Petrogenesis of the Xiarihamu mafic-ultramafic intrusion, NW China: Evidence from Mg-Sr-Nd isotopes

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The Xiarihamu mafic-ultramafic intrusion, NW China, hosts the largest magmatic Ni-Co sulfide deposit in an orogenic setting in the world. The petrogenesis of this intrusion are still poorly constrained. To address this issue, we present new analyses of Mg isotopes of pyroxenes, Sr-Nd isotopes of cumulate rocks from this intrusion and associated country rocks.

The Xiarihamu intrusion is composed of harzburgite, orthopyroxenite, websterite, and gabbronorite. The harzburgite are characterized by low $\delta^{26}Mg$ values of orthopyroxene and moderately high $^{87}Sr/^{86}Sr$ and positive $\varepsilon_{Nd}(t)$ of bulk rocks. Most orthopyroxenites, websterites, and gabbronorites have slightly higher $\delta^{26}Mg$ of orthopyroxene and higher $(^{87}Sr/^{86}Sr)_i$ and lower $\varepsilon_{Nd}(t)$ than harzburgites. In addition, rocks (including websterites and gabbronorites) from the marginal facies are marked by slightly low $\delta^{26}Mg$ of orthopyroxene and extremely high $(^{87}Sr/^{86}Sr)_i$ and negative $\varepsilon Nd(t)$ ratios. The country rocks have very low $\delta^{26}Mg$ values.

We propose that the Mg-Sr-Nd isotopic compositions of the harzburgite were inherited from the mantle source, which may have been previously metasomatized by subducted Mg-rich carbonates. The Mg-Sr-Nd isotopic variations of most orthopyroxenites, websterites, and gabbronorites may result from contamination of isotopically heavy crustal rock at a deep-seated magma chamber. In contrast, The Mg-Sr-Nd isotopic compositions of rocks from the marginal facies were produced by assimilation of country rocks at the Xiarihamu magma chamber.

These findings not only provide a detailed isotopic constraint on the petrogenesis of the Xiarihamu intrusion but also highlight the integrated magmatic processes (magma genesis, evolution, and emplacement) of a single magma plumbing system from deep mantle source to magma chambers.