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In-situ Lu-Hf geochronology of carbonates

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Recent advances in laser ablation reaction cell geochronology using LA-ICP-MS/MS (or QQQ) technology have allowed for a variety of minerals and mineral systems to be rapidly dated with the *in situ* Lu-Hf method, opening up new opportunities in geochronology. Carbonates are one of the most common minerals on Earth, forming in a wide range of geological settings, and accurate geochronological information on carbonate precipitation can be of great importance to geological studies. We present a method for Lu-Hf dating of carbonate minerals by LA-ICP-MS/MS and demonstrate data from a series of successfully dated carbonates. Effectively interference-free ^{176}Hf is measured by reacting with NH_3 gas, and large ablation beam diameters (170-260 microns) are used to obtain the required sensitivity to analyse low radiogenic Hf concentrations in carbonates.

The dated carbonate samples in this study include calcite, dolomite and bastnaesite and are sourced from mineral deposits, carbonatite intrusions and low grade metamorphic rocks. The obtained Lu-Hf ages as old as ~2 Ga for Lu concentrations as low as ~0.5 ppm and the typical analytical precision can be as low as <1% for weighted average ages of >0.5 Ga carbonates. Generally, the analysed carbonates don`t incorporate initial Hf during crystallisation. Therefore, the ^{176}Hf budget is almost entirely radiogenic, negating the need for isochrons and instead, allowing 'single ablation spot' Lu-Hf dates to be calculated. The preservation of Proterozoic carbonate ages implies that the Lu-Hf system can remain isotopically undisturbed over significant geological time. Hence, *In situ* Lu-Hf dating of carbonate can be used as a complementary technique to existing U-Pb methods, with samples in this study indicating that the Lu-Hf method is generally more suitable for dating older (>0.5 Ga) samples to allow sufficient Hf ingrowth. The carbonate Lu-Hf method is also better suited for samples from REE-enriched localities such as