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Trace Element and H-O-Sr Isotope Compositions in Basal Complex Rocks of La Gomera, Canary Islands: from Magmatic Processes to Meteoric Water Interactions

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Intrusive rocks (Basal Complexes) underlying the subaerial volcanic edifices are known from several islands of the Canary archipelago. These intrusive rocks can provide information on the early stages of island formation. Combined trace-element and isotope studies constrain the origin and evolution of these plutonic complexes, as already demonstrated by work from Fuerteventura and La Palma (Demény et al., 2004; 2008). These studies have not only detected primary, plume-related magmatic components interpreted to originate from subducted ocean crust, but H- and O-isotope compositions have also evidenced high-temperature interaction with meteoric water. Modelling the H- and O-isotope compositions of the infiltrating water, paleoelevations above 3,000 m above sea level have been inferred for Fuerteventura and La Palma (Demény et al., 2008; Javoy et al., 1986) whose present-day heights are much lower.

This paper presents major- and trace-element data of bulk rocks, H- and O-isotope compositions as well as Sr isotope ratios of amphiboles and biotites from the Basal Complex of La Gomera. The study was initiated to determine primary compositions and compare the evidence with that in the Basal Complex of La Palma. Initial results, however, suggested significant isotope exchange with meteoric water that could be used to infer the elevation of water infiltration. The data suggest a close genetic relationship of the La Gomera Basal Complex with the composition and magmatic evolution observed in La Palma, as similar starting compositions and fractional crystallization influences were detected. The H and O isotopic compositions are intermediate between primary-plume compositions inferred for Fuerteventura and La Palma and secondary compositions produced by water/rock interaction. Sr-isotope data record primary mantle compositions different from those observed for La Palma, excluding the possibility of seawater infiltration as a cause of alteration. The calculated isotopic compositions of the interacting fluids indicate a meteoric water origin, whose infiltration may have occurred at about 1500 m above sea level. The correlation between isotope data and stages of magmatic evolution stages indicates that meteoric waters interacted with the magma probably during crystallization and solidification. The paleoelevation estimate is in good agreement with that assumed by earlier volcanological studies and has a twofold significance: 1) even islands lower than 2,500 m a.s.l. may collapse by giant landslides, while others higher than 3,000 m may be in serious risk of collapse in the geological future; 2) during the emplacement of the plutonic series meteoric water was entering the magma system, hence a subaerial volcano must have existed at the time of emplacement of the Basal Complex. This observation indicates that the plutonic basal rocks rather belong to the early subaerial stages than the submarine phase as was thought in earlier studies.

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