

Detrital rutile: U-Pb, mineral chemistry and inclusions as archives of Precambrian history

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Much of what currently is known about the early Earth has been recovered from detrital minerals. This is profoundly related to the rather incomplete rock record. Zircon has offered most of this insight, as it is physically and chemically robust and contains a multi-isotopic toolkit U-Pb, Hf and O. Thus, it has been the ideal candidate to retrieve unique information about early Earth processes. However, zircon growth is mostly related to intermediate to felsic magmatism. This, in turn, has led to a certain bias in the record. This bias can be overcome if combined with detrital rutile, which is another robust common detrital heavy mineral in clastic sediments. It grows in a multitude of environments, including a range of P-T metamorphic conditions, from both felsic and mafic protoliths, in magmatic rocks and in hydrothermal systems. Mineral inclusions entrapped in rutile have been recently linked to peak metamorphic assemblages found in the host matrix, thus making this mineral highly attractive as a provenance tool for (U)HP and (U)HT metamorphic rocks, which may have been eroded from the rock record; the resultant detrital rutiles being the only record of these.

Here we present new insights from detrital rutiles in two different Proterozoic sequences, found in different cratons: the Paleoproterozoic Minas Supergroup in the São Francisco Craton (Brazil), and the Neoproterozoic Torridon Group in the North Atlantic Craton (Scotland). We combine Zr-in-rutile thermometry, trace elements, U-Pb, and mineral inclusions determined using EPMA, LA-ICPMS and EDS-SEM to give insight into growth environment and sources.

Detrital rutiles in the Moeda Fm. (Brazil) enclose a diversity of mineral inclusions, from Fe-Cu-As-Sb-rich to W-Cu-rich. These, combined with variable W contents have helped interpreting these as related to Au mineralising fluids. U-Pb isotopic dating indicates the source of the Au as the adjacent basement, which in turn implies that the source of the sedimentary-hosted gold present in the Moeda Fm. is the late Archean greenstones.

In Scotland, a previous study identified detrital rutile in the Torridon Group with main peak U-Pb ages at 1.07, 1.17, 1.53 and 1.87 Ga. The latter age does not have a zircon population equivalent. Hence, the significance of this population is yet unknown and quite speculative, and thus mineral inclusions, combined with trace elements will provide more clues to elucidate the source of these rutiles.