Fuji 1707 Hoei Gabbro as a subvolcanic magma chamber by comparison with layered intrusions

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1) Introduction: Geochemical and mineralogical evidence indicates that the Hoei Gabbro (gabbroic ejecta of the 1707 Hoei eruption of the Fuji Volcano) and the Fuji basalts were derived from common parent magmas [1]. The Hoei Gabbro is divided into three groups, where O group is adcumulates and P and F groups are orthocumulates [1]. Based on the proposed model of a subvolcanic magma chamber of Fuji volcano [1], we discuss the evolution of the magma chamber in comparison with reported layered intrusions.

2) Bulk rock compositions of the Hoei Gabbro: The estimated mean percentages of melts were 4 for the O group, 7 for the F group, and 21 for the P group. The bulk compositions of the O and F group largely vary with the mineral assemblage (plagioclase, olivine, pyroxene and oxides) [1]. In contrast, the P group shows limited bulk compositional variations and plots between the averages of the O group and the Fuji basalts.

3) Plagioclase compositions of the Hoei Gabbro: The K2O variation of plagioclases from the Hoei Gabbro confirms the common parent magmas with the Fuji basalts. Plagioclases of the Hoei Gabbro, except for the plagioclase-rich subgroup of the O group (O2), tend to deplete in Fe and Mg relative to those of the Fuji basalts. Plagioclases could reequilibrate to the coexisting mafic minerals by diffusion during post-cumulate processes, and would deplete in Fe and Mg [2, 3]. Some plagioclases of the O2 subgroup, however, preserve the original FeO content because of small amounts of coexisting mafic minerals.

4) Comparison with layered intrusions: In the North Arm Mountain complex, the rhythmic layers intercurrent between the homogeneous gabbro [4]. The bulk rock compositions of the rhythmic layers are depleted in incompatible elements showing an efficient loss of melts as shown in the O group of the Hoei Gabbro. The homogeneous gabbro is affected by melts and varies in composition with similar pattern to the P group. The interstitial liquid was lost in an open system from adcumulates by compaction in the Stillwater complex [5].

5) An evolution model for the subvolcanic magma chamber: In a basaltic magma chamber, blobs of crystal mash settled down and rhythmic layers occurred by sorting of minerals. Subsequent compaction and crystallization squeezed out the interstitial melt effectively and left the O and F group cumulates. The main P group cumulates crystallized in-situ in the upper part of the chamber with an inefficient melt loss. After certain degrees of fractional crystallization, magma lost from the chamber by eruptions. Remained melts completely crystallized as a melt-rich subgroup of the P group in the center of the chamber. Later, the fresh magma of the 1707 eruption brought fragments of the preexisted solidified cumulates.

6) References: [1] Yasui et al. (1998) Kazan 43, 43. [2] Togashi et al. 2013LPSC, 2280. [3] Phinney (1992) GCA 56, 1885. [4] Komor et al.(1990) JP. 31, 1. [5] Meurer et al. (2006) CMP. 151, 187.