Formation, extension and exhumation of high-grade crust in central Dronning Maud Land

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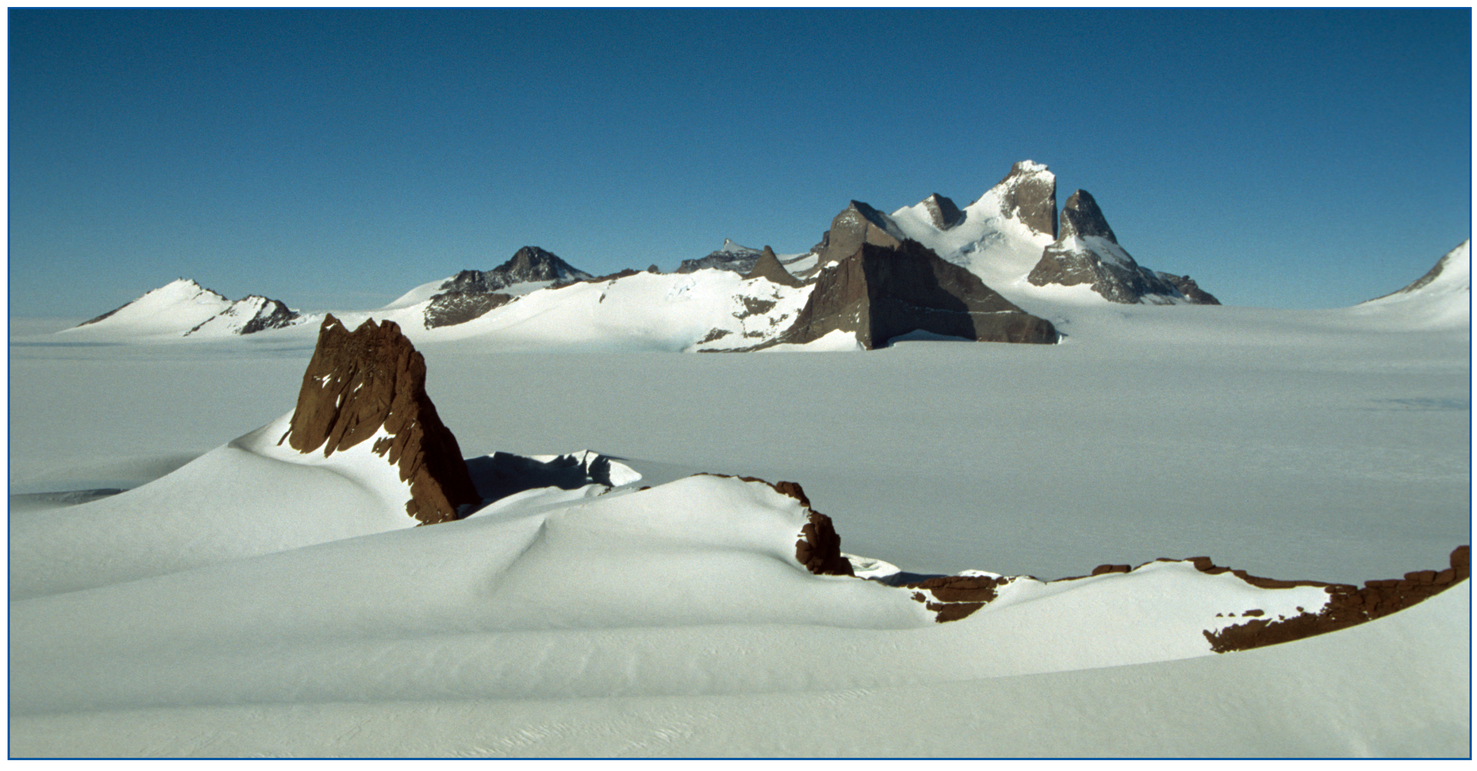
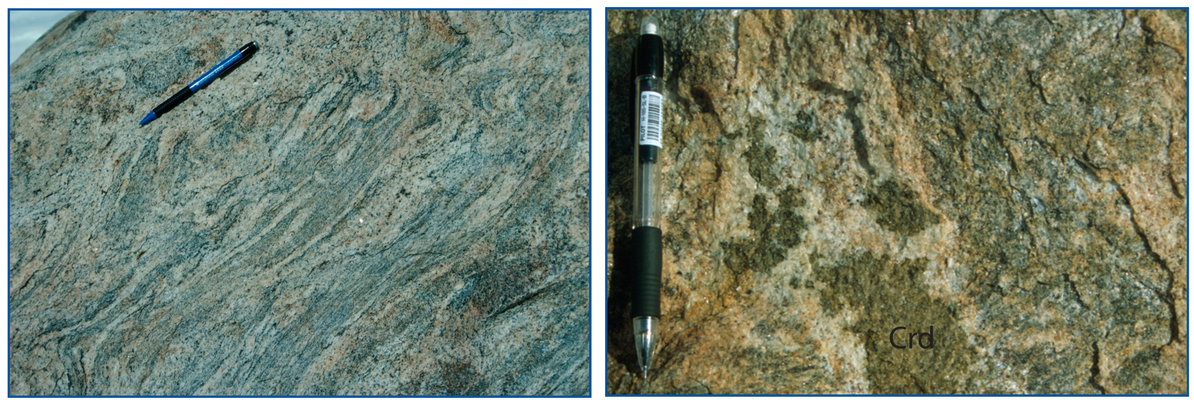
The mountains and nunataks of Mühlig-Hofmannfjella in central Dronning Maud Land (6-8 °E) comprise a deep-seated metamorphic-plutonic complex. The metamorphic rocks have a polyphase tectonothermal history with two orogenic episodes, the first in late Mesoproterozoic and the second in late Neoproterozoic/ Cambrian times. The main fabric (foliation) and the high-grade metamorphic mineral assemblages are the result of intense reworking during the Pan-African orogeny. Granulites, pelitic gneisses and migmatites experienced peak metamorphic temperatures of 800-900°C at mid-crustal levels. Peak conditions were followed by near-isothermal decompression recorded by a variety of reaction textures. The decompression was accompanied by partial melting and intrusion of voluminous bodies of quartz syenite (521± 4 Ma; Paulsson 2003). Extensional structures and the P-T path, indicate tectonic exhumation of the complex.



