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Chemical evolution of Avachinskiy volcano (Kamchatka) during the Holocene

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Avachinsky volcano is one of the most active volcanoes in the volcanic front of Kamchatka, located near Petropavlovsk-Kamchatsky. Previous studies recognized two distinct phases in the Holocene eruptive history of Avachinsky volcano: 1) early phase of rare and voluminous andesitic eruptions (7.25-3.5 ky BP) and 2) later phase of frequent eruptions of basaltic andesites associated with the construction of the Young Cone (3.5 ky BP to present) (Braitseva et al., 1998). The change in the eruptive style was marked by the initial eruption of the Young Cone $\sim$3.5 ky BP, which produced $\geq$3.6 km^3 of basaltic andesite tephra (Bazanova et al., 2003, 2004). In order to assess the chemical changes of Avachinsky magma associated with the sharp change in its eruptive style, we have studied a representative collection of samples from the ^{14}C-dated summary tephra sequence covering the entire history of the volcano. Here we report the pilot results of this study, obtained by microprobe investigation of matrix glasses and melt inclusions in minerals.

Both matrix glasses and melt inclusions in minerals span a large range of compositions and belong to the low- and middle-K series. Major geochemical trend of Avachinsky magmas is evident from the averaged compositions of matrix glasses and melt inclusions, which change from low-K rhyolitic in the early Holocene to predominantly middle-K andesitic in the late Holocene. The contrasting magmas cannot originate from each other by low pressure crystal differentiation and thus are considered to derive from different mantle and/or crustal sources. The trend of magma compositions toward more mafic and K-rich is nearly continuous during the Holocene. The most pronounced chemical changes correlate, however, with the beginning of the later phase of activity at 3.5 ky BP. Although the trends of average melt compositions are very systematic, magma hybridism is also evident in many samples studied. Chemically contrasting glass shards and melt inclusions were found in the samples of different ages and often found in the same tephra sample. These data indicate that mixing of low- and middle-K magmas took place during the whole Holocene history of the volcano. The amount of mafic middle-K magmas involved in the mixing process increased significantly through time.

In summary we propose that the Holocene evolution of Avachinsky volcano was driven by periodic supply of mafic middle-K magmas into crustal low-K silicic magma reservoir. Frequent injections of mafic magmas followed by mixing with rhyolites and subsequent volcanic eruptions led to exhausting of the low-K rhyolite magmas and resulted in the systematic change of bulk magma compositions to more mafic and K-rich over time.