**Supplement S1**

**Analytical methods**

Images of zircon in back-scattered electron (BSE) mode and zircon semiquantitative elemental spectra were acquired at the Institute of Geology of the Czech Academy of Sciences, Praha, using TESCAN Vega 3XMU scanning electron microscope (TESCAN ORSAY HOLDING, Brno, Czech Republic) equipped with a secondary electron detector (SE), a back-scattered electron detector (BSE) and a micro-analytical system for energy dispersive analysis (EDS) Oxford Instruments Ultim Max 65 with SDD (silicon drift detector) (Oxford Instruments, Abingdon, UK). An accelerating voltage of 20 kV was applied for the acquisitions of microphotographs and also for analytical acquisitions. The absorbed current for acquisitions of microphotographs was set to optimum values to obtain images of the best possible quality at higher magnifications. For the determinations of chemical composition with EDS, the absorbed current was set to achieve the optimum gain/yield of the detector.

Before 2017, elemental abundances of W, P, As, Nb, Ta, Si, Ti, Zr, Hf, Th, U, Y, La, Ce, Pr, Nd, Sm, Gd, Dy, Er, Yb, Al, Sc, Bi, Mn, Fe, Ca, Pb, S, and F in zircons were determined using a CAMECA SX100 electron microprobe housed at Masaryk University and Czech Geological Survey, Brno, and equipped with five WD spectrometers. Zircon composition was analyzed at an accelerating voltage and beam current of 15 kV and 40 nA, respectively, and with a beam diameter ranging from 1 to 5 μm. The following standards were used: metallic U (U), PbSe (Pb), ThO2 (Th), fluorapatite (P), YAG (Y), LaB6(La), CeAl(Ce), PrF3 (Pr), NdF3(Nd), SmF3 (Sm), GdF3(Gd), DyP5O14 (Dy), YErAG (Er), YbP5O14 (Yb), almandine (Al), andradite (Si, Ca, Fe), rhodonite (Mn), scheelite (W), baryte (S), topaz (F), InAs (As), columbite (Nb), CrTa2O6 (Ta), titanite (Ti), zircon (Zr), and ScVO4 (Sc).

After 2017, major and some minor elements in zircon were analyzed using the Jeol JXA— 8230 electron microprobe (JEOL Ltd., Akishima, Tokyo, Japan) housed at the Institute of Geology of the Czech Academy of Sciences, Praha, operated in the wavelength-dispersive mode. Elemental abundances of F, Al, Si, P, S, Ca, Sc, Ti, Mn, Fe, As, Y, Zr, Nb, La, Ce, Nd, Sm, Dy, Er, Yb, Hf,W, Pb, Bi, U, and Th in zircon were determined at an accelerating voltage of 15 kV and a beam current of 15 nA and with a beam diameter ranging from 1 to 2 microns. The counting times on each peak were optimized for individual elements according to their expected concentrations (20–60 s), and twice, half that time was used to obtain background counts on both sides of the peak. Again, X-ray lines and background offsets were selected to minimize interference. The following reference materials were used: fluorite (F), corundum (Al), quartz (Si), apatite (P), baryte (S), diopside (Ca), metallic Sc (Sc), rutile (Ti), Mn3O4 (Mn), hematite (Fe), gallium arsenide (As), synthetic cubic zirconia (Y, Zr), metallic Nb (Nb), REE glass standard La, Ce, Dy, Er, Nd, Sm, Yb, metallic hafnium (Hf), metallic W (W), crocoite (Pb), metallic Bi (Bi), metallic Th (Th), and metallic U (U). In all minerals, raw data were processed using the PRZ correction procedure (XPP method metal/oxide was applied). Empirically determined correction factors were applied to the overlapping X-ray lines. Detection limits (3 sigma) in wt. % were as follows: 0.009 (S), 0.012 (P), 0.013 (Ti), 0.015 (Hf), 0.018 (Ca), 0.020 (Nb, Sc), 0.025 (Si), 0.025 (La, U), 0.027 (Pb), 0.028 (F, Ce), 0.035 (Th), 0.040 (As, Ba), 0.048 (Gd, Mn), 0.050 (Er), 0.060 (Al, Fe, Y), 0.065 (Yb), 0.070 (Na), 0.075 (Zr), and 0.110 (Dy).

Empirical formulae were calculated on the basis of four atoms of oxygen in a formula unit (apfu).