Timing and source of rare earth element mineralisation in the Ditrău Alkaline Igneous Complex (DAIC), Romania

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Mineral deposits associated with alkaline igneous rocks are an important resource of critical metals, such as the rare earth elements (REE), niobium and zirconium. However, the magmatic, hydrothermal and mineralising history in these deposit types can be very complex.

The DAIC in NE Romania is a Triassic, miaskitic alkaline complex comprising a sequence of amphibolites, gabbros, syenites and nepheline syenites that culminate in an altered roof-zone cumulate. The DAIC is cross-cut by a series of late, REE-mineralised veins that contain monazite and allanite in a sulphide and carbonate-rich gangue. We have studied the complex to investigate whether these veins were formed from late-stage fluids related to the alkaline magmatic system, or whether they were formed in a later event.

In-situ U-Pb dating of both titanite and zircon in the amphibolite and syenites provide crystallisation ages of ca. 229 Ma. A Th-Pb monazite date of ca. 215 Ma, for the REE-mineralised veins, indicates that mineralised vein formation may post-date the crystallisation of the complex. Minerals in the REE-mineralised veins and magmatic units all have overlapping $\varepsilon Nd_{(i)}$ values of +5 to +6, indicating a similar parental mantle source. Carbonate from the REE-mineralised veins and altered roof-zone cumulate have $\delta^{13}C$ and $\delta^{18}O$ values that are indicative of primary igneous carbonatite. These data are consistent with mineralised veins forming from late, possibly carbonatite-related, fluids that post-date silicate magmatism.

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