Auxiliary Material B2: Apatite and Zircon (U-Th)/He Thermochronology Analytical Procedures

All apatite and zircon (U-Th)/He analyses were conducted at the University of Kansas Isotope Geochemistry Laboratory. Euhedral mineral grains selected were between 70 – 120 μm (width) and 100 – 200 μm (length). Each grain was individually photographed, measured, and Ft corrected using Alpha-Ejection Correction software [*Farley et al*., 1996]. 3 aliquots were run for each sample unless further analysis was necessary for better reproducibility. 6 single grain aliquots were run for each detrital sample. ^{4}He was degassed in an ultra high vacuum line by heating with a Nd:YAG laser [*House et al*., 2000]. Individual apatite aliquots were heated for ~5 minutes at 1085°C, and zircon aliquots for ~10 minutes at 1285°C. The liberated gas was spiked with ^{3}He and cooled to ~16 K in a cryogenic trap in order to remove any impurities and increase the mass spectrometric measurement by ~60%. The ^{4}He/^{3}He ratio was then measured via isotope dilution using a Balzers Prisma quadrapole noble gas mass spectrometer. Following ^{4}He extraction, aliquots were prepared for analysis of parent isotopes ^{238}U, ^{235}U, ^{232}Th and ^{147}Sm. Apatites samples were left in Pt packets, dissolved with 27% HNO_3 and spiked with known amounts of ^{235}U, ^{230}Th, and ^{149}Sm. Zircon grains were unpacked from Pt packets, spiked with ^{235}U, ^{230}Th, ^{149}Sm, loaded into Teflon micro-capsules, and dissolved in pressure digestion vessels in an HF-7N HNO_3 mixture for 84-96 hours at 220°C followed by 6N HCl for 12 hours at 180°C. U, Th, and Sm contents were measured via isotope dilution on an inductively coupled plasma mass spectrometer (ICP-MS), and the parent-daughter ratios were used to calculate the cooling age.

Farley, K., R. Wolf, and L. Silver (1996), The effects of long alpha-stopping distances on (U-Th)/He ages, *Geochimica et Cosmochimica Acta*, *60*(21), 4223-4229.

House, M., K. Farley, and D. Stockli (2000), Helium chronometry of apatite and titanite usingNd-YAG laser heating, *Earth and Planetary Science Letters*, *183*(3-4), 365-368.