Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.25230

The earliest intra-oceanic subduction initiation of the Neo-Tethys Ocean was recorded by Late Triassic SSZ-type oceanic crustal rocks in Southern Tibet

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When the subduction of the Neo-Tethyan oceanic plate first started is the key scientific issue for understanding the evolution and metallogenesis of the Neo-Tethyan region. Here we report the first discovery of late Triassic SSZ-type cumulative rocks with boninitic signature in the Luobusa ophiolite from the Yarlung-Zangbo suture zone, which may record so far the earliest intra-oceanic subduction history of the Neo-Tethyan ocean. The crustal rocks of the Luobusa ophiolite mainly consist of serpentinite, pyroxenite, isotropic gabbronorite, and layered gabbro. Zircon and apatite U-Pb dating of the cumulative rocks yield consistent formation age of 216-217 Ma. These rocks yield typical igneous stratifications and mesocumulative textures with a mineral crystallization sequence of spinel→olivine→orthopyroxene→clinopyroxene→plagioclase. The clinopyroxenes exhibit large variations in Mg# values (72-90) and the plagioclases are calcium-enriched (An = 62-99). These lines of evidence indicate that the parental magma of the Luobusa cumulative rocks is a hydrous primary magma enriched in calcium and silicon. Trace element compositions of the equilibrium melt of clinopyroxene in the cumulative rocks are characterized by depletions of rare earth elements (REEs) and high field strength elements (HFSEs, e.g., Ti) and enrichments of large ion lithophile elements (LILEs, e.g., Ba), comparable with those of boninitic magmas. Thermodynamic modelling results indicate that the Luobusa cumulative rocks could be produced by various degrees of fractional crystallization (19%-56%) of boninitic magmas. In summary, the late Triassic Luobusa cumulative rocks originated from the fractional crystallization of boninitic magmas at a fore-arc basin of a supra-subduction zone environment during the earliest intra-oceanic subduction of the Neo-Tethyan oceanic plate. Recognition of this late Triassic subduction event could help explain multiple distinct features of Neo-Tethys, including paleogeography reconstruction, formation of podiform chromite deposit, and evolution of heterogeneous ophiolitic mantle peridotites.