Two contrasting modes of continental break-up associated with the formation of the Paleo- and Neo-Tethys in Iran: Implications for petrological and geodynamic evolution at a regional scale

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Petrogenesis and Tectono-Magmatic implications

The REE petrogenetic modeling indicate that the different rock-types were generated from different mantle sources and different partial melting degrees, as well as at different melting depths. Results are summarized in Table 1.

Table 1: Summary of the melting conditions for the different rock-types. Abbreviations, DMM: depleted MORB mantle; N-MORB: normal (undepleted) ocean ridge basalt chemical component; EM: enriched (plume type) mantle; OIB: ocean island basalt chemical component; gt=garnet; sp=spinel. The number of times a given element is enriched or depleted relative to a chondrite, normalized to 100.

Rock-type | Mantle source | Mantle composition | Melting depth (approximate) | Melting degree
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DMM | EM | shallow | 0% | 0%
N-MORB | EM | shallow | 0% | 0%
EM | EM | shallow | 0% | 0%
OIB | EM | shallow | 0% | 0%

The different mantle melting styles and the different rock associations, as well as different regional geologic evidence observed in the Misho and Kermanshah areas indicate different geodynamic mechanisms for the continental rifting and opening of the Paleo- and Neo-Tethys, respectively.

P-MORB (a) • EM: enriched (plume type) mantle; OIB: ocean island basalt chemical component; gt=garnet; sp=spinel. The number of times a given element is enriched or depleted relative to a chondrite, normalized to 100.

Fig.1: Tectonic setting of the Misho Mafic Complex and surrounding areas and location of the study area.

Fig.2: Simplified geologic map of the East Maho Mass (a) and simplified reconstructed columnar section of the Precambrian basement (b).

Fig.3: Chondrite-normalized REE patterns for isotropic gabbros and basalts from the Misho Mafic Complex. Normalizing values are from Sun and McDonough (1989).

Fig.4: Simplified geologic map of the Kermanshah area (a) and simplified reconstructed columnar section (b) of the ocean-continent transition zone (OCTZ) associated in the region map.

Fig.5: a) REE patterns of the Kermanshah ophiolites; b) REE patterns of the Misho Mafic Complex; c) REE patterns of continental margin ophiolites (CMOs); d) REE patterns of oceanic island basalts (OIBs). The extent of each trace element to differentiate the misso ophiolites from continental margin ophiolites (CMOs) is shown in the isotopic composition, which can be used to identify different magmatic sources. The b) trace elements show the initial rift-drift tectonics of the Paleo-Tethys and Neo-Tethys in Iran in order to assess the possible geodynamic mechanisms responsible for the formation of these two basaltic series.

Fig.6: Schematic 2D model (not to scale) illustrating the initial rift-drift tectonics of the Paleo-Tethys in Iran.

Fig.7: Schematic 2D model (not to scale) illustrating the initial rift-drift tectonics of the Neo-Tethys in Iran.

The initial rift-drift tectonics of the Neo-Tethys was triggered by mantle plume activity and was affected by plume-related magmatism and associated lithospheric thinning at a regional scale (Fig.7a). The mantle plume is responsible for variable magmatic enrichment of the overlying asthenospheric mantle. The polybaric nature of the mantle from deep to shallow levels was facilitated by the uplift of hot plume material. The REE composition indicates that the Neo-Tethys is related to the Neo-Tethys magmas in central-eastern Asia. The regional tectonic and the widespread occurrence of oceanic plateaus in the Neo-Tethys further support this hypothesis.

References