**S1. Supplementary material. Analytical methods**

*Mineral chemistry and monazite EPMA geochronology*

Chemical mineral characterization was made in two representative metapelitic samples: sample 7621 of metatexite from El Portezuelo Metamorphic–Igneous Complex and 14067 sample of garnet schist from Quebrada del Molle Metamorphic Complex. The chemical analyses were performed with an electron microprobe (EPMA) CAMECA SX 100 equipped with five wavelengths dispersive (WDS) spectrometers at the Institut für Mineralogie und Kristallchemie, Stuttgart University, Germany. For analysing silicates we used an accelerating voltage 15 kV and beam current of 10 to 20 nA. Mineral compounds were used as standards.

Structural formulae were calculated for garnet, cordierite, biotite, white mica and plagioclase on the basis of 24, 18, 22, 22 and 32 anhydrous oxygen, respectively. All Fe was treated as FeO. The complete list of chemical analyses is reported in Table 1 of the Supplementary Material.

For in situ U-Th-Pb dating of monazite (EPMA geochronology) we used an acceleration voltage of 20 kV, a beam current of 150 nA and a beam size of ~ 3 µm. For each full analysis of monazite, the most common rare-earth elements (REEs) and Pb, U, Th, P, Ca, Si and Y were measured using the following emission lines and standards: Ca-Kα (diopside), U-Mß (UO2), Th-Mα (ThO2), Pb-Mα (PbTe), P-Kα (apatite), Ce-Lα, La-Lα, Y-Lα, Pr-Lß, Nd-Lα, Sm-Lα and Gd-Lß (REE orthophosphates), Si-Kα (wollastonite). For the backgound measurements of REEs, we followed the recommendations of Reed & Buckley (1998). The counting times on both peak and background for the critical elements Pb, U and Th were: 300 s for Pb-Mß, 150 s for U-Mα and Th-Mα, 600 s for Pb-Mß, 300 s for U-Mα and Th-Mα. We measured U and Th with a normal-sized PET spectrometer crystal, while Pb was analysed using a large PET crystal. Similar to Scherrer *et al*. (2000), a (small) correction of the U-Mß peak was applied due to the contribution of the Th-Mγ line. Pb concentrations were further corrected due to peaks of Y and Th overlapping Pb-Mα.The counting times for all other elements ranged between 200 s and 20 s for both peak and background. All REEs were measured with LIF (lithium fluoride) spectrometer crystals. For calculations the Isoplot program of Ludwig (1999) was applied. Analytical conditions have been tested against different Palaeozoic monazites before and after each measuring session (Saidenbachite monazite: Massonne *et al*. 2007; Moacyr monazite: Dumond *et al.* 2008). The results of the monazite standard analyses are reported in document S3 of the Supplementary material. These monazites have been dated with other geochronological methods as well.

*U-Pb LA-MC-ICP-MS geochronology*

Zircon and monazite grains were separated following the classic method. The starting material was 3 kg of rock which was crushed and sieved. The fractions retained in less than 140-micron mesh were separated using hydraulic processes to obtain heavy mineral preconcentrates. These were treated with bromoform to obtain the complete heavy mineral spectra. Methylene iodide was used to achieve a fraction enriched in zircon and monazite, followed by electromagnetic separation with a FrantzTM Isodynamic equipment when necessary. The final selection of crystals, mounted in 2 cm diameter epoxy resin and polished, was examined under a binocular microscope. The grains were photographed in reflected and transmitted light, and cathodoluminescense (CL) images were produced in order to investigate the internal structures of crystals as well as to characterize different populations.

LA-ICP-MS analyses were carried out at the Geochronological Research Centre, Sao Paulo University, Brazil, using a 193nm excimer laser (Photon Machines) coupled to a Neptune multicollector, double-focusing, magnetic sector ICP-MS. Operating procedures and parameters are discussed by Sato *et al*. (2011). Fractionation in the plasma was corrected by normalizing U/Pb and Pb/Pb ratios of the unknown samples to those of zircon standards (GJ 1, 206Pb/238Pb age by IDTIMS = 599.8 ± 2.4 Ma).

*U-Pb SHRIMP geochronology*

The U-Th-Pb SHRIMP analyses in zircon were made using SHRIMP RG at the Research School of Earth Sciences, The Australian National University, Canberra, Australia as described by Williams (1998, and references therein). Each analysis consisted of 4 scans through the mass range, with the reference zircon analysed once for every five unknown samples. Subsequently, the data were reduced using the SQUID Excel macro of Ludwig (2001). Since young zircons with normal U contents have low 207Pb/235U ratios and statistically highly imprecise 204Pb/206Pb ratios, common-Pb correction was made using the measured 204Pb measurements only for ages older than about 1100 Ma, and 207Pb measurements for younger ages (see Williams 1998); in the latter case there are no common-Pb corrected 207Pb/235U ratios reported in Table 4 of the Supplementary Material.

*40Ar-39Ar geochronology*

Mechanical separation of biotite and white mica from the whole rock and the following 40Ar/39Ar analyses were done at the Geochronological Research Centre of the University of São Paulo (Brazil). Separation and concentration consisted of hand crushing of centimetre-scale sample chips using steel pestle and mortar to reduce size to mm-scale, sieving for size fractions of #250-500 and <#250 µm and final magnetic purification through a isodynamic FrantzTM separator.

Micas were loaded as multi-grain replicates into a 21-pit aluminium disk along with the Fish Canyon sanidine standard (FCs) arranged in a cross-like geometry. Neutron-flux irradiation was taken in the cadmium lined in-core (CLICIT) facility at the Oregon State University TRIGA reactor, for 15 hours. After radioactive cooling (approximately 4 weeks), each sample was divided into two aliquots, each one containing two or three irradiated grains, and loaded on a Cu-disk and progressively step-heated by a solid state Nd:YVO4 (532 nm) Verdi 6W Coherent laser. Data reduction including correction for nuclear interferences, background (blank) and mass discrimination, as well J-value determination and graphical representation were made using the Ar/ArCALC v2.5.2 software (Koppers 2012). The ages for the unknown samples were calculated relative to the age of 28.01 ± 0.04 Ma for the FCs standard (Phillips & Matchan 2013), assuming the 40K decay constant of Steiger & Jäger (1977). The J-factor value for this irradiation was 0.00423 ± 0.00003.