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

E. CONTE[1], E. WIDOM*[1], Z. FRANCA[2]

[1] Department of Geology & Environmental Earth Science, Miami University, Oxford OH 45056, USA; conteer@miamioh.edu, widome@miamioh.edu

(*presenting author)

[2] Geosciences Department, Azores University, Sao Miguel, 9501- 801, Portugal; zfranca@uac.pt

The recently revised stratigraphy of Sete Cidades volcano, São Miguel, Azores records 17 young trachytic eruptions (Pepom 1-17; Queiroz, 1997). Previous ^{14}C studies have constrained eruptions P2-P17 to be younger than 5,000 years (Booth et al., 1978; Moore and Rubin, 1991). 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 P1-P17 deposits in addition to ^{14}C analysis of paleosols from within the eruptive sequence, to constrain petrogenetic processes, eruptive ages and repose intervals associated with the Sete Cidades magmatic system (Conte et al., 2010, 2012). Major and trace element analyses show limited major element variation (~63% SiO_2) 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 6-stage evolutionary process. Stages 1, 3 and 5 (P1-P5, P6-P8, P10-P13) are characterized by decreasing Zr with stratigraphic height, which we attribute to injection of a less evolved trachytic magma into the Sete Cidades magma chamber. Stages 2, 4 and 6 (P5-P6, P9-P10, P13-P17) are characterized by an increase in Zr concentration with stratigraphic height, and reflect evolution of trachytic magma via 29-56% fractionation of the observed mineral assemblage including sanidine>biotite> hornblende>Fe-Ti oxide>apatite. Sr isotopic variation in leached whole rock samples ($^{87}Sr/^{86}Sr$= 0.70375-0.70439) further requires minor assimilation of hydrothermally altered syenite wall-rock (Snyder et al., 2004, 2007). Nd and Pb isotopic compositions are essentially invariant ($^{143}Nd/^{144}Nd$=0.51287; $^{206}Pb/^{204}Pb$=19.52-19.56) and within the range of local basalts, consistent with trachytic magma evolution from parental basalts derived from a common

mantle source. Six samples have also been analyzed for U-series disequilibria. Present-day $^{226}Ra/^{230}Th$ 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. Previously determined ^{14}C ages for P2, P14 and P17 are 3.6 ka, 1.86 ka and 500 years, respectively (Booth et al., 1978; Queiroz, 1997). New ^{14}C age constraints from paleosols beneath P1 indicates a maximum eruptive age of 6,360±85 years B.P., suggesting that the recent trachytic activity of Sete Cidades may have begun earlier than previously thought. In contrast, our ^{226}Ra data indicate a maximum eruptive age for P14 of only 882 years B.P., significantly younger than the 1.9 ka ^{14}C age. Paleosols sampled from below the most recent eruptive deposit (P17) indicate it is only 420±45 years B.P., also slightly younger than previously thought. Together, the new ^{14}C ages of the paleosols found below P1 and P17 suggest an average recurrence interval of ~350 years for Sete Cidades, although a recent recurrence interval of only ~220 years is calculated for P14 to P17. This recurrence interval is comparable to that of the neighboring Furnas volcanoes (~200 years), but substantially shorter than that of nearby Fogo volcano (1,200 years), and should be considered in any future volcanic hazard planning.