

Source and magma mixing processes in continental collision zone: Geochemical evidence from postcollisional mafic igneous rocks in the Dabie orogen

LI-QUN DAI*, ZI-FU ZHAO AND YONG-FEI ZHENG

School of Earth and Space Sciences, University of Science and
Technology of China, Hefei 230026, China
(lqdai@mail.ustc.edu.cn)

Source heterogeneity and magma mixing have been widely recognized by field observations, whole-rock and mineral geochemical studies of mafic igneous rocks. While the source heterogeneity is realized by the source mixing between different components in the source, the magma mixing is the mixing between two or more magma batches to form a hybrid magma. The both source and magma mixing processes can result in the heterogeneous compositions of whole-rock and mineral elements and isotopes. Thus, it is crucial to identify the nature of source and magma processes when deciphering the petrogenesis of igneous rocks.

Early Cretaceous postcollisional mafic rocks in the Dabie orogen exhibit petrological and geochemical heterogeneities, recording not only the source mixing during continental subduction but also the magma mixing during postcollisional magmatism. These mafic rocks exhibit arc-like trace element distribution patterns and enriched Sr-Nd-Pb isotope compositions, indicating their derivation from fertile and enriched mantle sources. They have variable whole-rock $\epsilon_{\text{Nd}}(t)$ values of -17.6 to -5.2 and zircon $\epsilon_{\text{Hf}}(t)$ values of -29.0 to -7.7, suggesting their source heterogeneity. Clinopyroxene phenocrysts exhibit complex textural and compositional variations, recording three stages of magma evolution. Cpx-1 core has low Cr and Ni, but high Ba, Rb and K contents, indicating its crystallization from a mafic melt derived from mantle peridotite containing phlogopite. Cpx-1 mantle and Cpx-2 exhibit significantly high Cr, Ni and Al_2O_3 but low Rb and Ba contents, suggesting a pyroxenite source. The mixed and evolved mafic melts are produced to crystallize Cpx-1 rim, Amp-2 and matrix minerals. Taken together, the heterogeneous mantle source would be generated by the source mixing due to the reaction of the subcontinental lithospheric mantle (SCLM) peridotite with felsic melts derived from different rocks of the subducted continental crust. The magma mixing would occur between mafic melts derived from the heterogeneous metasomatic mantle domains of different ultramafic lithologies in the postcollisional stage.