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Cretaceous-Cenozoic magmatism in the Pamir and a comparison with Tibet

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The Pamir, as the Tibetan Plateau, formed during multiple subduction and accretion cycles in the Paleozoic to Cenozoic, leading to the formation of extremely thickened crust (at present ∼70 km). Several magmatic episodes with distinct compositions have been observed and described for Tibet; for the Pamir no systematic investigation exists. This study addresses this issue and relates the Tibetan magmatism to that of the Pamir, investigating similarities with respect to timing, composition, petrogenesis, and geodynamic setting.

The studied samples from the southern and central Pamir cover ages from Cretaceous to Miocene and are predominantly plutonic. Zircon U-Pb dating revealed that Cretaceous magmatism occurred in two time intervals with peaks at 102-110 Ma and 67-77 Ma, producing peraluminous (A/CNK: 1.0-1.5), (high-K) calc-alkaline magmas. The Cretaceous magmatic episodes cannot be distinguished based on their trace element concentrations but by means of their isotope geochemistry. The Early Cretaceous sequence features initial ε_{Nd} and $^{87}Sr/^{86}Sr$ values that range from -8.5 to -11.0 and 0.7099 to 0.7116, respectively. In contrast, the Late Cretaceous sequence features higher initial ε_{Nd} and lower $^{87}Sr/^{86}Sr$ values from -4.6 to -6.5 and 0.7080 to 0.7097, respectively. From the currently available data, it appears that the main episode of Cenozoic magmatism occurred at 14-25 Ma with chemically bimodal magmatism. The Cenozoic rocks comprise slightly peraluminous to metaluminous (A/CNK: 0.95-1.07), high-K calc-alkaline granodiorites, granites, and leucogranites, with initial ε_{Nd} values of -6.4 to -8.3. The Early Miocene alkali-basalts show slightly negative Nb-Ta-Ti and Eu anomalies, have initial ε_{Nd} values of -4.2 to -8.3 and initial $^{87}Sr/^{86}Sr$ values of 0.7064 to 0.7105. The coevally intruded leuco- and biotite-granites are slightly peraluminous to metaluminous (A/CNK: 0.99-1.07) and show overlapping isotopic compositions with initial ε_{Nd} values of -6.4 and -7.3 and initial $^{87}Sr/^{86}Sr$ of 0.7073 and 0.7093.

A remarkable feature is the shift from almost pure continental crustal ε_{Nd} values, observed in the Early Cretaceous granitoids, to higher values in Late Cretaceous granitoids that suggest a higher degree of a primary mantle component in the latter. Overall, this may reflect a change in the melting regime and/or the source of the granitoids during the Cretaceous. During the Cenozoic the ?Nd values decrease continuously with the age of the samples.

A similar magmatic gap as discovered for the Pamir (∼100-80 Ma) was observed in Tibet at 75-60 Ma (see e.g. Chung et al. 2005). It is assumed that the Cretaceous magmatic activity on the Tibetan Plateau is related to northward, low-angle subduction before the India-Asia collision, and the magmatic gap is caused by slab roll-back accompanied by southward migration of asthenospheric convection, causing the final phase of Gangdese-arc magmatism to be dominated by an asthenospheric mantle source component. Isotopic signatures of the Tibetan samples closely match the Pamiran magmatites, leading to the assumption that similar processes led to their formation.

References

Chung, S.L. et al., 2005, Tibetan tectonic evolution inferred from spatial and temporal variations in post-collisional magmatism, Earth-Sci. Rev., 68, 173-196