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Eclogitization on the way up? Lu-Hf garnet chronology of metasomatic ultrahigh-pressure rocks from the Western Gneiss Complex, Norway

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The Western Gneiss Complex (WGC) is a fragment of continental crust that was subjected to high- and ultrahigh pressure (HP; UHP) conditions as a result of Caledonian continental collision (420-400 Ma). Most eclogites and related high-pressure rocks have yielded chronological and petrological data that are consistent with a generalized model of Caledonian continental subduction. Nevertheless, a distinct suite of eclogitic rocks – metasomatized Fe-Ti meta-peridotites – indicate extreme pressure conditions that do not fit the regional field gradient and yield unexpectedly young ages. This has lead to alternative models of non-lithostatic pressure conditions, which explain local and late generation of extreme pressures during fluid-flow and melting in orogenic belts.
The validity of both models is testable through high-precision chronology; however, so far only limited age constraints have been provided for these (ultra-)mafic rocks. In this study, we subject two orthopyroxene-bearing eclogites to Lu-Hf garnet chronology; a method that provides precise and robust data for garnet even at the extreme temperature. Conventional barometry indicates equilibration of the main garnet-bearing assemblage at c. 4.3 GPa and Lu-Hf garnet chronology yields ages of c. 393 Ma. These results overlap with Sm-Nd garnet and U-Pb zircon ages from the nearby diamond-bearing Svartberget peridotite body and leucosomes in its host gneiss. However, the results are $\geq$ 10 Ma younger than garnet ages for 'normal' eclogite lenses in the WGC and correspond to a time when the terrane was already exhumed to 30-35 km depth. The discrepancy in P-T-t evolution between the bulk of the WGC, and the UHP (ultra-)mafic rocks indicates that the latter rocks reflect localized fluid-induced re-equilibration at pressures higher than lithostatic. The new data provide new support for the occurrence of this phenomenon in deep continental crust undergoing exhumation and partial melting, and quantify the pressures and time scales involved.