Geophysical Research Abstracts,
Vol. 11, EGU2009-653, 2009
EGU General Assembly 2009
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Fluid-rock interaction in the Miocene Tejeda intrusive complex, Gran Canaria, Canary Islands

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The intra-caldera volcaniclastic deposits of the Miocene Tejeda caldera on Gran Canaria host a ∼12 km diameter intrusive complex, comprising ∼500 peralkaline trachytic to phonolitic cone sheets, surrounding a central core of hypabyssal syenite stocks. Both intrusive rock types display textural and mineralogical features indicative of secondary fluid-rock interaction, including (i) deuteric mineral phases (e.g. aegirine, riebeckite, analcime), (ii) exsolved alkali feldspar and Fe-Ti oxide phenocrysts, (iii) pervasive phyllosilicate and zeolite replacement, and (iv) dendritic Mn-oxide coatings, suggesting the intrusive complex sustained an active hydrothermal system during emplacement, cooling, and after solidification. Altered cone sheets have δ^{18}O values ranging from 0.1 to 10.0 per mil (n = 22), and δD values between –62 to –149 per mil (n = 28). Altered syenites have δ^{18}O values of 0.9, 1.5, and 2.5 per mil, and corresponding δD values of –91, –99, and –121 per mil. The majority of samples are depleted in ^{18}O relative to the typical δ^{18}O-range for unaltered trachytes and syenites (δ^{18}O = 6-8 per mil), indicative of interaction with low-δ^{18}O fluids at high temperature. A positive correlation between δD and δ^{18}O, which parallels the global meteoric water line, suggests local meteoric water was the dominant hydrothermal fluid source. No systematic variation in δ^{18}O or δD was detected across the cone sheet swarm, reflecting overprinting of isotopic compositions during successive intrusive events. However, the highest δ^{18}O values (8.2-10.0 per mil) occur in clay- and zeolite-rich cone sheets from the central part of the intrusive complex, suggesting overall inward-cooling or 'shrinking' of the hydrothermal system. By combining mineralogical and isotopic data, two phases of alteration can be distinguished in the Tejeda Intrusive Complex: (i) high-temperature (∼300-500˚C) deuteric alteration by late-magmatic, alkali-rich fluids, and (ii) lower temperature (<300˚C) retrograde alteration related to the influx of low-δ^{18}O and low-δD meteoric waters, facilitated by the relatively permeable nature of the surrounding volcanic deposits. The large variation in δD values in the cone sheets may reflect a progressive increase in the recharge altitude of local meteoric water related to resurgent doming within the Tejeda caldera, and/or the presence of a topographic high (perhaps a volcanic edifice) above the intrusive complex.