Wenxiao Zhou, Feng Chang, Bo Huang, Bin Xia, Dong Fu, Ernest Chi Fru, Haiquan Li, Xinbiao Lü, and Cheng Mao, 2023, Oceanic subduction to continental collision in the NE Proto-Tethys revealed by early Paleozoic eclogites with high-temperature granulite-facies overprinting in the East Kunlun orogenic belt, northern Tibet: GSA Bulletin, https://doi.org/10.1130/B36718.1.

Supplemental Material

Text. Analytical Methods.

Table S1. Representative electron microprobe analyses of garnet in eclogite samples.

Table S2. Representative analyses of clinopyroxene (omphacite)in eclogite samples.

Table S3. Representative microprobe analyses of low-sodic clinopyroxene in eclogite samples.

Table S4. Representative microprobe analyses of amphibole in eclogite samples.

Table S5. Representative microprobe analyses of plagioclase in eclogite samples.

Table S6. Representative microprobe analyses of other minerals (orthopyroxene and epidote) in eclogite samples.

Table S7. Whole rock major (wt%) and trace element (ppm) analyses of eclogites in Nuomuhong area, EKOB.

Table S8. SHRIMP Zircon U-Pb isotopic data from the eclogite in Nuomuhong area, EKOB.

Table S9. Rare Earth Elements (ppm) analyses of the tested zircons from the retrograde eclogites.

ANALYTICAL METHODS.

Mineral Compositions Analyses

Mineral compositions were obtained using a JAX-8230 electron probe micro-analyzer at the Center of Materials Research and Testing, Wuhan University of Technology, Wuhan, China, with an accelerating voltage of 20 kV, a beam current of 1×10^{-9} A, and a beam diameter of 5 μm. The data acquisition time of each point was approximately 4 minutes. The mineral compositions were calculated using the Geokit program (Lu, 2004). The most representative mineral chemistry data is found in Table S1 - S6.

Whole-rock Major and Trace Elements

Whole-rock samples were crushed in a corundum jaw crusher to a size of 60 mesh. Approximately 60 g was powdered in an agate ring mill to a size of less than 200 mesh. The major elements were analyzed by X-ray fluorescence spectrometry (3080E1; Rigaku, Tokyo, Japan) at the Hubei Institute of Geology and Mineral Resources, Chinese Ministry of Land and Resources, with analytical errors better than 2%. FeO was determined using the traditional wet chemical method. The trace element concentrations were determined by ICP-MS (X.Series,

Thermo Fisher Scientific, Germany) at the Hubei Institute of Geology and Mineral Resources, Chinese Ministry of Land and Resources. The analytical procedures were similar to those described by (Liu et al., 2008). Powder samples of approximately 50 mg were digested by $HF+HNO_3$ in Teflon bombs. An internal standard solution containing the single element Rh was used to monitor signal drift during counting. A set of international and Chinese national rock standards, including AGV-2, BHVO-2, BCR-2, RGM-1 and GSR-1, were chosen as the calibrating elements. The analytical precision for most of the elements was generally better than 5%. Results are show on Tables S7.

U-Pb Zircon Geochronology

Zircon grains for U-Pb dating were separated using standard density and magnetic separation techniques at the mineral separation laboratory at the Bureau of Geology and Mineral Resources of Hebei Province in Langfang City. Representative zircons were hand-picked, mounted on adhesive tape, embedded in epoxy resin, polished to approximately half their thickness and photographed under reflected and transmitted light (Song et al., 2002). The zircon structure and origin were studied by cathodeluminescence (CL) imaging using a MonoCL3+ instrument (Gatan Inc., UK) mounted on a Quanta 400 FEG scanning electron microscope (FEI Inc., US) at the State Key Laboratory of Continental Dynamics, Northwestern University, Xi'an. The accelerating voltage was 10 kV, and the beam current was 240 μA.

To obtain the age of the peak metamorphic eclogite facies or primary rock, age analysis and testing were performed by SHRIMP II. Single-grain zircons were selected at the Langfang mineral separation laboratory. The zircons were separated using the standard heavy liquid and electromagnetic method, and more than 500 zircon grains were obtained. The zircon-target, photography, and analytical tests were performed at BJSHRIMP. The selected zircon and the standard zircon sample were fixed on colorless glass plates with an epoxy resin and polished. To obtain accurate age information, the internal structures of the zircons were checked with reflected light images, transmitted light images and CL images. All the test points were selected to avoid inclusions and cracks. To monitor the stability of the instrument and isotope fractionation, a standard test was performed every 3 unknown sample measurements. The analysis principles and processes were taken from Compston, et al., Williams and Clasesson (Claesson and Williams, 1987; Compston et al., 1984). During the experiment, the intensity of the primary ion flow (O^{2-}) was 3.45-3.75 nA, the spot diameter was 23 μm, the sample points were cleaned for 150 s, and each data point was composed of five scans. TEM (417 Ma), whose mother rock was derived from a distillate body near Canberra, Australia, was used for sample age correction (Black et al., 2003). Data processing and age calculations using Isplote 3.0 (Ludwing, 2003), normal lead correction using the direct determination of the ^{204}Pb, average Pb isotopic composition has been given by the Stacey-Kramers model (Compston et al., 1984; Stacey and Kramers, 1975). Results are show on Tables S8.

LA-ICP-MS Zircon In Situ Trace-element Analyses

In situ trace-element analysis of zircon was determined at the State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan, China. Detailed operating conditions for the laser ablation system and the ICP-MS instrument and data reduction are the same as description by Zong et al. (2017). Laser sampling was performed using a GeolasPro laser ablation system that consists of a COMPexPro 102 ArF excimer laser (wavelength of 193 nm and maximum energy of 200 mJ) and a MicroLas optical system. An

Agilent 7700e ICP-MS instrument was used to acquire ion-signal intensities. Helium was applied as a carrier gas. Argon was used as the make-up gas and mixed with the carrier gas via a T-connector before entering the ICP. A "wire" signal smoothing device is included in this laser ablation system (Hu et al., 2015). The spot size and frequency of the laser were set to 32 μm and 5 Hz, respectively, in this study. Zircon 91500 and glass NIST610 were used as external standards for U-Pb dating and trace element calibration, respectively. Each analysis incorporated a background acquisition of approximately 20-30 s followed by 50 s of data acquisition from the sample. An Excel-based software ICPMSDataCal was used to perform off-line selection and integration of background and analyzed signals, time-drift correction and quantitative calibration for trace element analysis (Liu et al., 2008; Liu et al., 2010). Results are show on Tables S9.

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