THE DIAMANTINA MONAZITE: A PROPOSED LOW-TH NEW REFERENCE MATERIAL FOR MICROANALYSIS

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RESUMO: The increase of use of laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) for U-Pb geochronology or Nd (monazite)-Hf (zircon) isotopic tracing has increased the need for well-calibrated reference materials, because of the inherently destructive nature of the technique. An ideal natural mineral for these purposes should be chemically and isotopically homogeneous, devoid of imperfections (e.g. fractures, inclusions, zoning) and available in sufficient quantities for distribution to different laboratories. The variable Th content (thousands of ppm to > 20 wt. %) in monazite might be a challenge in the development of new reference materials (r.m.) due to the potential for matrix effects (especially for U-Pb and O isotope analyses by SHRIMP/SIMS). The few available monazite r.m. have Th contents ranging from ~ 3 wt% (USGS 44069) to ~ 13 wt% (Thompson Mine). Currently, there is no low-Th monazite reference material for U-Pb geochronology by LA-ICP-MS, and only very small quantities of a monazite r.m. (2234) is available for U-Pb geochronology by SIMS/SHRIMP. Low-Th monazite is commonly found in hydrothermal and diagenetic systems, as well as in carbonatites. In this last case, the low Si activity stabilizes accessory minerals such as baddeleyite or perovskite, for which the U-Pb systematics is not straightforward or is hampered by the lack of standards. This facilitates the dating of other accessory minerals more commonly used, such as monazite. We propose in this work a hydrothermal monazite from the Diamantina area (Espinhaço range, SE Brazil), as a low-Th reference material for U-Pb geochronology (LA-ICP-MS and SHRIMP/SIMS) and Sm-Nd isotope geochemistry (LA-ICP-MS). BSE imaging shows that the sample is homogeneous, with no chemical zoning or inclusions. U-Pb ID-TIMS dating (Toronto and Oslo) yielded a Concordia age of 495.5 ± 0.5 Ma. LA-(Q, SF and MC)-ICP-MS U-Pb geochronology performed at Universidade Federal de Ouro Preto (UFOP) and Australia National University (ANU) and SHRIMP analyses (ANU) yield the same age as the TIMS age, within error. LA-ICP-MS dating using Diamantina monazite as primary r.m. successfully reproduced the ages of other monazite U-Pb standards (USGS 44069, Bananeira and Thompson Mine), treated as unknowns. Besides its use as a primary calibration material for geochronology, Diamantina monazite would also be very useful more generally as a secondary (quality control) standard to assess composition-related matrix effects when dating using higher-Th monazite primary standards. LA-MC-ICP-MS Sm-Nd isotope measurements (UFOP) show that Diamantina monazite is also an excellent potential reference material for Nd-isotope tracing, with εNd_{495Ma} = -18.6 ± 0.4 (2SD). Additionally, in a plot of $^{147}Sm/^{144}Nd$ vs. $^{143}Nd/^{144}Nd$, the data group together and are consistent with the 495 Ma theoretical isochron. The $^{147}Sm/^{144}Nd$ and $^{143}Nd/^{144}Nd$ ratios have relative standard deviation of 0.56% and 0.002%, respectively, comparable or better than other proposed Sm-Nd reference materials for LA-MC-ICP-MS (e.g. Steenkampskraal, Manangoutry or Itambé). Therefore, we propose Diamantina monazite as a low-Th reference material for U-Pb geochrology by LA-ICP-MS or SHRIMP and as potential Sm-Nd isotope reference material for LA-MC-ICP-MS, subject to obtaining solution ID-TIMS Sm-Nd-isotope data. We are willing to distribute this material upon request to other facilities.

PALAVRAS-CHAVE: MONAZITE, REFERENCE MATERIAL, LA-ICP-MS