The use of apatite and titanite as a new window into magma genesis and early Earth

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The use of detrital zircons has been widely applied to the investigation of crustal evolution and sedimentary provenance. However, trace element chemistry of zircons does not provide useful constraints on magma chemistry or petrogenesis. Here we present new results showing that other accessory minerals (particularly apatite and titanite) can offer new insights into the host magmas and ultimately into the Early Earth.

New results show that the compositions of apatite and titanite allow: (i) back-calculation of the REE content of the melt (and thence host rock), and (ii) estimation of the original whole rock Sr content. It is further shown that the chemistry of apatite inclusions armoured within zircon can also help to constrain the petrogenesis of the granitoids, offering new information that may not be apparent from whole-rock chemistry. Finally, the high Ba-Sr granites (Northern Highlands, Scotland) studied in this contribution, which have been suggested to represent "Phanerozoic sanukitoids", provide constraints on the behaviour of accessory phases within sanukitoid magmas. Sanukitoid chemistry has been defined as intermediate between that of typical TTG signature and modern arc granitoids. They appear between 2.95-2.68 Ga and have been linked to the onset of subduction, which makes them essential to understand the development of modern plate tectonics. The results highlight that apatite compositions might discriminate modern granitoids (< 2.5 Ga) from sanukitoid-like signatures, which has important implications for documenting the secular magmatic record of crustal evolution via detrital zircons and their mineral inclusions.