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Geochemical and petrographical investigations of trondhjemites and associated mafic rocks in the Trondheim Nappe Complex, central Norwegian Caledonides

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The Trondheim Nappe Complex (TNC) forms a major part of the higher, Köli subdivision of the Upper Allochthon in the central Norwegian Caledonides. It is in this area of Mid Norway that trondhjemites were first described and defined. Several large up to 200 km^2 in outcrop size – and numerous, smaller plutonic bodies and dykes occur within the TNC, intruded in metasedimentary and metavolcanic rocks, including ophiolites, that derive from the Iapetus Ocean. These slightly metamorphosed igneous bodies and dykes are typically felsic, often trondhjemitic rocks that are generally associated with more mafic, dioritic to gabbroic plutons.

A detailed petrographical and geochemical investigation of these magmatic rocks was started to reveal a clearer petrogenetic relationship between the felsic trondhjemites and their mafic associates, and thus helps in deriving a more complete petrogenetic model for Phanerozoic trondhjemites. This might also have important implications for the palaeotectonic development of the Caledonian orogen. Geochemical data obtained so far, show that the trondhjemites are of the high-Al_2O_3 type, formed at a continental margin, while the associated mafic rocks show calc-alkaline characteristics with mantle affinity. Caution should be used when referring to trondhjemites, since not all the felsic 'trondhjemitic' rocks share the typical characteristics of trondhjemites, such as a high Na/K ratio and strongly depleted heavy REE. Seven samples so far dated, using U-Pb geochronology on zircons (ID-TIMS) from trondhjemites and diorites, all fall in the range 439-432 Ma, which is just shortly before the attainment of Scandian peak

metamorphism in this part of the Caledonides.

Comparing the analytical data of these Early Silurian trondhjemites with existing data of Cenozoic adakites and Archaean tonalite-trondhjemite-granodiorite (TTG) series will help to provide a link between these rock types. Melting of a downgoing slab of young and hot oceanic crust is the common hypothesis for adakite and trondhjemite formation. This would, however, demand extraordinary conditions for the voluminous TNC trondhjemites and does not provide an adequate explanation for the common association with mafic rocks. Preliminary geochemical modelling shows that partial melting of mafic rocks metamorphosed to amphibolite or garnet-amphibolite can explain the genesis of the TNC trondhjemites. The question then rises whether these source rocks were either subducted oceanic crust or underplated lower crust. Remelting of the lower crust by ascending mafic sulbalkaline magmas formed in the mantle wedge would more readily account for the common association of trondhjemites and dioritic rocks.

More information about the source material will be obtained by acquiring radiogenic isotope data by means of multi-collector ICP-MS measurements. Further detailed petrographical and geochemical investigations and more extensive petrogenetic modelling will lead to a better understanding of the melting processes that accompanied the subduction of continental margins.