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# Zircon U-Pb and Lu-Hf record from the Archean Lewisian Gneiss Complex, NW Scotland

**Lanita Gutieva**[1], Annika Dziggel[1], Silvia Volante[1], and Tim Johnson[2]

[1]Ruhr-Universität Bochum, Geology, Mineralogy and Geophysics, Bochum, Germany (lanita3000@mail.ru)

[2]School of Earth and Planetary Sciences, Curtin University, Perth, WA, Australia (tim.johnson@curtin.edu.au)

The Lewisian Gneiss Complex (LGC) in NW Scotland, a classic example of Archean lower crust, is mostly composed of deformed and metamorphosed tonalite–trondhjemite–granodiorite (TTG) gneisses, gneissose granite sheets, and subordinate mafic, ultramafic, and metasedimentary lithologies. It has been traditionally subdivided into three regions that are interpreted to record discrete ages and metamorphic histories, and which are separated by crustal-scale shear zones. A smear of concordant U–Pb zircon ages from the granulite-facies central region has been interpreted to record metamorphic resetting of earlier magmatic and granulite facies metamorphic ages during a subsequent high-temperature metamorphic event. Here, we present U–Pb and Hf isotope data collected via laser-ablation split-stream (LASS) analyses of zircon cores from twenty-seven felsic meta-igneous rocks from the northern, southern, and central regions of the LGC, as well as U–Pb data from zircon rims within most of those samples.

In samples from the northern and southern regions, the crystallization age (i.e., from zircon cores) was calculated from the upper-intercept age, yielding age range of 2.82-2.63 Ga for the northern, and 3.11–2.63 Ga for the southern region. Zircons in these samples generally have thin or no rims, suggesting an absence of a prolonged high-grade (granulite facies) metamorphic event in those regions. In the central region, zircon cores yield U–Pb crystallization ages between ca. 3.0 Ga and 2.7 Ga, while zircon rims define a continuous spread of ages from ca. 2.8 to 2.4 Ga. Overall, the central region exhibits a continuous and overlapping smear of zircon core and rim ages, suggesting a protracted thermal event in which high-ultrahigh temperature conditions were maintained for >200 m.y., and that discrete magmatic and metamorphic ‘events' are difficult to identify. Nevertheless, an estimation of the crystallization age of each sample is crucial for interpreting their Lu–Hf isotopic signature. Zircon cores from the tonalite–trondhjemite gneisses have broadly chondritic compositions with a range of calculated mean initial εHf of +2.5 to –1.2, potentially reflecting a mixture of juvenile material and reworked crust, with one outlier at $\varepsilon Hf_i$ = +4.5 perhaps indicating a renewed influx of juvenile magma. Granite gneisses also have near-chondritic values, although the range is larger and the two youngest granite gneisses have slightly sub-chondritic $\varepsilon Hf_i$ (–1.5 and –2.5), which indicates that pre-existing crust was involved in their formation. Since there is no significant difference in the Hf isotopic composition between rocks from the three regions, or between the TTG and granite gneisses, we suggest that the broadly chondritic $\varepsilon Hf_i$ in most of our samples reflects mixing of both depleted mantle and evolved crust

during their generation. Despite the similarity of the U-Pb and εHf data from the three regions, the data do not allow to unambiguously discriminate whether the LGC is composed of different levels of a once continuous Archean continent or discrete microcontinents that were amalgamated in the late Archean to Paleoproterozoic.