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Field relationship of high-grade Neo- to Mesoarchaean rocks of South-East Greenland: Tectonometamorphic and magmatic evolution

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ABSTRACT

South-East Greenland forms part of the North Atlantic Craton and is characterized by migmatitic orthogneisses, narrow bands of mafic granulite, ultramafic and possible meta-sedimentary rocks, and alkaline-carbonatitic intrusive rocks. Mafic granulite, meta-sedimentary and ultramafic rocks form the basement for the emplacement of granitic intrusions at ca. 2865 Ma that lasted episodically until ca. 2790 Ma and continuously during 2750–2700 Ma. The area is structurally complex with evidence of at least seven deformation events including reclined and mushroom-like fold interference patterns. An older (>2790 Ma) foliation formed in granitic rocks and the basement during the Timmiarmiut Orogeny (D_T). Deformation associated with the ca. 2790–2700 Ma Skjoldungen Orogeny folded this early foliation, and is associated with a penetrative foliation that is refolded progressively in a northeast–southwest oriented stress field. The orientation of the stress field progressively rotated into a northnorthwest–southsoutheast orientation during the last stages of the orogeny. The orogeny is also characterized by syn-deformational anatexis at granulite-facies (at approximately 800 °C and 5–8 kbar, ca. 2790–2740 Ma), which decreased to the amphibolite-facies at ca. 2730 Ma.

The late- to post-tectonic granite and alkaline rocks assigned to the Skjoldungen Alkaline Province intruded the central-northern part around 2710 Ma. This was followed by north–south extensional deformation during the Singertat Stage forming discrete shear-zones at greenschist-facies grades, which is coeval with the emplacement of pegmatite, ijolite, and carbonatite emplacement during ca. 2680–2650 Ma.

Similar lithology and tectonic processes in the Tasiusarsuaq Terrane of southern West Greenland and the Lewisian Complex in Scotland suggest a possibly large Archaean terrane at that time, which, taking the present size, at least covered around 500–600 km in an east–west direction and approximately 200 km in a north–south direction.

1. Introduction

The geology of the North Atlantic Craton (NAC) in the southeastern part of Greenland is virtually undocumented as shown by the limited amount (four) of peer-reviewed papers available for the region (Andrews et al., 1973; Bridgwater et al., 1973; Nutman and Rosing, 1994; Blichert-Toft et al., 1995). In the 1960s, researchers from British universities undertook the first scientific expeditions along coastal areas in the region. In the late 1960s and early 1970s, the Geological Survey of Greenland (now the Geological Survey of Denmark and Greenland; GEUS) completed reconnaissance geological mapping using boats for the 1:2,500,000-scale geological map of Greenland. This was followed by reconnaissance mapping at 1:500,000-scale during 1977–78 and 1981–1982, and helicopter traversing in 1986–87.

Exploration companies have done almost no mineral exploration in South-East Greenland. During 2009, the area between Timmiarmiut and Bernstorff Isfjord shown in Fig. 1 was visited during a four-week reconnaissance aiming to define future scientific projects and targets of economic interest. GEUS' operation was ship-based and was conducted together with a regional stream-sediment- and water-sampling project. Field access was by zodiac and helicopter, and two geologists worked on various locations chosen from the 1:500,000-sheet and old field notes.

Archaean rocks in South-East Greenland are of particular interest because they possibly represent a link between the Nain Craton of Canada, the NAC in the western part of Greenland, and the Lewisian Complex of Scotland (cf. Bridgwater et al., 1973; Escher et al., 1976). The NAC in South-East Greenland is mainly characterized by migmatitic gneisses and alkaline intrusions of the Skjoldungen Alkaline Province (SAP), which are characteristics that are unusual compared to other Archaean cratons of the world (Blichert-Toft et al., 1995).

