Supplementary Material 1: LA-ICP-MS zircon U-Pb dating method

Zircon grains were contracted from mechanical crushed rock sample weighted about 2-3 kg by conventional heavy liquid and magnetic separation methods, followed by hand-picking under a binocular microscope for purifying. Representative zircon grains were mounted on double-sided tape, cast in epoxy resin, and polished to expose the zircon insides suitable for analysis. Prior to U-Pb isotope analyses, microphotographs and cathodoluminescence (CL) images of the polished zircon grains were obtained by using a polarizing microscope (under both transmission and reflection modes) and a JSM6510 scanning electron microscope with GATAN CL, respectively, at the Beijing Gaonianlinghang Geo Analysis Co. Ltd. in order to reveal the morphology and internal structure of the zircon grains, and thus guiding the selection of potential analytical zircon domains.

Zircon U–Pb isotope analyses were conducted by using a laser ablation inductively coupled plasma mass spectrometer (LA-ICP-MS) at the Key Laboratory of Regional Geology and Mineralization, Hebei GEO University, China. The instrument couples a quadrupole ICP-MS (THERMO-ICAP RQ) and 193-nm ArF Excimer laser (RESOlution-LR) with Laurin Technic S155 sample-chamber and GeoStar μGISTM software. For the present work, laser spot size was set to 29 μm for most analyses, laser energy density at 3 J/cm^2, and repetition rate at 8 Hz. During the analytical procedure, each spot analysis comprised acquisition of 10 seconds for background (blank), 40 seconds for laser ablated sample, and 20 seconds for sample-chamber flushing after the ablation. The ablated material is carried into the ICP-MS by the high-purity Helium gas stream with flux of 0.6 L/min. The whole laser path was fluxed with Ar (0.8 L/min) to increase energy stability. The counting time is 20 ms for each element. Zircon 91500 (1062.4±0.8 Ma [1]) was used for external standard to calibrate in**ter-el**ement and isotopic fractionations, and zircon GJ–1 (602±3 Ma [2]) was also used as the secondary standard to supervise the deviation of age calculation. Analyses of zircon standards 91500 and GJ-1 during this study yielded ages of 1062.2 ± 5.1 Ma (mean square of weighted deviates (MSWD) = 0.25, n = 30; Figure A1), and 602.3 ± 3.8 Ma (MSWD = 0.51, n = 15; Figure A2), respectively, compared to their suggested reference ages. The data was processed using ICPMSDataCal software [3], and common lead correction followed the method of [4]. Decay constants used are those recommended by [5], and the concordia and relative probability diagrams, as well as pooled age calculation, were performed by using the program Isoplot 3.0 [6]. Analyses that were >10% discordant or < 5% reverse discordant were not considered further. The LA–ICP–MS zircon isotope ratios and age uncertainties presented in Supplementary Table S1 are quoted at the 1-sigma level, whereas those for pooled weighted mean ages are at the 95% confidence.

Due to small amount of ^{207}Pb formed in young (i.e. <1000 Ma) zircon grains, which results in high analytical uncertainties, the determination of the ages for young zircon grains has to be primarily based on their ^{206}Pb/^{238}U ratios, whereas the older zircon ages are derived from their ^{207}Pb/^{206}Pb ratios. This means that interpreted ages are ^{206}Pb/^{238}U ages for young zircon grains but ^{207}Pb/^{206}Pb ages for old ones.

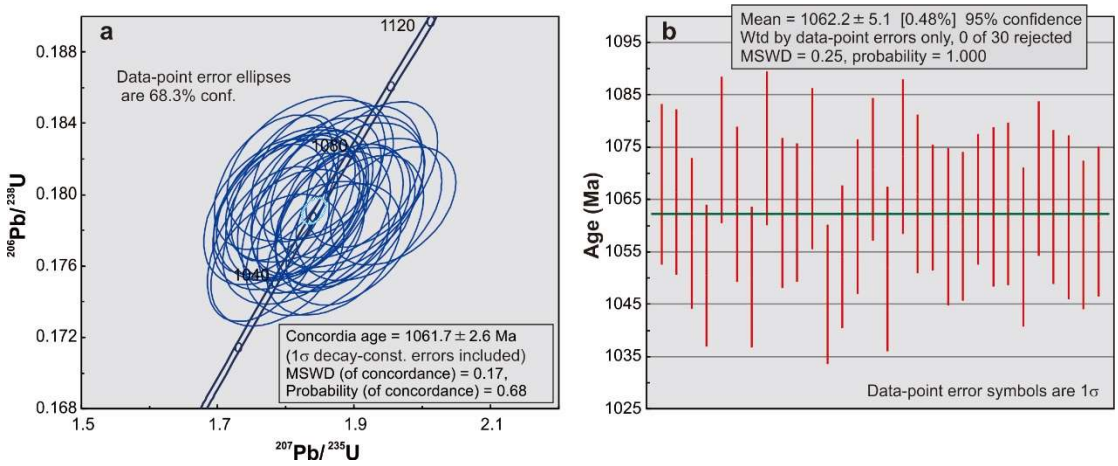

Figure S1. Analytical U-Pb data for standard zircon 91500

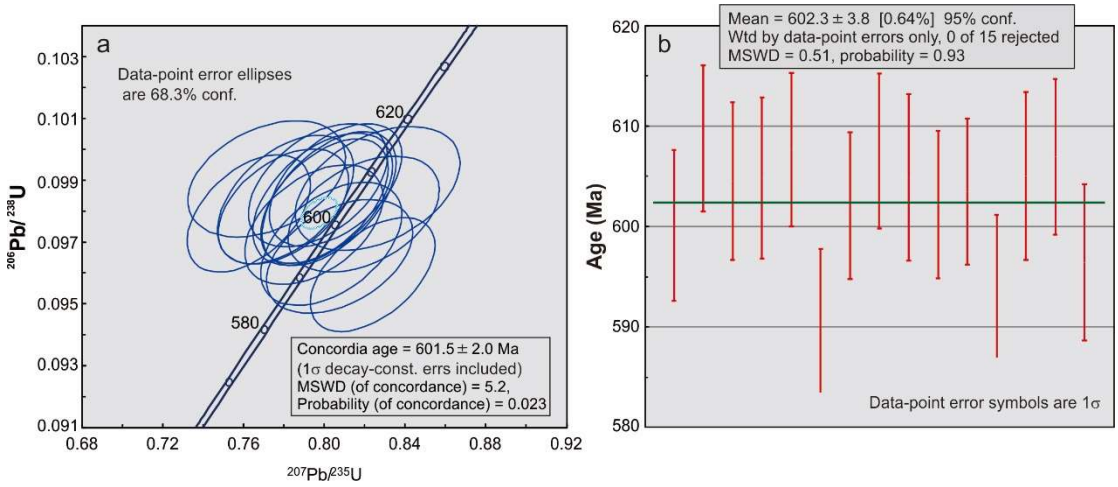

Figure S2. Analytical U-Pb data for standard zircon JG-1

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