In-situ Lu-Hf garnet geochronology by LA-ICP-MS/MS

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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, therefore useful for dating a wide variety of lithologies and geological processes. Traditional application of this dating method requires chemical separation of the isobaric parent (^{176}Lu) and daughter (^{176}Hf) isotopes prior to high-precision analysis. Often, this results in a loss of textural context of the analysed minerals. The recent development of in-situ (laser-ablation based) Lu–Hf geochronology by LA–ICP–MS/MS and NH3 reaction gas allows the resolution of ^{176}Lu, ^{176}Hf and ^{176}Yb interferences, as Hf reacts with the NH3 to form high-order reaction products which can be measured independently of Lu and Yb (Simpson et al., 2021). 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. Some first applications of these types of strategies will be presented, including data from a variety of lithologies and metamorphic facies, with a focus on strengths and limitations of the method.

References

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.