

Nd isotopic characteristics of the South and North Liaohe Groups and tectonic implications

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The Liaohe Group is an important Paleoproterozoic stratigraphic unit in the northeastern part of the North China Craton and traditionally is subdivided into the North and South Liaohe Groups. Associated with both the North and South Liaohe Groups are voluminous Paleoproterozoic granitoid rocks, named the Liaoji granitoids. Different tectonic models, including terrane amalgamation, continent-arc collision and rift closure, have been proposed to interpret the tectonic setting and evolution of the North and South Liaohe Groups and associated Liaoji granitoids. At the centre of the controversy between these models is whether or not the North and South Liaohe Groups developed on the same Archean basement. Nd isotopic geochemistry of the Liaoji granitoids provides important constraints on this controversial issue. The Liaoji granitoids associated with the North and South Liaohe Groups display similar ϵ_{Nd} values, restricted to a narrow range from 0 to 2, implying that these granitoid rocks were derived from the same or a similar magma source. Moreover, the Liaoji granitoids associated with the North and South Liaohe Groups have similar Nd model age (TDM), ranging from 2.4 Ga to 2.6 Ga, suggesting that the protoliths of the Liaoji granitoids associated with both the groups may have formed simultaneously, and that the basement rocks underneath the Liaoji granitoids and associated North and South Liaohe Groups belong to the same continental block rather than two different blocks. Combining lithological, structural and geochronological considerations, we interpret the North and South Liaohe Groups as having developed on a single late Archean basement that underwent Paleoproterozoic rifting associated with the intrusion of the Liaoji granitoids and the formation of the Liaohe Group, and closed upon itself in the Paleoproterozoic.

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Trace element and Hf-Nd isotopic profiling of crustal contamination across the marginal zone of the Muskox intrusion, Nunavut

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We present the first combined trace element, Hf-Nd isotopic study from the marginal zone of the 1.27 Ga Muskox intrusion in order to constrain the extent and character of crustal contamination and the potential for formation of Ni-Cu-PGE sulphide mineralization. The two regions studied, West Pyrrhotite Lake (WPL) and Far West Margin (FWM), have different characteristic chemical and isotopic variations. The WPL region is adjacent to metaplutonic rocks, is unmineralized, and records the complete stratigraphy of the marginal zone. The FWM region however is adjacent to metasedimentary rocks, is weakly mineralized, and the contact norite is not present. Trace element and isotopic data record a sharp increase in crustal contamination within 5 m of the contact in both regions, however elevated La/Sm and La/Nb values do extend up to 60 m from the contact at the FWM. Initial ϵ_{Nd} and ϵ_{Hf} (1.27 Ga) values within the marginal zone range from 0 to -12 and +2.1 to -15, respectively, and T_{CHUR} model ages range from 1.13 Ga in peridotite to 2.5 Ga in contaminated gabbro-norite. The adjacent country rocks have much higher ϵ_{Hf} and ϵ_{Nd} values at 1.27 Ga ranging from -20 to -29 and -14 to -16. The initial ϵ_{Nd} values of peridotite within the marginal zone overlap those from the overlying 1500-m-thick layered series [1] confirming an undepleted mantle source. The combined Hf-Nd isotopic and trace element results indicate that significant crustal contamination is restricted to a thin boundary zone especially in the WPL region. As a result, the conditions for formation of significant sulphide mineralization in the marginal zone of the Muskox intrusion are not optimal. The volume of contaminated magma was insufficient to generate a large quantity of sulphide liquid and the metal content of sulphide was limited by the inability of this sulphide liquid to interact with subsequent magma pulses.

Reference

[1] Stewart, B.W. & DePaolo, D.J. (1996) AGU Geophysical Monograph **95**, 277-292.