

Petrology of mafic-ultramafic complexes within the Archean Lewisian complex of NW Scotland

UDRY Arya ; mai 2010

Supervisor : Prof. Othmar MUNTENER, Institut de Minéralogie et Géochimie

The Lewisian complex is a fragment of the ancient Laurentian continental mass, which is now buried beneath the metasediments of the Scottish highlands. The Archean gneisses from the Lewisian complex represent a long, and complex part of Earth history. Kinny and Friend (1997), Friend and Kinny (2001) and Love et al.

(2004) proposed that this complex is composed of several terranes with different Archean histories but a common Proterozoic history. This is a controversial theory.

The study region is located in the central region of northwestern Scotland, between Loch Laxford and Loch Inver. The field area consists of a variety of basic to ultrabasic bodies embedded in banded tonalitic gneisses. Granulite-facies parageneses are common in these rocks. It has been demonstrated that mafic and ultramafic bodies correspond to an older crust and that surrounding granodiorite and tonalite rocks are of calc-alkaline affinity, indicating a subduction zone environment. Whole-rock analysis on Drumbeg and Scourie rocks confirm this hypothesis, however in-situ major and trace element analysis should also be performed to further verify this hypothesis. With the application of in-situ methods such as microprobe and LA ICPMS, new results provide evidence for the resetting of the igneous features of mineral phases in gabbros and ultramafic rocks under granulite-facies metamorphism. The calculated P-T conditions for the granulite-facies assemblages are constrained between 8.5-13 kb and 840-900°C. These conditions are consistent with modern thermal conditions for active island arc lower crust. Therefore, we conclude that the Archean crust had modern thermal conditions, which contradicts the widely accepted hypothesis that the Archean Earth was considerably hotter than the modern Earth.

Precise in-situ U-Pb dating-studies on zircons yield granulite-facies event ages of 2719 ± 27 Ma, 2685 ± 7.7 Ma and 2563 ± 28 Ma for a Drumbeg gneiss and 2873 ± 35 Ma, 2783 ± 12 Ma, 2676 ± 31 Ma and 2574 ± 190 Ma for a Scourie granitic pegmatite. They display common ages between c.2700 Ma and 2560 Ma. We conclude that these ages correspond to several discrete granulitic events. They are distributed over more than 300 Ma, a period of time during which several geodynamic events may have occurred. These ages are similar to granulite-facies ages in the southern region of the Lewisian complex and so question the theory of terrane.