Electronic Appendix A

ANALYTICAL METHODS

(a) Electron Microprobe Analysis

Compositional analyses of representative minerals of the high-pressure mafic granulite (sample G62) were determined using a wavelength dispersive JOEL JXA 8100 electron microprobe at the Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing. Compositional analyses of minerals of the other rocks (samples WH18, WH82, WH84, G59, G81 and G89) and X-ray compositional mapping of garnet (Fig. 5) were conducted using a JOEL JXA 8230 wavelength dispersive electron microprobe at the School of Resources and Environmental Engineering, Hefei University of Technology, China. The analytical conditions were: accelerating voltage of 15 kV, a beam current of 20 nA, an electron beam diameter of 3–5 μm, and counting time of 10–20 s. Natural and synthetic minerals were utilized as standards, and the program ZAF was employed for matrix corrections. At least three grains were analyzed for each mineral, and three (inclusion mineral) to one hundred (garnet) spots were analyzed on each grain. The representative mean chemical compositions of the minerals used for estimating *P-T* conditions are listed in Table S1.

(b) U–Pb Dating of Zircon

Zircon crystals were separated through conventional density and magnetic techniques and then were hand-picked for purity. Zircon from samples WH18, WH82, WH84, G59,

G81 and G89, as well as zircon standards Plešovice (Sláma et al., 2008) and Qinghu (Li et al., 2009), were mounted in 2.54-cm-diameter epoxy disks and then were polished to section the crystals in half for secondary ionization mass spectrometry (SIMS) analysis. Zircon grains of the metapelite sample G59 were mounted in another epoxy disk and processed in the same way for laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) analysis. Transmitted and reflected light micrographs and cathodoluminescence (CL) images of all the zircon grains were captured to reveal internal structures and to inform the selection of potential analytical spots.

(b.1) SIMS U-Pb Dating of Zircon

Zircon from samples G62, WH18, WH84, G89, WH82 and G81 mounted in the epoxy disks with zircon standards Plešovice (Sláma et al., 2008) and Qinghu (Li et al., 2009) were vacuum-coated with high-purity gold prior to SIMS analysis, and isotopes of U, Th, and Pb were measured using a Cameca IMS-1280 SIMS mass spectrometer, at the Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing. Detailed descriptions of the instrument and analytical procedure are given in Li et al. (2009). The size of the primary O_2^- ion beam spot was set as ~20 μm × 30 μm. The zircon standard Plešovice was tested to calibrate Pb/U ratios, and the zircon standard 91500 (Wiedenbeck et al., 1995) was employed to calibrate U and Th concentrations. The measurements were corrected for common Pb using non-radiogenic ^{204}Pb. An average present-day crustal composition (Stacey and Kramers, 1975) was adopted for common Pb based on the assumption that the common Pb is largely related to surface contamination introduced during sample preparation. The Isoplot/Ex program v. 3.75 (Ludwig, 2012) was used for data reduction.

Uncertainties of individual analysis given in the data table are reported at the 1σ level, and the concordia U/Pb (Pb/Pb) mean ages are given at the 95% confidence level. To monitor the external uncertainties of SIMS U–Pb dating, the zircon standard Qinghu was alternately analyzed as an unknown in this study. A total of 24 measurements of Qinghu zircon yielded a concordia age of 159.7 ± 0.58 Ma, which is identical to the reference value of 159.5 ± 0.2 Ma (Li et al., 2013). The SIMS dating results are listed in Table S2.

(b.2) LA-ICP-MS U–Pb Dating of Zircon

LA-ICP-MS U–Pb dating and trace element measurements of zircon separated from the metapelite sample G59 were conducted using an Agilent 7500a LA-ICP-MS connected to a Geolas-193 UV laser ablation system at the State Key Laboratory of Continental Dynamics, Northwest University, Xi'an, China. Detailed descriptions of the instruments and analytical procedures are provided by Liu et al. (2007). The spot diameter was set to ~30 μm and the laser repetition rate to 6 Hz. Helium was applied as the carrier gas and mixed with argon as the make-up gas before entering the LA-ICP-MS. U–Th–Pb ratios were calibrated against the external zircon standard 91500 with a reference $^{206}Pb/^{238}U$ age of 1064.1 ± 3.2 Ma (Wiedenbeck et al., 1995). Concentrations of trace elements were calibrated using the internal standard ^{29}Si, which refers to the synthetic silicate glass NIST 610 (Pearce et al., 1997). The GLITTER program v. 4.0 was employed for data processing, and the Isoplot/Ex program v. 3.75 (Ludwig, 2012) was used for data reduction. The LA-ICP-MS dating results are listed in Table S3.

(c) Whole-rock major elements

Fresh samples of granulite (G62), amphibolite (G89) and metapelite (G81) were crushed and powdered to 200 mesh in an agate mill. Whole-rock major elements were analyzed using fused glass disks by X-ray fluorescence (XRF) spectroscopy with a Philips PW1400 spectrometer at the Institute of Geology and Geophysics, Chinese Academy of Sciences (IGGCAS). Loss on ignition (crystal water) was determined by gravimetry after heating at 1100 °C. Analytical precision is generally ≤ 5%.