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Supplementary Material DR-Text 1: Analytical methods

1.1 Zircon geochronology and geochemistry

Zircon grains from eclogites (SA52A, SA53A, SA55A, SA56A) and an associated meta-pegmatite (SA-57A) from the same location as eclogite sample SA56A were separated for U–Pb dating by conventional heavy liquid and magnetic techniques at the Special Laboratory of the Geological Team of Hebei Province, Langfang, China. Internal structures of zircons were imaged using transmitted- and reflected-light optical microscopy and cathodoluminescence (CL) at the Institute of Geology, Chinese Academy of Geological Sciences, Beijing, China, and then spot positions for dating were selected.

U–Pb dating and trace element analysis of zircons were conducted synchronously by the LA–ICP–MS methodology at the State Key Laboratory of Continental Dynamics in the Northwest University, Xi'an, China. The laser-ablation system used is a GeoLas 200M equipped with a 193 nm ArF-excimer laser, and a homogenizing and imaging optical system (MicroLas, Göttingen, Germany). Spots were performed on the ELAN 6100 ICP-MS from Perkin Elmer/SCIEX (Canada) with a dynamic reaction cell (DRC). The laser-ablation spot size was set at 29 μm and 54 μm for large grains, and laser energy and frequency of 210 mJ and 10 Hz for 40 s were used. Harvard zircon 91500 with a weighted mean $^{206}Pb/^{238}U$ age of 1065.4 ± 0.6 Ma (Wiedenbeck et al., 2004; Liu et al., 2010) was used as an external standard and was analyzed twice every 5–10 analyses to correct for both instrumental mass bias and depth-dependent elemental and isotopic fractionation. The NIST610 was used as external reference and internal standard for Si to calibrate the trace element contents. Offline raw data selection and background and time-drift correction of the zircon analysis were performed by the Glitter 4.0 software (Macquarie University, Griffin et al., 2008) after $^{207}Pb/^{206}Pb$, $^{206}Pb/^{238}U$, $^{207}Pb/^{235}U$ and $^{208}Pb/^{232}Th$ ratios were calculated. ISOPLOT version 4.15 were used to calculate and plot the U–Pb concordia diagrams and weighted mean ages (Ludwig, 2012).

1.2 Zircon Hf isotopic analysis

Zircon Lu–Hf isotopic analysis was performed at the State Key Laboratory of Continental Dynamics in the Northwest University, Xi'an, China, on the same zircon grains that were subjected to U–Pb dating by using a Nu Plasma MC-ICP-MS connected to a GeoLas 2005 193 nm laser system. Helium was used as a carrier gas. The spot size was set at 44 μm, while the laser repetition rate was 10 Hz, and the energy density applied was 15–20 J/ cm^2. Raw count rates for ^{172}Yb, ^{173}Yb, ^{175}Lu, ^{176}(Hf +Yb +Lu), ^{177}Hf, ^{178}Hf, ^{179}Hf and ^{180}Hf were collected simultaneously. The detailed analytical methodology followed that of Yuan et al. (2008). Standard zircons 91500 (Wiedenbeck et al. 1995) and GJ-1 (Jackson et al. 2004) were re-analyzed as an unknown sample to check the quality of the data during the analysis. The obtained $^{176}Hf/^{177}Hf$ ratios of the 91500 and GJ-1 standards were 0.282295±0.000022 (n=5, 2σ) and 0.282029 ± 0.000016 (n=5, 2σ), respectively, which are in good agreement with the recommended $^{176}Hf/^{177}Hf$ ratios within 2σ (0.282307 ± 0.000058, 2σ; 0.282015 ± 0.000019, 2σ) (Elhlou et al., 2006; Griffin et al., 2006).

