CONTROL ID: 1456301

TITLE: Role of crystallizational differention in the origin of island-arc andesitic melts: evidence from data on melt inclusions and oxygen isotopes

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ABSTRACT BODY: Several recent studies of melt inclusions in island-arc rocks revealed a strong bimodality of the melt compositions at the predominance of basic and silicic melts and the scarcity of intermediate melts with SiO2=59-66 wt% (e.g. [1]). These observations were used to interpret the origin of island-arc andesites by magma mingling, crustal assimilation and crystal accumulation rather than by fractional crystallization of basaltic magmas.
In this work we addressed the question about the scarcity of andesitic melts in island-arc setting by systematic study of bulk compositions, melt inclusions and oxygen isotopes in minerals from Avachinskiy volcano in Kamchatka. We studied ~500 melt inclusions in 6 different mineral phases (Ol, Cpx, Opx, Pl, Amph, Mt), and concentrated on rapidly-quenched tephra samples from 40 Holocene eruptions of andesites and basaltic andesites. The melt inclusions span a large range of compositions from basalts to rhyolites. In comparison with host bulk tephra samples, melt inclusions tend to have more silicic compositions (up to 10 wt% of SiO2), and this disparity tend to increase with increasing SiO2 content in the host rocks. Both melt inclusion and host rock compositions form trends along the line dividing low- and middle-K island-arc series, and variations of major elements are continuous, without apparent bimodality, which is observed in data set from [1]. The MI statistical distribution is rather three-modal with maxima at ~56-58, ~66 and 74 wt% of SiO2. Much of the major element variability in MI can be explained by fractional crystallization from parental basaltic melts using numerical modeling of crystallization path. Magnetite crystallization starts at ~58 wt% of SiO2 and affects significantly on the evolutional path of melts. Abundant crystallization of magnetite lead to formation of more silica rich coexistent melts and change of crystallizing assemblage occurred at ~60 wt% of SiO2, when Opx replaced Ol, and Amph and Ap become stable. Paragenesis of OPx, CPx, Amph, Pl, Mt, Ilm and Ap dominated the following evolution of melts toward strongly acid compositions with 78-80 wt% SiO2.
Individual Pl and Amph crystals are in magmatic isotopic equilibrium, have heavy δ18O values increasing from 6.3 ‰ in basaltic andesites to 7.1 ‰ in andesites, suggesting that magmatic evolution started from primary high-d18O basalt likely related to the abundant high-d18O sources described for Kamchatkan primitive magmas. The oxygen isotopic data support the conclusion that island-arc

crystallization of high-d18O.
The new data on composition of melt inclusions allowed us to reconstruct the entire spectrum of parental melts for Avacha volcano. Melt inclusions in different minerals form coherent trends of major elements, which can be well explained by fractional crystallization. Unlike some other island-arc volcanoes, Avachinskiy melts do not display clear bimodality of SiO2 content. Melts of intermediate compositions are relatively abundant and found in minerals from basaltic andesites. [1] Reuby & Blundy (2009) Nature, 461(7268), 1269-1273.

KEYWORDS: [1038] GEOCHEMISTRY / Mantle processes, [1041] GEOCHEMISTRY / Stable isotope geochemistry.

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