



Tectonic mélange records the Silurian–Devonian subduction-metamorphic process of the middle-southern Dunhuang terrane, southernmost Central Asian Orogenic Belt

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The intermediate-high grade metamorphic complex of the middle-southern Dunhuang terrane, northwestern China, southernmost Central Asian Orogenic Belt (CAOB), consists of eclogite, mafic granulite, and amphibolite as puddingstones within a matrix of metapelitic gneiss and marble, exhibiting typical block-in-matrix fabrics of tectonic mélange. In this study, the first discovery of Paleozoic eclogite in the southern Dunhuang terrane bears testimony to the subduction zone setting of these metamorphic complex. High-resolution secondary ion mass spectrometry (SIMS) U-Pb dating of metamorphic zircons and $^{40}\text{Ar}/^{39}\text{Ar}$ dating of hornblende obtained from the puddingstones and/or matrix metapelite suggests that the metamorphism occurred during ca. 430–365 Ma, advocating prolonged slab subduction due to the closure of the southern segment of Paleo-Asian Ocean. Geothermobarometry and thermodynamic modeling results reveal that the metamorphic rocks all record similar clockwise metamorphic pressure-temperature-time (P-T-t) paths indicative of the orogenic setting. However, remarkable differences between metamorphic peak P-T conditions, ranging from 830 °C / 24.2 kbar for the eclogite puddingstone to 700 °C / 10.2 kbar for the metapelite matrix in the Hongliuxia area, from 860 °C / 16.9 kbar for the HP granulite puddingstone to 720 °C / 6.8 kbar for the matrix in the Qingshigou area, and from 830 °C / 16.5 kbar for the HP granulite puddingstone to 635 °C / 6.0 kbar for the matrix in the Dongbatu-Mogutai area were found in the mélange rocks. This indicates the mixing of rocks from significantly different depths to create a tectonic mélange in a subduction channel, possibly juxtaposed during the uplift stage. Namely, these rocks were possibly subducted and equilibrated at various depths asynchronously, and in consequence, witnessed heterogeneities in the timing of metamorphic equilibration and P-T evolution, pointing to independent tectonic evolutions of different slices inside a subduction channel. Our data further suggest that the Dunhuang region was not a stable block formed in the Precambrian as believed before, but a Paleozoic orogenic belt of Silurian to Devonian.

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