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Monazite, Accessory (to the) Regional Manager: Simultaneous multi-isotopic and elemental analysis of monazite as pathfinder for VHMS mineralization.

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Monazite has taken a leading role in petrochronology due to its ability to incroporate a broad range of trace elements (TE), including Sm-Nd, in addition to its qualities as a reliable U-Pb geochronometer. Due to the similar isotopic behaviour of the Hf and Nd isotopic systems, they can both be used to identify source material from the depleted mantle versus crust. Recent developments in techniques have enabled robust in-situ Sm-Nd isotopic analysis of accessory minerals which bridge the gap between Nd-in-monazite and the traditional Hf-in-zircon investigations.

Metamictization of zircon renders it unreliable for U-Pb geochronology, whereas monazite is impervious to the effects of metamictization and as such is a more robust in dating the crystallization of Ca-poor, U-rich plutonic rocks. The Archaean Penzance granite, in the Yilgarn Craton, Western Australia, is a HFSE-enriched granite that is associated with the Teutonic Bore volcanic-hosted massive sulphide (VHMS) Camp, and that contains metamict zircon with juvenile εHf_0 isotopic signature [1]. We obtained new simultaneous Laser Ablation Split-Stream (LASS) Inductively Coupled Plasma Mass Spectrometry (ICPMS) Sm-Nd isotopes, U/Th-Pb dating and TE analyses which indicate that monazite from the Penzance granite also record juvenile εNd_t isotopic signature (εNd_0 ca. +1.7). Furthermore, the Penzance monazite have pronounced negative Eu anomalies, distinctive Gd_N/Lu_N versus Eu_N/Eu_N* values and REE, compared to monazite from other source rocks, and undisturbed U-Th-Pb system. Therefore, with combined U-Pb-TE-Nd isotope analyses, monazites bear great potential as a tool to preserve and monitor the distinctive character of parental granite.

In addition to the Penzance granite, temporal and spatial association between juvenile, HFSE-rich granites and VHMS-fertile volcanic sequences has been reported elsewhere in the Yilgarn Craton and throughout the world. Geochemical and geochronological analysis of detrital accessory mineral phases has been employed as a pathfinder for mineral deposits in several recent studies, albeit such exploration tools require minerals with distinctive chemical signatures that can also act as geochronometers. The results presented here suggest that monazite might be effectively used as an indicator of detrital sourcing from juvenile, HFSE-rich granites, and, therefore, VHMS favourable terrains.