Apatite and titanite as tracers of magma petrogenesis and recorders of geodynamic evolution

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Accessory minerals hosting rare earth elements (REE; e.g. zircon, apatite, titanite, allanite) represent a low modal proportion of igneous rocks but often dominate the REE budget. They are therefore important in petrogenetic studies, and are also used widely to discriminate and constrain sandstone provenance. Apatite and titanite are ubiquitous minerals for which trace element partition coefficients are well known and have been shown to be sensitive to changes in magma composition. Recent trace element work has suggested that these minerals can be particularly informative in petrogenetic studies and may permit calculation of the host rock chemistry.

In this contribution, a variety of different-aged and geochemically distinct samples have been studied, including Archaean Tonalite-Trondhjemite-Granodiorite (TTG, Karelian Province), sanukitoids (Karelian Province) and Phanerozoic Basalt-Andesite-Dacite-Rhyolite (BADR, Guernsey Igneous Complex). These different compositional types have been genetically linked to distinct geodynamic scenarios that may track the onset and evolution of subduction-driven plate tectonics from the Archaean (TTG) to opening of a mantle wedge at the Archaean-Proterozoic transition (sanukitoids) and "modern" plate tectonics (BADR).

Careful electron imaging, and *in-situ* (LA-ICPMS and SIMS) analyses on apatite (as inclusions in zircon or in the matrix) and titanite show that these minerals give access to: (i) the crystallization history, and (ii) the whole-rock chemistry of their hosts. More importantly, their chemistries seems to discriminate the compositional magma shift through time (TTG=> Sanukitoid=> BADR). Finally, preserved apatite inclusions present in titanite and zircon offers a novel way to look at the sedimentary record as the surrounding minerals can be dated and their isotopic compositions analysed (Hf+O for zircon, or Nd+O for titanite). Such combined data will allow unbiased sampling of secular magmatic records, which may provide a more accurate representation of the response of magma generation to changing geodynamics, such as the onset of deep subduction.