

A new EPMA standard for CHIME dating: chemical compositions of monazite grains from Madagascar

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Chemical U-Th-Pb dating of monazite and zircon (e.g. CHIME by Suzuki and Adachi, 1991) is widely used in geochronological research. Electron probe microanalyzer (EPMA) studies of U, Th and Pb provide high-spatial resolution data for age determination in monazite and zircon grains.

It is important to prepare high quality standard materials for the EPMA analysis of U, Th and Pb. However, suitable standards for U and Th are not easy to obtain.

To obtain a reliable Th standard, two monazite grains (mm-4 and mm-1) from Madagascar were analysed by EPMA. Euxenite provided by Smellie et al (1978) and glasses by Drake and Weill (1972) were used as standards for U, Th, Y and rare earth elements. The effects of X-ray interference for REEs, U and Pb were carefully removed using the methods of Reed and Buckley (1998) and Suzuki et al. (1999). For REE analysis, an improved analysing crystal was used to obtain high-energy resolution.

The elements measured and their detection limits (as weight percent at 2 sigma) are: P (0.02), Si (0.002), Ca (0.03), U (0.003), Th (0.02), Pb (0.007), Y (0.008), La (0.03), Ce (0.02), Pr (0.02), Nd (0.02), Sm (0.02), Eu (0.02), Gd (0.02), Tb (0.02), Dy (0.02), Ho (0.02), Er (0.02), Tm (0.02), Yb (0.02), Lu (0.02), Ti (0.02), Cr (0.01), Al (0.01), Fe (0.02), Sr (0.02), Zn (0.02), Cu (0.03), Ni (0.03), Mn (0.006), K (0.01), Na (0.01), Cl (0.02) and F (0.03). The following elements were not detected in either grain: Ti, Cr, Al, Fe, Sr, Zn, Cu, Ni, Mn, K, Na, Cl and F. The average chemical compositions (as weight percent) of ten analyses on each monazite grain are as follows:

(mm-4) SiO₂ = 4.00, P₂O₅ = 23.4, UO₂ = 0.52, ThO₂ = 18.5, PbO = 0.43, CaO = 0.15, Y₂O₃ = 0.86, La₂O₃ = 6.38, Ce₂O₃ = 22.0, Pr₂O₃ = 3.43, Nd₂O₃ = 12.5, Sm₂O₃ = 3.82, Eu₂O₃ = 0.06, Gd₂O₃ = 3.22, Tb₂O₃ = 0.10, Dy₂O₃ = 0.22, Ho₂O₃ = 0.55, Er₂O₃ = 0.00, Tm₂O₃ = 0.36, Yb₂O₃ = 0.00, Lu₂O₃ = 0.00

(mm-1) SiO₂ = 1.36, P₂O₅ = 27.9, UO₂ = 0.38, ThO₂ = 10.7, PbO = 0.22, CaO = 0.91, Y₂O₃ = 3.34, La₂O₃ = 9.94, Ce₂O₃ = 22.6, Pr₂O₃ = 2.86, Nd₂O₃ = 11.2, Sm₂O₃ = 2.53, Eu₂O₃ = 0.60, Gd₂O₃ = 2.91, Tb₂O₃ = 0.21, Dy₂O₃ = 0.49, Ho₂O₃ = 0.62, Er₂O₃ = 0.24, Tm₂O₃ = 0.45, Yb₂O₃ = 0.25, Lu₂O₃ = 0.20

Both monazite grains contain sufficient amounts of thorium and uranium to be useful as standard materials for CHIME dating of monazite and zircon. In addition, grain mm-1 contains enough yttrium. However, since the monazite grains contain both Th and U, peak separation must be done to remove the effects of X-ray interference between the Th M beta line and the U M alpha line.

References

- Drake, M.J. and Weill, D.F., *Chem. Geol.* 10: 179, 1972
- Reed, S.J.B. and Buckley, A., *Min. Mag.* 62: 1, 1998
- Smellie, J.A.T., Cogger, N. and Herrington, J. *Chem. Geol.* 22: 1, 1978
- Suzuki, K. and Adachi, M., *Geochem. J.* 25: 357, 1991
- Suzuki, K., Adachi, M., Kato, T. and Yogo, S., *Geochemistry* 33: 1, 1999