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In situ Lu–Hf geochronology of garnet by LA–ICP–MS/MS and applications to metamorphic rocks

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Lu–Hf geochronology is a powerful tool to date a variety of geological processes, by targeting high-Lu low-Hf minerals such as apatite, xenotime, lawsonite and garnet. Traditional application of this dating method requires chemical separation of the isobaric parent (^{176}Lu) and daughter (^{176}Hf) isotopes, which often results in a loss of textural context of the analysed minerals. The recent development of in-situ Lu–Hf geochronology by LA–ICP–MS/MS using NH_3 as a reaction gas allows the resolution of ^{176}Lu, ^{176}Hf and ^{176}Yb interferences, as Hf reacts with the NH_3 to form high-order reaction products which can be measured independently of Lu and Yb [1]. This method offers a number of advantages including rapid analysis with high spatial resolution, as well as targeted control on textural relationships of the analysed mineral, the simultaneous collection of trace and major element data, and the ability to include or exclude mineral inclusions from data signals. For garnet, in-situ Lu–Hf geochronology is an important tool to directly date metamorphism and couple the timing of garnet growth with P–T conditions, distinguish polymetamorphism in single grains or samples, and to undertake rapid campaign-style geochronology across large metamorphic terranes. A first application of these types of strategies is shown through a campaign-style study dating garnet across the high- to ultrahigh-pressure Western Gneiss Region in Norway by the in situ Lu–Hf method. Data from a from a variety of lithologies and metamorphic facies will be presented, with a focus on strengths and limitations of the technique.

[1] Simpson, A., Gilbert, S., Tamblyn, R., Hand, M., Spandler, C., Gillespie, J., Nixon, A. and Glorie, S., 2021. In-situ Lu–Hf geochronology of garnet, apatite and xenotime by LA ICP MS/MS. *Chemical Geology*, *577*, p.120299.