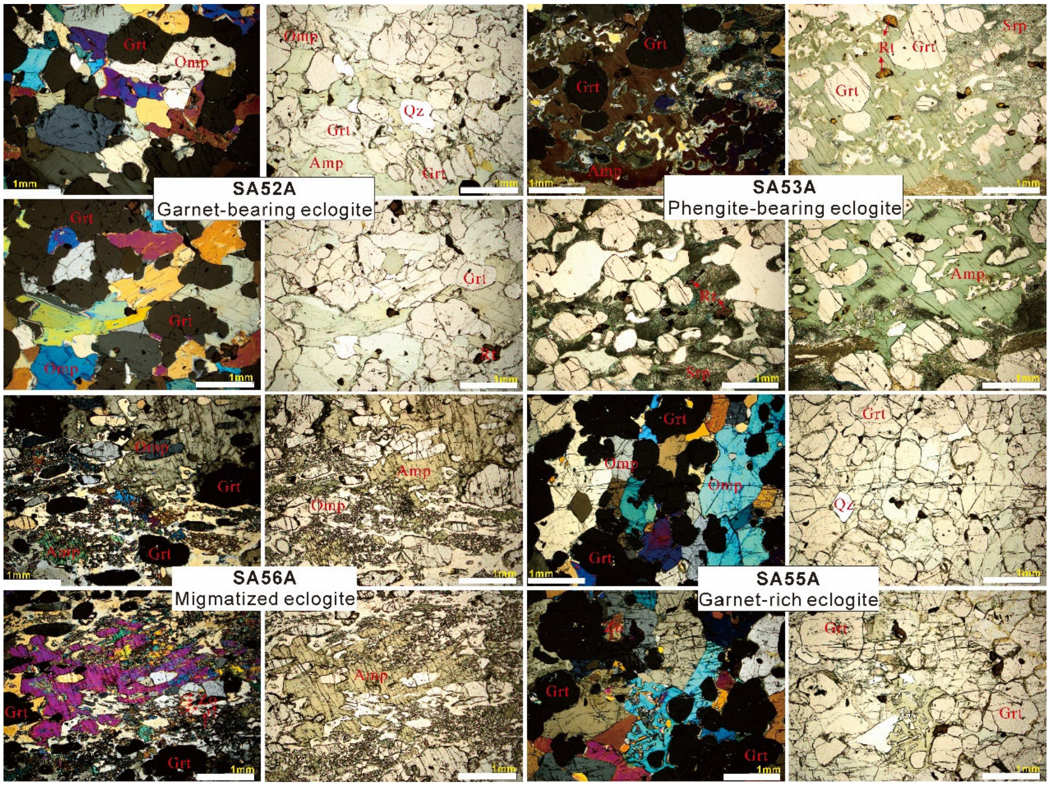
The initial $^{176}Hf/^{177}Hf$ values are expressed as εHf(t), which is calculated using the decay constant for ^{176}Lu of 1.867×10^{-11} (Söderlund et al., 2004) and present-day chondritic ratios of $^{176}Hf/^{177}Hf$=0.282785 and $^{176}Lu/^{177}Hf$=0.0336 (Bouvier et al., 2008). Single-stage Hf model ages (T_{DM1}) were calculated relative to a depleted mantle model with present-day $^{176}Hf/^{177}Hf$=0.28325 and $^{176}Lu/^{177}Hf$=0.0384 ratios (Vervoort and Blichert–Toft, 1999; Griffin et al., 2000). Two-stage Hf model ages (T_{DM2}) were also calculated, using a $^{176}Lu/^{177}Hf$ value of 0.015 for the average continental crust (Griffin et al., 2002).

For time calibration, vs. 2021/05 of the International Stratigraphic Chart (Cohen et al., 2013) is used.

