Insights into high-magnesium andesite genesis

XIAOWEI LI[12], XUANXUE MO[1], XUEHUI YU[1], YI DING[1], XIONGFEI HUANG[1], PING WEI[1], WENYAN HE[1]

[1] State Key Laboratory of Geological Processes and Mineral Resources, School of Earth Science and Resources, China University of Geosciences, Beijing 100083, China

[2] Key Laboratory of Orogenic Belts and Crustal Evolution, MOE, School of Earth and Space Sciences, Peking University, Beijing, 100871, China

A combined study of mineral compositions, bulk-rock major-trace elements and Sr-Nd isotopes as well as laser fusion $^{40}Ar/^{39}Ar$ geochronology was conducted for Mesozoic andesitic volcanics from West Qinling, Central China. The results provide insights into the origin of high-magnesium andesites. The Maixiu pyroxene andesites (MPAs) display a hyalopilitic texture, and the predominant phenocryst phases are plagioclase, orthopyroxene and clinopyroxene. Orthopyroxene generally displays delicately normal zoning, whereas some clinopyroxene grains exhibit reverse zonings. Textural relations indicate that magma mixing plays a crucial role for the genesis of high-magnesium andesites. The MPAs are characterized by high magnesium contents in some samples. The MPAs display enriched light rare earth elements and relatively high $(La/Yb)_N$ ratios (5–9). Clinopyroxene phenocrysts are depleted in some HFSE (e.g., Nb, Zr, Hf, and Ti) and some LILE (i.e., Ba, K and Sr), and are enriched in some other HFSE (e.g., Th and U), REE (e.g., Nd and Sm) and some other LILE (e.g., Rb and Pb). The MPAs have uniformly low εNd(t) values (–7.74 to–9.27) and high $(^{87}Sr/^{86}Sr)t$ ratios (0.70788 to 0.71225). Laser fusion $^{40}Ar/^{39}Ar$ dating for matrix glass yields an isochron age of 227–234 Ma. Based on data for clinopyroxene phenocrysts, we estimate a temperature range of 956 to 1087 °C with the mean value of 1032 ± 39 °C (1σ), and a pressure range from 5.9 to 13.6 kbar with an average of 9.8 ± 1.9 kbar (1σ). We conclude that the petrogenesis of the high-magnesium andesites in West Qinling Orogen may have involved magma mixing between melts derived from the sedimentary cover of the northward-subducting A'nyemaqen–Mianlue oceanic slab and peridotite-derived basaltic melts from the overriding mantle wedge during the initial collision stage between the North China Craton and the Yangtze Craton.

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