Transitional crust-mantle geodynamics recorded by Late Archean (~3.0-2.5 Ga) multiple K-rich granitoids of North China Craton

WEI WANG[1] AND SHUWEN LIU[2]

[1] School of Earth Sciences and Resources, China University of Geosciences, Beijing 100083, PR China

[2] School of Earth and Space Sciences, Peking University, Beijing 100871, PR China

Lithological assemblages, chronological data, and petrochemical features of multiple late Archean K-rich granitoid rocks (~3.0-2.9, ~2.7, and ~2.6-2.4 Ga (mostly ~2.53-2.47 Ga)) from North China Craton are reviewed to unravel the crust-mantle geodynamic origin of late Archean K-rich granitoid magmatism.

The Mesoarchean granitic gneisses of Anshan-Benxi are strongly peraluminous with muscovite and tourmaline. They show low CaO/Na_2O, Al_2O_3/TiO_2, ΔSr, and $(La/Yb)_N$, and negative zircon ƐHf(t) that formed by high-T-low-P melting of metapelites. Linear zircon ƐHf(t)-age array of ~3.8-2.9 Ga felsic rocks implies sluggish crust-mantle interactions under a stagnant-lid setting.

Early Neoarchean K-rich granitoids occur in Jiaobei and southern North China Craton. The quartz monzodioritic to granodioritic rocks show moderate FeO_T+MgO but high Mg#. They contain euhedral muscovite with peraluminous features and mildly depleted zircon ƐHf(t), indicating hydrous mantle sources with recycled sediment melts. The monzo-/syenogranitic rocks have mildly depleted to negative zircon ƐHf(t), high CaO/Na_2O and Al_2O_3/TiO_2, and moderate ΔSr and $(La/Yb)_N$, suggesting high-P-low-T melting of clay-poor sedimentary rocks. Moderate crust-mantle interactions and melt-dominated mantle metasomatism are linked to hot subduction and arc-continent accretion processes.

Late Neoarchean K-rich granitoids are ubiquitous across the craton. The intermediate rocks show high FeO_T+MgO and Mg#. Chemical modeling, coupled with low Nb/Th and TiO_2/Yb, high La/Yb and Nb/Yb, and positive correlation of $(Hf/Sm)_N$ and $(Nb/La)_N$, indicate derivation from variably enriched mantle sources metasomatized by fluids. The acidic rocks have varied CaO/Na_2O, A/CNK, and normalized REE patterns, and depleted to strongly enriched zircon ƐHf(t). These data suggest complex crustal sources at diverse crustal levels with mantle inputs. Given vigorous crust-mantle interactions, fluid-dominated mantle metasomatism, and peaked sediment involvement and crustal thickness at ~2530-2480 Ma, late Neoarchean granitoid magmatism occurred possibly at Phanerozoic-like plate tectonics.

In summary, the above late Archean K-rich granitoid magmatism record transition from stagnant-lid to gradually stabilized plate tectonics. The crust-mantle interactions enhanced stepwise, and exerted a first-order control on the increasing lithological and chemical diversification of the K-rich granitoids.