EGU2020-12837
https://doi.org/10.5194/egusphere-egu2020-12837
EGU General Assembly 2020

Persistence of melt-bearing Archean lower crust for >200 m.y.— An example from the Lewisian Complex, northwest Scotland

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Geochronological data in zircon from Archaean tonalite–trondhjemite–tonalite (TTG) gneisses is commonly difficult to interpret. A notable example are TTG gneisses from the Lewisian Gneiss Complex (LGC), northwest Scotland, which have metamorphic zircon ages that define a more-or-less continuous spread through the Neoarchaean, with no clear relationship to zircon textures. These data are generally interpreted to record discrete high-grade events at c. 2.7 Ga and c. 2.5 Ga, with intermediate ages reflecting variable Pb-loss. Although ancient diffusion of Pb is commonly invoked to explain such protracted age spreads, trace element data in zircon may permit identification of otherwise cryptic magmatic and metamorphic episodes. Although zircons from the TTG gneiss analyzed here show a characteristic spread of Neoarchaean ages, they exhibit subtle but key step changes in trace element compositions that are difficult to ascribe to diffusive resetting, but which are consistent with emplacement of regionally-extensive bodies of mafic magma. These data suggest suprasolidus metamorphic temperatures persisted for 200 Myr or more during the Neoarchaean. Such long-lived high-grade metamorphism is supported by data from zircon grains from a nearby monzogranite sheet. These preserve distinctive trace element compositions suggesting derivation from a mafic source, and define a well-constrained U–Pb zircon age of c. 2.6 Ga that is intermediate between the two previously proposed discrete metamorphic episodes. The persistence for hundreds of millions of years of melt-bearing lower crust was probably the norm during the Archaean.