

The closure timing of the Paleo-Tethys Ocean in the Lhasa terrane: Constraints from U–Pb, Lu–Hf, Sm–Nd and Ar–Ar multichronometric dating on the Lhasa eclogites, Tibet

HAO CHENG¹, YUMENG LIU¹
AND JEFFREY D. VERVOORT²

¹State Key Laboratory of Marine Geology, Tongji University, Shanghai 200092, China

²School of Earth and Environmental Sciences, Washington State University, Pullman, WA 99164, USA

As the main tectonic component of the Himalayan–Tibetan orogen, the Lhasa terrane, has received much attention as it preserves records of the entire history of the orogeny. The occurrence of high-pressure eclogites has a significant bearing on the Paleo-Tethys subduction and plate suturing processes in this area. An eclogite from the Bailang country was investigated with a combined metamorphic P–T and U–Pb, Lu–Hf, Sm–Nd and Ar–Ar multichronometric approach. Pseudosection modeling combined with thermobarometric calculations indicate that the Bailang eclogite equilibrated at about 25–28 kbar and 450–520 °C, which is much lower than those of Sumdo and Jilang eclogites in this belt. Garnet–whole rock–omphacite Lu–Hf and Sm–Nd ages of 238.1 ± 3.6 Ma and 230.0 ± 4.7 Ma were obtained on the sample respectively, which is largely consistent with the corresponding zircon U–Pb age of 243 ± 6 Ma within uncertainty. Because metamorphic temperature of the samples is well below the Lu–Hf and Sm–Nd closure temperatures in garnet, the garnet displays a core-to-rim decrease in Mn and HREE concentrations typical of prograde zoning, and the slightly U-shaped Sm zoning pattern, the Lu–Hf and Sm–Nd ages were thus interpreted as the age of eclogite-facies metamorphism with the Lu–Hf age skewing to an earlier garnet growth and the Sm–Nd age towards a late garnet growth. The diversion of peak metamorphic conditions and the distinct metamorphic ages for the Bailang eclogite, the Sumdo eclogite and the Jiang eclogite in the same (ultra)-high-pressure belt indicate that this region comprises different slices that had distinct P–T histories and hence underwent (U)HP metamorphism at different times. The initiation of the opening the Paleo-Tethys basin in the Lhasa terrane could trace back to the early Permian. The ultimate closure of the Paleo-Tethys basin in the Lhasa terrane was no earlier than ca. 238 Ma.