

Geochronological constraints on the tectonothermal history of the Shetland Caledonides, Scotland

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The Caledonian orogenic belt spans Norway, East Greenland, Scotland, and Ireland. In a central location between the Norwegian, Greenlandic, and northern Scottish sectors lies Shetland; an inlier of metamorphic basement in the Mesozoic sediments of the North Sea.

Here we present Lu-Hf and Sm-Nd garnet ages, and Rb-Sr mica ages for metamorphic lithologies across a wide geographic and stratigraphic area of Shetland. Lu-Hf and Sm-Nd garnet ages are interpreted to represent the timing of peak metamorphic conditions in garnets where prograde zoning is observed in trace element LA-ICPMS profiles. Conversely Rb-Sr mica ages appear to relate to deformation-induced recrystallisation.

Caledonian prograde garnet ages of c.480-c.430 Ma are prevalent throughout the whole of Shetland, with three distinct thermal pulses: c.475 Ma (n=6), c.450 Ma (n=4), and c.435 Ma (n=2). These relate to the Ordovician Grampian (I & II) and Silurian Scandian phases of accretion, similar to those observed in the Caledonides of mainland Scotland.

Whilst Rb-Sr mineral ages paint a similar picture, some subtle differences may necessitate a more complex explanation¹. An apparent paucity of Silurian Rb-Sr ages suggests that extensive reworking of mica fabrics did not occur during the Scandian event despite metamorphic conditions permitting new, albeit limited, garnet growth. However, Devonian Rb-Sr mica ages in westernmost Shetland are consistent with the diachronous northward-younging of the thrust belts that define the western Laurentian margin, suggesting a late orogenic evolution that has more in common with East Greenland and Norway than with northern Scotland.

¹Walker et al. (2015) *JGSL*