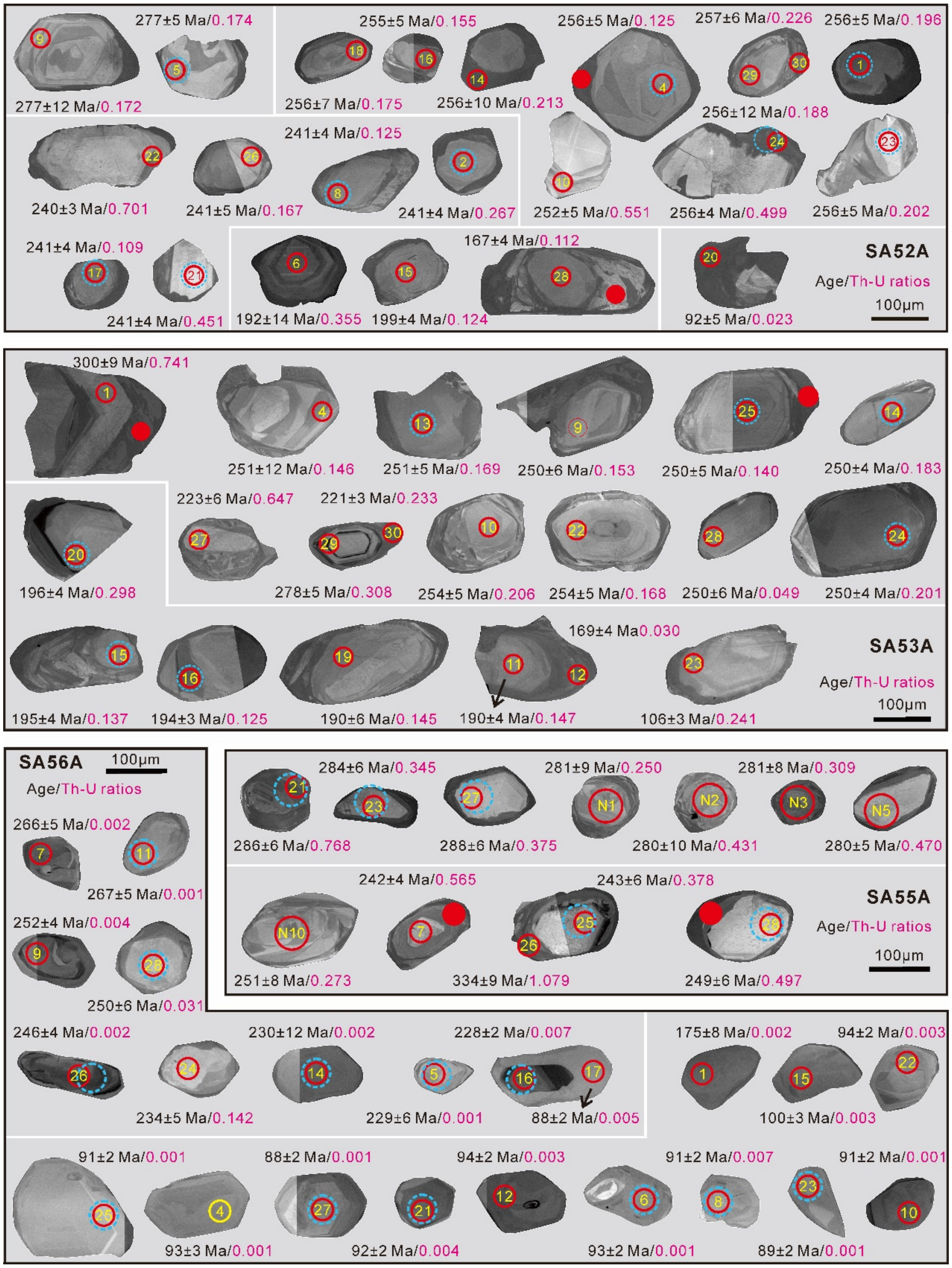
1.3 *Whole-rock geochemical analysis*

In addition to the dated samples, we collected further samples for geochemical analysis in each outcrop. These are similar in petrography varying slightly in the amount of main minerals and microfabrics. The major and trace element compositions of eleven eclogite samples (SA45A1–A4, SA52A, SA53A, SA55A, SA56A, KO30A, KO31A) of the SKC were generated using the XRF (Rigku RIX 2100) and the ICP-MS (PE6 100 DRC), respectively. All the analyses were performed at the State Key Laboratory of Continental Dynamics, Northwest University, Xi'an, China. All samples weretrimmed to remove weathered surfaces before being cleaned with deionized water and crushed to 200 mesh in an agate mill.

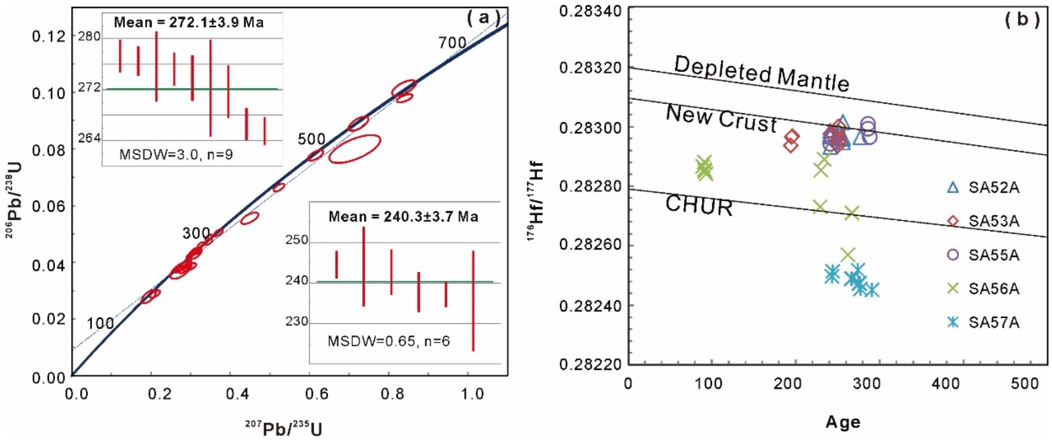
For major element analysis, 0.5 g sample powders were mixed with 5.2 g $Li_2B_4O_7$, 0.4 g LiF, 0.3 g NH_4NO_3 and minor LiBr in a platinum pot and melted to a glass disc in a high frequency melting instrument prior to analysis. For trace element analysis, sample powders were digested using a HF + HNO_3 mixture in high-pressure Teflon bombs at 190 °C for 48 h. Analyses of USGS and Chinese national rock standards (BCR-2, GSR-1 and GSR-3) indicate that both analytical precision and accuracy for major elements are generally better than 5 %, and for most of the trace elements except for the transition metals are better than 2 % and 10 %, respectively. In addition, one sample was selected randomly to be analyzed twice after every ten samples to assess the accuracy.



