Geophysical Research Abstracts, Vol. 7, 06696, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06696

A new procedure for the routine zircon (U-Th)/He age measurement

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The zircon (U-Th)/He system holds great potential as a thermochronometer to provide insight into the thermal histories of, for instance, orogenic belts, especially when integrated with apatite (U-Th)/He, fission track and ^{39}Ar-^{40}Ar techniques. Recent advances in the understanding of the diffusive behaviour of He in zircon predict a partial retention zone between 170-190˚C [1]. Although He extraction is routine, several different procedures for U and Th extraction are currently in use. These methods require large volumes of flux [2], and are prone to partial recovery of U and Th [1] and reduced analytical precision. The principal aim of this project was to develop a simple and routine technique for the dissolution of zircon allowing fast sample throughput without the above complications. We have developed a procedure based on conventional U-Pb acid dissolution techniques followed by ion exchange column chemistry.

Individual crystals are loaded into Pt capsules, and heated to 1190ºC for 30 minutes to extract the helium. The Pt capsules are then dissolved in a Parr™ bomb using HF and HNO with mono-isotopic U and Th spikes, followed by HCl. Dissolution in 1.5 M HNO_3 then allows the samples to be passed through TRU resin (50-100 μm). The resin bed is rinsed with 1.5 M HNO_3, and 3 M HCl removing matrix elements and contaminating Pt, before elution of U and Th using 0.1 M HCl and 0.3 M HF, and a final dissolution in dilute HNO_3 before ICP-MS analysis. The complete dissolution of both zircon and Pt capsule prevents the possibility of partial U and Th extraction through incomplete recovery of fractured crystals, and deposition of volatilised U and Th on the inner surface of the Pt capsules. It also avoids the introduction of large volumes of Li metaborate or other flux and, although the column chemistry requires approximately 5 hours, it allows the complete removal of the Pt preventing (i) Pt-Ar^+ interference at masses 230, 232, 234, 235, 236 and 238, (ii) sensitivity reduction and

(iii) “memory effects” during ICP-MS analysis.

6 single zircon crystals from Fish Canyon Tuff yield a mean (U-Th)/He age of 26.1 $\pm$ 2.3 Ma. This compares to (U-Th)/He ages of 28.6 $\pm$ 1.4 Ma [2] and 27.3 $\pm$ 2.1 Ma [3], the accepted zircon fission track age of 27.8 $\pm$ 0.7 Ma, and the zircon U-Pb age of 27.52 $\pm$ 0.09 Ma [4], and shows this procedure is viable for routine determination of zircon (U-Th)/He ages. Further data obtained from this study, showing the application of this thermochronometer to determine rates of plutonic cooling and denudation will be discussed.

[1] Reiners et al. (2004) *Geochimica et Cosmochima Acta*. **68**, 1157-1887

[2] Tagami et al. (2003) *EPSL*. **207**, 57-67

[3] Reiners et al. (2002) *Tectonophysics*. **349**, 247-308

[4] Lanphere & Baadsgaard (2001) *Chemical Geology*. **175**, 653-671