This manuscript is the first paper resulting from concurrent studies by geoscientists from various fields working with GEUS in

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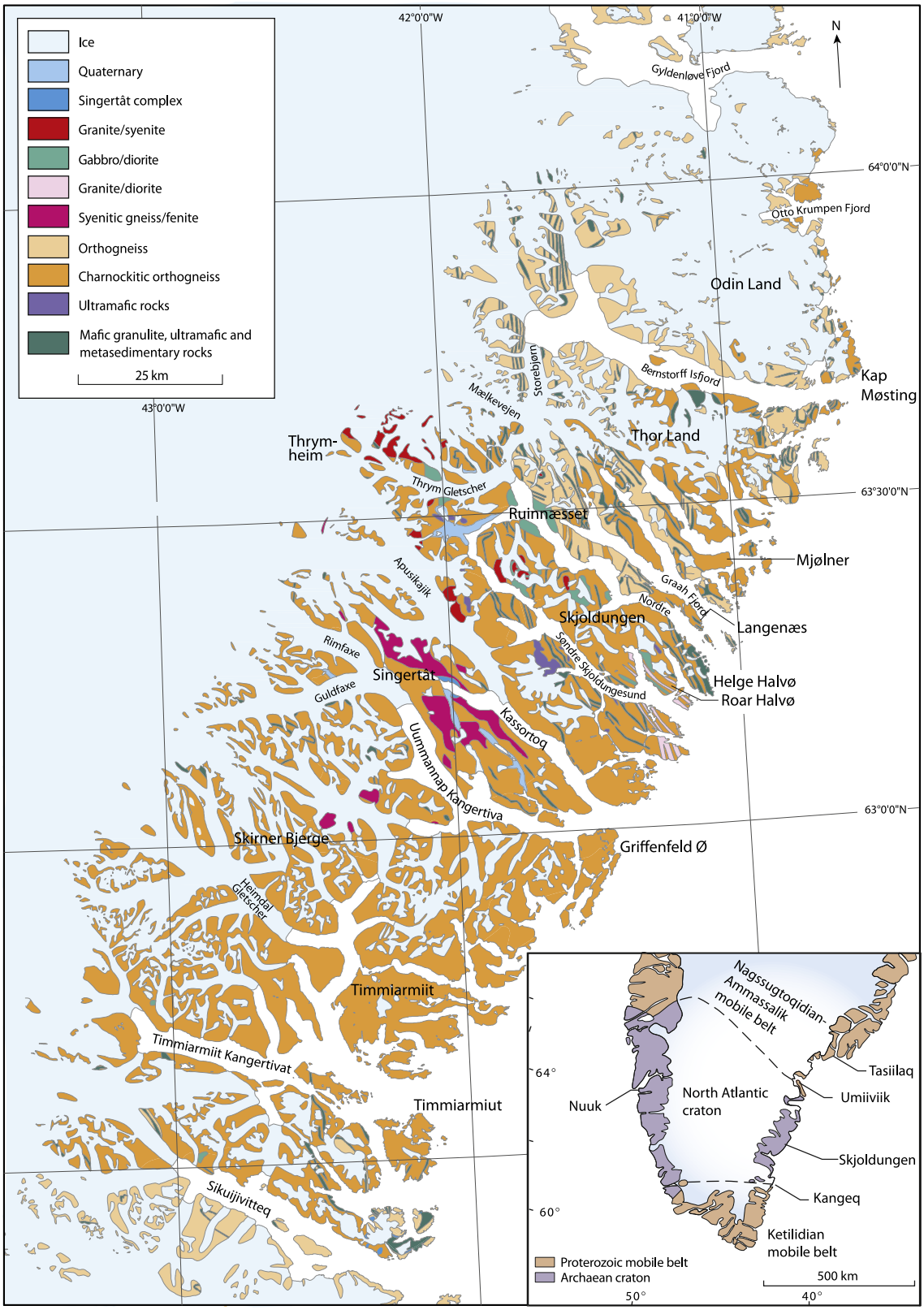

Fig. 1. Schematic geological map showing the different lithologies of the NAC. The 2009 field work area lies between Bernstorff Isfjord in the north and Sikuijivitteq in the south. Inset shows the location of the NAC in southern Greenland and the location of the Skjoldungen area.
Modified after Escher (1990).

South-East Greenland. This is a review of published literature and GEUS archival material, and reinterprets the regional geology using new field data, petrology, whole rock geochemistry, and U/Pb zircon age data. The aim of this paper is to give a regional overview and to decipher the regional geological history of the study area.