrence and its main eruptive features of a future eruption.

Information from hydrogen and oxygen stable isotopes combined with detailed petrologic data reveal in Deception Island (i) fast ascent and quenching of most magmas, preserving pre-eruptive magmatic signal of water contents and isotopic ratios, with local modification by rehydration due to glass exposition to seawater, meteoric and fumarolic waters; (ii) a plumbing system(s) currently dominated by closed-system degassing leading to explosive eruptions; (iii) control on the interactions of ascending magmas with the surface waters producing hydrovolcanic activity throughout the two main fault systems in Deception Island. These results can be considered in further studies of volcanic monitoring to improve the capability to interpret geophysical data and signals recorded during volcanic unrest episodes, and hence, forecast volcanic eruptions and related hazards.

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