

Petrogenesis of recent trachytic eruptions from Sete Cidades volcano, São Miguel, Azores (Portugal)

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Sete Cidades has produced 12 intracaldera, trachytic eruptions (Sete A-L) within the last ~4-5 ka [1,2]. We have completed detailed petrographic, major and trace element, Sr, Nd and Pb isotope and U-series disequilibria studies of whole rock samples from the Sete A-L deposits to constrain petrogenetic processes, eruptive ages and repose intervals associated with the Sete Cidades magmatic system [3]. Major and trace element analyses were performed on a suite of 16 samples representing all of the deposits from Sete A-L. The data show limited major element variation (~63% SiO₂) but highly variable trace element abundances (e.g. >1.6-fold variations in Zr and ~4-fold variations in Sr). Trace element abundances show a complex relationship with stratigraphy that we interpret to reflect a 3-stage evolutionary process. Stage 1 (Sete A-B), characterized by an increase in Zr concentration with stratigraphic height, reflects evolution of a trachytic magma via 35% fractionation of the observed mineral assemblage including sanidine>biotite>clinopyroxene>Fe-Ti oxides>apatite. Stage 2 (Sete B-F) is characterized by decreasing Zr concentrations with stratigraphic height, suggesting injection of a less evolved trachytic magma into the Sete Cidades magma chamber. Stage 3 (Sete F-L) is recorded by an increase in Zr with stratigraphic height, and is consistent with 54% crystallization of the observed mineral assemblage. Sr isotopic variation in leached whole rock samples (⁸⁷Sr/⁸⁶Sr=0.70375-0.70439) further requires assimilation of hydrothermally altered syenite wall-rock [4,5]. Nd and Pb isotopic compositions are essentially invariant (¹⁴³Nd/¹⁴⁴Nd=0.51287; ²⁰⁶Pb/²⁰⁴Pb=19.52-19.56) and within the range of local basalts, consistent with trachytic magma evolution from parental basalts derived from a single mantle source over the past ~4-5 ka. Six samples have also been analyzed for U-series disequilibria, and all are Th-enriched and Ra-depleted. With one exception, ²³⁸U/²³²Th and ²³⁰Th/²³²Th activity ratios are constant with (²³⁸U/²³²Th)≈0.88 and (²³⁰Th/²³²Th)≈0.96, similar to basalts from the Sete Cidades region, and consistent with the trachytes deriving from parental basalts that evolved rapidly (within ~10 ka) to produce the Sete A-L trachytic magmas. Present-day ²²⁶Ra/²³⁰Th activity ratios range from 0.32-0.75, consistent with recent and extensive sanidine fractionation during trachyte magma evolution, and further allowing constraints on the maximum eruptive ages. Preliminary data indicate a maximum eruptive age of 912 years B.P. for Sete B, which suggests that the recent recurrence interval of Sete Cidades may be only ~42 years, much shorter than the recurrence intervals of 200 and 1200 years at neighboring Furnas and Fogo volcanoes [6].

[1] Booth et al. (1978) *Roy. Soc. Lon.* **288**, 271-319. [2] Queiroz (1997) *Universidade dos Açores* **226p**. [3] Conte et al. (2010) *Geochim. Cosmochim. Ac.* **74**, A188. [4] Snyder et al. (2007) *Chem. Geo* **239**, 138-155. [5] Snyder et al. (2004) *J. Petrol.* **45**, 723-738. [6] Rowland-Smith (2007) *Miami University*.

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