

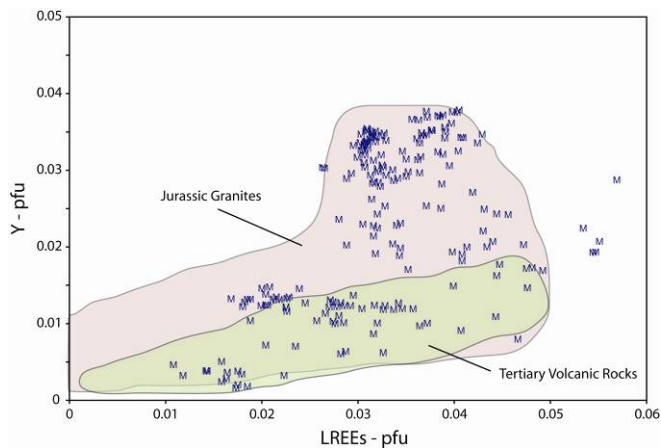
Titanite as a tool in tephra provenance studies: An example from the Late Jurassic

BART J. KOWALLIS¹, ERIC H. CHRISTIANSEN¹
AND ANDREW P. BARTH²

¹Department of Geology, Brigham Young University, Provo, UT 84602

²Department of Geology, IUPUI, 723 West Michigan Street, Indianapolis, IN 46202

Titanite (sphene) is a common accessory mineral in plutonic and metamorphic rocks, but has been reported to be uncommon in volcanic rocks. This does not appear to be the case for the Middle and Late Jurassic ashes preserved as bentonites in the Temple Cap, Carmel, and Morrison Formations in southwestern Utah where more than 50% of 120 ash beds examined contain titanite. In Cretaceous and Tertiary volcanic ash beds from western North America, only about 7% of 130 beds examined have titanite. Chemical analyses of the Jurassic bentonites suggest that they are derived from mostly calc-alkaline fallout ash that temporally and spatially appears to have originated from the Mesozoic volcanic arc located to the west of the bentonite localities. However, correlating the ash beds to more exact source areas than just the Jurassic arc has not previously been done. We have found that titanites from some Late Jurassic Morrison Formation ash beds (dated at 150 to 148 Ma) have elevated concentrations of LREEs, Y and Mn. Figure 1 shows Y vs LREEs per formula unit for titanites from Morrison Formation ash beds compared to titanites from Tertiary volcanic and plutonic rocks from the western US and to some Late Jurassic granites from southern California. The range of compositions for Morrison Formation titanites is close to the range of the Late Jurassic granites and suggest that at least some of these ash beds may have erupted from this part of the arc. Locating the source area for these ash beds may help us better constrain the tectonic processes responsible for this Late Jurassic magmatic pulse.



Influence of matrix effects on U-Th-Pb dating of monazite by ion microprobe

A. MÖLLER¹ AND D.R. NELSON²

¹Institut f. Geowissenschaften, Univ. Potsdam, Postfach 601553 D-14415 Potsdam (amoeller@geo.uni-potsdam.de)

²Department of Applied Physics, Curtin University, Bentley 6102, Australia (d.nelson@info.curtin.edu.au)

Monazite is unarguably the second most important mineral used for U-Th-Pb dating. Its high U and Th abundances enable determination of very precise dates and its chemistry (e.g. Y content) may be used as an indicator of monazite growth reactions, allowing direct correlation of age data to the metamorphic, magmatic or fluid evolution (e.g. Foster et al. 2000; Pyle et al. 2001).

However, numerous authors have noted that ion microprobe analysis of Th-rich monazite can yield discordant Pb-U and Pb-Th dates that may compromise their accuracy (e.g. Stern & Berman 2000; Zhu & O'Nions 1998) and geological interpretation. This discordance may be attributable to matrix effects, i.e. differences between the ablation or ionization characteristics of the inter-element fractionation standard is not appropriate for high-Th monazite. Yet no systematic attempt has been made to relate the effect to the crystal chemistry of monazite and the different possible substitutions towards the phosphates brabantite ($\text{CaTh}(\text{PO}_4)_2$), and xenotime (YPO_4) or the silicate huttonite (ThSiO_4). For example, the F6 standard used for chemical U-Th-Pb dating belongs to the brabantite series, whereas the MAD SHRIMP standard used in Perth is part of the huttonite series. Our study aims to fill this gap.

We will report results from comparative EMPA and ion microprobe studies carried out on the same monazite grains covering parts of the different solid solution series. In a first phase, monazites with ages older than 200 Ma were chosen to avoid possible additional complications from the presence of excess ^{206}Pb .

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References

- Foster G., Kinny P., Vance D., Prince C. and Harris N., (2000) *EPSL* **181**, 327-340.
- Pyle J.M., Spear F.S., Rudnick R.L. and McDonough W.F., (2001) *J. Petrol* **42**, 2083-2107.
- Stern R.A. & Berman R.G. (2000) *Ch Geol* **172**, 113-130.
- Zhu X.K. & O'Nions R.K. (1998) *Ch Geol* **144**, 305-312.