What controls the composition of low-temperature monazite?

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Low-T monazite is characterized by lower Th than high-T counterparts, and by higher Eu and the absence of a significant Eu anomaly. These features, and other variations in REE, can provide insights into the influences of bulk rock and fluid compositions, and P-T on the growth of low-T monazite. Five generations of monazite with distinctive compositions occur within greenschist-facies meta-sedimentary rocks of the Jack Hills belt in Australia.

Monazite in iron ore derived from BIF is ~3.08 Ga and has very low concentrations of both U (~10–150 ppm) and Th (<0.5%). It has unusually high Eu (0.5–1.7% Eu_2O_3) and a positive Eu anomaly, which distinguishes it from monazite in clastic sedimentary rocks. Monazite from pelitic schist related to a major shear zone that cuts the Jack Hills belt is dated at ~1.85 Ga. It has low U and Th, and only a slight negative Eu anomaly, typical of low-T metamorphic monazite.

Three generations of monazite, discrete grains rather than single grains preserving multiple ages, are found in one sample of conglomerate. A ~3 Ga group occurs in heavy mineral bands with zircon, chromite and xenotime. It has low Th (<2%) and low U (<100 ppm), as well as low La and high Nd (but a pronounced negative Eu anomaly). Grains <3 Ga are interpreted to be derived from detrital monazite by dissolution and reprecipitation. By contrast, Neoarchaean (~2.6 Ga) metamorphic monazite has relatively high U but low Th (both ~1%). It has a negative Eu anomaly, but high La and low Nd resulting in a distinctly different REE pattern from the older group. The third generation of monazite in the conglomerate has ages <1.0 Ga, very low U (<50 ppm) and Th (<0.5%), a negative Eu anomaly and La and Nd values between the two other groups. The occurrence of three generations of monazite with different chemistries within the same sample suggests that composition may be influenced more by the chemistry of metamorphic fluids and T than the compositions of precursor phosphates or the bulk rock. Deciphering these chemical characteristics will facilitate modelling of low-T fluid flow and metamorphic processes.

Submarine volcanism in the Ross Sea, Antarctica: Bearing on the nature of mantle sources

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We dredged some Neogene basanitic lavas from seven volcanic edifices in the Ross Sea, Antarctica – a part of the West Antarctic Rift System (WARS) and one of the world's largest alkaline magmatic provinces – for a study aimed at two principal objectives: (1) Geochemically interrogating the most primitive magmatic rocks to try and understand the nature of the seismically abnormal mantle domain recently identified beneath the shoulder of the Transantarctic Mountains (TAM), the Ross Sea Embayment and Marie Byrd Land; and (2) Using $^{40}Ar/^{39}Ar$ geochronology to establish a temporal link between magmatism and tectonism, particularly in the Terror Rift. We have attempted to answer the questions of whether magmatism is due to a hot mantle or wet mantle, and whether rifting in the area triggered magmatic activity of vice versa.

Early results show that the area does not have an age-progressive hotspot track, and the magmatism post-dates the main phase of extension along the Terror Rift within the WARS, which supports a decompression melting model without the benefit of a significant thermal anomaly. However, preliminary volatile measurements on olivine-hosted melt inclusions have not yielded high water concentrations (<1 wt%), though this effort still needs to be expanded before a clear picture emerges. The major oxide compositions of lavas in the WARS are best matched to experimental melts of carbonated peridotite, though garnet pyroxenite can also be a minor source. The Pb and Nd isotopic systems are decoupled from each other, suggesting removal of fluid-mobile elements from the mantle source possibly during the long history of subduction along the Paleo-Pacific margin of Gondwana. Extremely unradiogenic $^{187}Os/^{188}Os$ ranging to as low as 0.1081 ± 0.0001 hints at the involvement of lithospheric components in generation of magmas in the WARS.