The secular evolution of titanite and apatite trace element chemistry as a tracer of magmatic evolution

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The magmatic record has evolved through geological time from Tonalite Tronjhemite Granodiorite (TTG) in the Archean toward typical arc magma compositions (BADR) observable at the present day. The Archean-Proterozoic transition is marked by the appearance of sanukitoids, which have been found on every continent.

This shift in composition has been interpreted by some as reflecting major geodynamic changes and, in particular, the appearance of sanukitoids has been linked to the onset of subduction-driven plate tectonics.

However, there are remaining fundamental questions about the conditions of the early Earth as its record is extremely sparse (e.g. composition of the crust, geodynamic regime. For example, recent studies are still debating the composition of the early Earth crust: felsic or mafic? The processes leading to the differentiation of the crust during the early Earth need, therefore, to be better characterized. New tools are required to provide further insights on Earth evolution via the petrogenetic analysis of the Archean-Hadean record and the transition to the post-Archaean.

Trace element geochemistry of accessory phases can give additional information about the petrogenesis and the sources of their host rocks. In this contribution, we present new geochemical data on accessory phases (titanite, apatite, zircon) from a compilation of granitoids through geological time: TTG's, sanukitoids and BADR from a variety of settings. We demonstrate that trace element analysis and detailed petrographic work on these phases can give direct access to petrogenesis of the host magmas. In this study, apatite and titanite trace element chemistry is also shown to track changes in magma composition through time. These observations offer a new way of interrogating the magmatic record through time and insight into the secular evolution of plate tectonics and the continental crust.