Pre-eruptive magmatic depth and physical properties of newly formed caldera: the case of Hijiori, northeast Japan

ISOJI MIYAGI[1], NORIKO KITA[2], AND YUICHI MORISHITA[3]

[1]Geological Survey of Japan, Tsukuba Central 7, 1-1-1 Higashi, Tsukuba, Ibaraki 305-8567, JAPAN
[2]Department of Geoscience, University of Wisconsin-Madison, Weeks Hall, 1215 W Dayton St, Madison, WI 53706, USA
[3]Department of Geosciences, Shizuoka University, 836, Ohya, Shizuoka 422-8529, JAPAN

Hijiori caldera, northeastern Japan, is a good example to understand pre-eruptive magmatic conditions of a caldera volcano before its first appearance to the surface because Hijiori caldera emerged at a place where no volcano ever existed approximately 1.2 ka. Using bulk and micro chemical compositions, thermodynamic calculations, and petrographic interpretations, we estimated the depth, density, bulk modulus, bubble content, crystal content, and bulk water content of the magma chamber of Hijiori caldera. The chemical mass balance calculations and thermodynamic modeling of the erupted magmas indicate that the upper portion of the Hijiori magmatic plumbing system was located at depths approximately between 2 and 4 km, and had the following characteristics; (1) pre-eruptive temperature: about 780°C, (2) bulk magma composition: 66 ±1.5 wt. % SiO_2, (3) bulk magmatic H_2O: approximately 2.5 wt. %, and variable characteristics that depend on depth; (4) crystal content: ≤ 57 vol.%, (5) bulk modulus of magma: 0.1--0.8 GPa, (6) magma density: 1.8--2.3 g/cc, and (7) amount of excess magmatic H_2O: 11--32 vol. % or 48--81 mol. %. The range of melt water contents found in quartz-hosted melt inclusions (2-9 wt.%) suggests that the range of depth phenocrysts growth to be wide (2--13 km). Our data suggest the presence of a vertically elongated magma chamber whose top is nearly solidified but highly vesiculated; this chamber is probably grown and re-mobilized by repeated injections of a small amount of hot dacitic magma sourced from depth.