Paleoproterozoic multi-stage magmatism recoganition of the western Ordos Block basement, North China Craton: geochemistry and Sr-Nd-Pb-Hf isotopic data from the drillhole basement granitoids

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Based on the petrogenesis and zircon ages of the drillhole samples from the Ordos Block basement, three stages of granitic magmatism are identified. The first-stage granitoids was emplaced at 2.49 Ga, and composed by peraluminous shoshonite K-rich granites with high SiO_2, K_2O/Na_2O, LREEs and LILEs. They have low $(^{87}Rb/^{86}Sr)i$, slightly positive $\varepsilon_{Nd}(t)$, $\varepsilon_{Hf}(t)$ and variable $^{206}Pb/^{204}Pb$, $^{208}Pb/^{204}Pb$ and high $^{207}Pb/^{204}Pb$, suggesting that they were formed by partial melting from juvenal crust. Their high Al_2O_3/TiO_2, low $(CaO+FeO^T+MgO+TiO_2)$ and variable Rb/Sr further indicate that their protolith are dominatly metapelites with minor metagraywackes. Second stage of granitoids were formed in 2.19-2.04 Ga, showing calc-alkaline, high-K calc-alkaline to shoshonite peraluminous granites with minor peraluminous granodiorites and diorites. They are characterized by variable SiO_2, K_2O/Na_2O, Rb/Sr, high LREE, LILEs and low HFSEs as well as variable $(^{87}Rb/^{86}Sr)i$, $\varepsilon_{Nd}(t)$, $\varepsilon_{Hf}(t)$, $^{208}Pb/^{204}Pb$ and low $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$. Their Rb/Sr, Al_2O_3/TiO_2 and $(CaO+FeO^T+MgO+TiO_2)$ are also variable, demonstrating that they were generated by the partial melting from both ancient metasedimentary and juvenal meta-basaltic rocks with different crustal residence ages. Last stage of granitoids were produced at 1.93 Ga, belonging to magnesian, high-K calk-alkaline diorite with low SiO_2, K_2O/Na_2O, Rb/Sr ratios, less radiogenic Sr-Nb and radiogenic Pb isotopic composition. They have right-inclined REE patterns with positive Eu anomalies and multi-element patterns with negtive spikes of Nb, Ta, P, Ti and positive spikes of Pb, Sr, Ba. Combining their low Rb/Sr, Al_2O_3/TiO_2 and high $(CaO+FeO^T+MgO+TiO_2)$, they were likely formed by the partial melting of pre-existing amphibolite materials. Consequently, all evidneces confirm that the Western Block of North China Craton is an Archean continental block with ancient crust remnant which underwent mult-stage tectonothermal events during the Paleoproterozoic.