Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29882

P-T variations of pre-eruptive magma through fractional crystallization using igneous thermobarometry in the hotspot volcanism of Jeju Island

KYEHWA JIN[1], CHAEWON PARK[1], JAEWON SEO[1], YUNGOO SONG[1], SEISUN HONG[2] AND UNGSAN AHN[3]

[1]Yonsei University

[2]Korea Institute of Geoscience and Mineral Resources

[3]Wolrld Heritage Office, Jeju Special Self-Governing Provincial Government

Hotspot volcanism within oceanic plates occurs in an environment that is less affected by secondary effects such as contamination from crustal interactions or chemical modifications due to water influx. We estimate the variance of pressure-temperature (P-T) conditions on magma evolution process using primary magma calculation and igneous thermobarometry[1] in the hotspot volcanism of Jeju Island.

The volcanic rocks of Jeju Island have a sequential distribution of five rock types based on the TAS diagram[2]. Estimated P-T conditions of the basaltic primary magma in Jeju, calculated using the PRIMELT3 method[3] are highest in basalt and decrease as the SiO_2 content increases. Temperatures ranging from 1,456 to 1,516°C, and pressure ranging from 2.1 to 2.88 GPa, corresponding to depths ranging from 69.3 km to 95 km. Results of thermobarometry for each mineral, classified by rock type, are presented in Table.

In basaltic primary magma, olivine begins to crystallize at 1,434.3°C and a depth of 47.2 km, continuing to crystallize as it ascends until reaching 1,203.5°C at a depth of 20.8 km. Clinopyroxene crystallizes at a lower P-T condition after olivine has started to crystallize, initiating at 1,253.9°C and 43.6 km and continuing its crystallization until reaching 1,110.8°C at a depth of 10.9 km. Eventually, feldspar crystallizes under the lowest P-T conditions, at 1,139°C and 22.8 km, and continues to crystallize as it ascends until reaching 876.9°C at a depth of 5.3 km. These results indicate that Jeju Island's volcanic activity resulted from different magma stages occurring under various temperature and depth conditions within the same hotspot volcanism.

[1] Putirka, *Reviews in Mineralogy and Geochemistry* 2008; 69 (1): 61–120

[2] Le Bas et al., (1986), *Journal of Petrology*, 27, 745-750.

[3] Herzberg, C., and P. D. Asimow (2015), *Geochem. Geophys. Geosyst.*, 16, 563–578.

Magma type	Rock type	Olivine-Liquid P (GPa)-T (°C)[1]	Clinopyroxene-Liquid P (GPa)-T (°C)[1]	Feldspar-Liquid P (GPa)[1]	Two-Feldspar T (°C)[1]
Basaltic magma	Basalt	P (0.93-1.43) T (1264.9-1434.3)	P (0.52-1.32) T (1119.6-1253.9)	0.39-0.69	919.0-1139.0
	Trachybasalt	P (0.86-1.15) T (1202.9-1314.6)	P (0.4-0.88) T (1113.7-1157.9)	0.53-0.57	957-1034.5
	Basaltic-trachyandesite	P (0.63-0.70) T (1203.5-1248.5)	P (0.33-0.96) T (1110.8-1224.7)	0.16-0.31	876.9-961.7
Felsic magma	Trachyandesite	T (1141.9-1180.9)	T (987.6-1128.7)	-	875.6-941.3
	Trachyte	T (1164.3-1305.7)	T (956.4-1024.3)	-	908.6-957.6