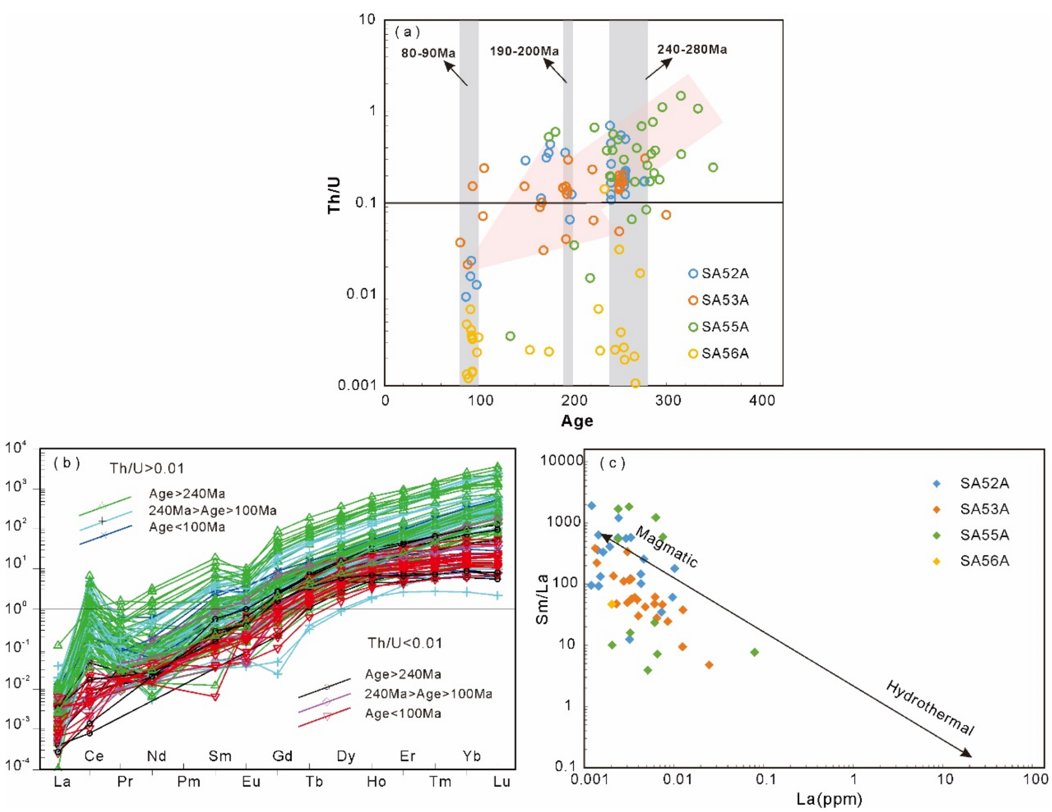
DR-Fig. 1: Microphotographs showing the mineralogy and microfabrics of studied eclogite samples. Abbreviations: Omp: omphacite, Grt: garnet, Qz: quartz, Amp: amphibole, Rt: rutile, Srp: serpentinized minerals, Ph: Phengite, Zo: zoisite.



