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Metamorphic and age constraints on tectono-thermal reworking in the western H.U. Sverdrupfjella: A new crustal evolution model for Western Dronning Maud Land, Antarctica

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Western Dronning Maud Land (WDML) of East Antarctica is argued to consist of two major crustal domains, namely the low-grade Archaean Kalahari-Grunehogna Craton and the high-grade Maud belt (e.g. Grantham et al., 1995; Jacobs et al. 2008). The geodynamic and tectono-thermal crustal evolution histories of these two proposed domains remain a debated topic in Rodinia and Gondwana reconstructions. In this study we conducted a petrological and metamorphic comparison of Mesoproterozoic metabasic rocks on the eastern margin of the Archaean Grunehogna Craton and the adjacent westernmost Maud Belt, across a major structural discontinuity known as the Pencksökket-Jutulstraumen Discontinuity (PJD). As such we evaluate to what extent the two domains of WDML represent independent crustal growth and metamorphic histories.

Metamorphic constraints on low-grade rocks on the eastern Grunehogna craton record greenschist facies conditions of T = 340 $\pm$ 25oC and P = 2.9 $\pm$ 0.8 kbar. The high-grade PT-constraint of T =700 $\pm$ 30oC and P = 9.0 $\pm$ 2 kbar for the western extreme of the Maud Belt, derived from garnet-hornblende-plagioclase-quartz geothermobarometry and phase diagram modeling in PERPLEX, is very similar to that reported for the eastern Maud Belt and thus, does not support the concept of a westward decreasing metamorphic field gradient within the Maud Belt as previously proposed. Laser-ablation-ICP-MS U-Pb dating of titanite in a hornblende-plagioclase-quartz symplectite (after garnet breakdown), yielded a Pan-African age for high-grade metamorphism in the westernmost Maud belt, which overlaps with the age of tectonic decompression in the eastern Maud Belt. The new U-Pb age data argues against previous models that invoke only late-Mesoproterozoic high-grade metamorphism in the western Maud Belt. The new petrological data indicate that the inferred sub-glacial boundary (PJD) between the Grunehogna Craton and the Maud Belt, represents a major metamorphic hiatus as a Pan-African thrust, which was subsequently reactivated during Gondwana break-up. These new results are integrated with published regional age (e.g. Frimmel, 2004) and geochemical (Grosch et al., 2007) data to propose a new geodynamic evolution model for Western Dronning Maud Land, with implications for Rodinia and Gondwana reconstructions.

The revised Mesoproterozoic to Pan-African crustal evolution model for western Dronning Maud Land, proposes that the Maud Belt initially formed as a continental volcanic arc on the southeastern Grunehogna Craton margin, and not as an independent, Mesoproterozoic juvenile oceanic island arc. It follows that the PJD does not represent a Mesoproterozoic suture zone between a juvenile island arc and the Grunehogna Craton, but more likely a continental, Mesoproterozoic-Pan-African back-arc thrust zone. It is proposed herein, that large parts of the southeastern Kalahari-Grunehogna Craton margin (that included the Maud continental volcanic arc crust), experienced major tectonic reworking at eclogite to upper amphibolite facies conditions during Gondwana assembly. As such the new data from Western Dronning Maud Land has important implications for the extension of the Mozambique Belt into Antarctica and the location of the main suture zone between East and West Gondwana.