

Zircon Hf isotopic constraints on the Jurassic-Oligocene magmatic rocks in the Lut-Sistan region, eastern Iran: Implications for the magmatic evolution

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This study presents new zircon Hf isotopic results for 28 magmatic rocks of Jurassic-Oligocene ages in the Lut-Sistan region to better understand the magmatic evolution of eastern Iran before and after the Lut-Afghan collision. The Middle Jurassic (~168 Ma) granitoids yielded a wide range of zircon $\varepsilon_{\text{Hf}}(\text{T})$ values from +8 to -1, revealing the similarity of variable isotopic feature of the coeval magmatic rocks forming along the Sanandaj-Sirjan zone, in agreement with the hypothesis of anti-clockwise rotation of the Lut block. The Early Cretaceous (113-107 Ma) gabbros that belong to the Birjand ophiolite indisputably show depleted mantle-derived zircon Hf isotope compositions of $\varepsilon_{\text{Hf}}(\text{T})$ values from +16 to +12 and thus confirm their oceanic crustal origin. Another ~110 Ma diorite without ophiolitic affinity has relatively lower zircon $\varepsilon_{\text{Hf}}(\text{T})$ values from +9 to +6, and it also contains abundant inherited zircons that show $\varepsilon_{\text{Hf}}(\text{T})$ values between +5 and -2 at ~168 Ma, indicative of the widespread distribution of the Middle Jurassic magmatism in northern part of this region. In the Late Cretaceous, the emplacement of ~86 Ma granitoids also yielded depleted mantle-like zircon Hf isotopes of highly positive zircon $\varepsilon_{\text{Hf}}(\text{T})$ values from +17 to +10, and the other granites yielded lower zircon $\varepsilon_{\text{Hf}}(\text{T})$ values from +12 to +4 at 74-71 Ma. After the closure of the Sistan ocean during the Late Cretaceous (to Paleocene), the 57-53 Ma granitoids gave zircon $\varepsilon_{\text{Hf}}(\text{T})$ values from +12 to +3 in the Early Eocene. Then, the zircon Hf isotopic results of extensive Eocene-Oligocene (46-24 Ma) magmatic rocks show a much variable signature of zircon $\varepsilon_{\text{Hf}}(\text{T})$ values between +14 and -2, indicating the heterogeneity of widespread post-collisional magmas during this period. On the whole, the highly radiogenic zircon Hf isotopic features were mostly obtained from dated magmatic rocks in the Lut-Sistan region, similar to our recent observation on the magmatic rocks developed by the Neotethyan evolution in the Urumieh-Dokhtar magmatic arc, which suggest that the depleted-mantle component has played a critical role on the magmatic evolution since at least the Jurassic time.

Keywords: Zircon Hf isotopes, Lut-Sistan region, Iran, magmatic evolution