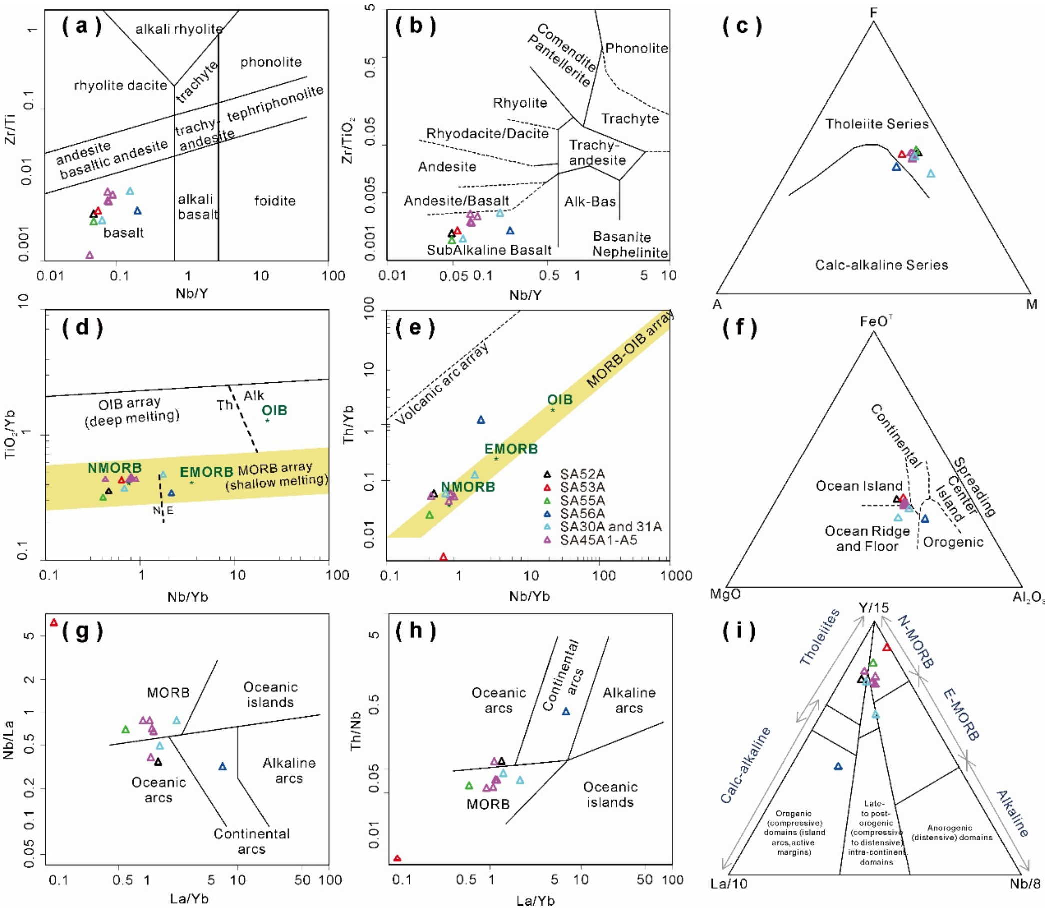
DR-Fig. 2: Cathodoluminescence images of studied eclogite zircons. Notation: Red circle means U-Pb dating point; blue circle means Hf data point; filled red circles means discordant point, their laser-ablation spot size was 29 μm and 44 μm, respectively. The number in N-x was 54 μm for some large grains.



DR-Fig. 3 Supplemental plot of Fig. 2 in the main text. U-Pb zircon age data (a) from meta-pegmatite samples (SA57A), weigthed $^{206}Pb/^{238}U$ mean ages are shown. CHUR: Chondritic Uniform Reservoir. New crust line is from Dhuime et al. (2011). In Hf isotopic diagrams (B), samples represent zircons from eclogites except SA57A, which is a Permian eclogite.



DR-Fig. 4: Trace element characteristics and variation diagrams of eclogite zircons. (a) Th/U ratio vs. age plot; (b) Chondrite-normalized REE diagram from McDonough and Sun (1995); (c) Plot of La vs. Sm/La from Hoskin (2005).



DR-Fig. 5: Geochemical characteristics of eclogites. Classification diagrams (a) Zr/Ti vs. Nb/Y plot (after Pearce, 1996); (b) Zr/TiO_2 vs. Nb/Y plot (after Winchester and Floyd, 1977); (c) AFM plot (after Irvine and Baragar, 1971) and tectonic discrimination diagrams (d) Nb/Yb vs. TiO_2/Yb plot and (e) Nb/Yb vs. Th/Yb plot (after Pearce, 2008); (f) FeO^T-MgO- Al_2O_3 plot (after Pearce et al., 1977); (g) La/Yb vs. Nb/La plot and (h) La/Yb vs. Th/Nb plot (after Hollocher et al., 2012); (i) La-Y-Nb diagram (after Cabanis and Lecolle, 1989). Explanation for samples is in panel (e).

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