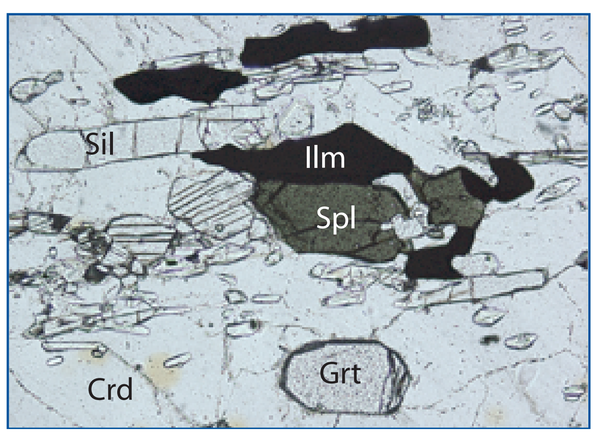
Field relations

The gneissic banding and foliation of the metamorphic complex is cut by extensional shear bands and shear zones (yellow arrow). Tight foldhinges and intrafolial folds indicate that the layers and gneissosity are transposed structures (red arrow). The extensional structures show a progressive evolution from ductile through semiductile towards brittle conditions. The quartz syenites post-date formation of the main gneiss fabric, but contain narrow semiductile to brittle shear zones illustrating that the extension continued also after their emplacement at c. 520 Ma.

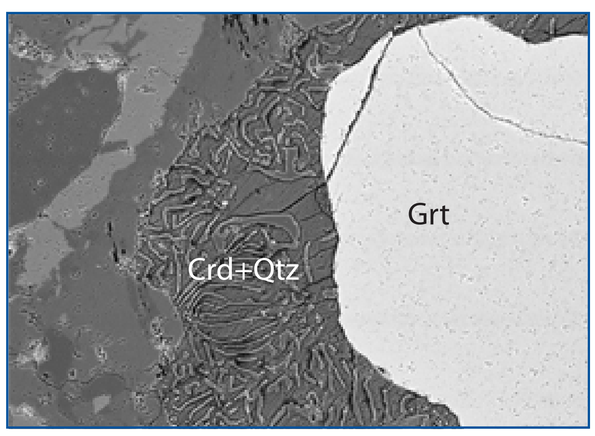


Migmatization has affected large parts of the metamorphic sequence. Metasedimentary rocks occur as Grt-Bt-migmatites and Sil-bearing gniesses. Late leucosomes i metapelitic rocks contain large aggregates of cordierite and are interpreted to have formed by decompressional melting.

Textures



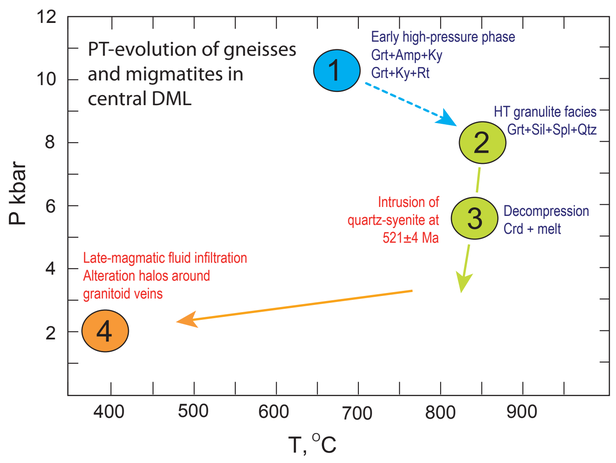
Peak metamorphic, granulite facies assemblages in pelitic rocks include Grt+Sil+Spl+Qtz. During re-equilibration to lower P, peak assemblages break down to Crd-bearing assemblages.



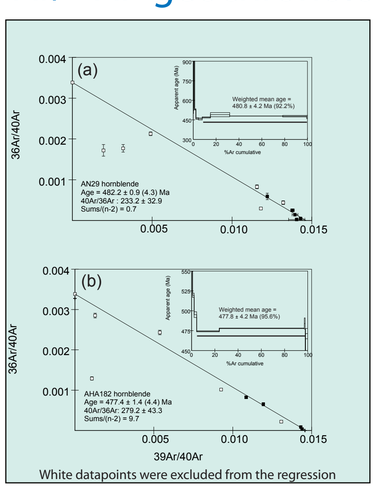
Garnet in pelitic rocks is partially replaced by a fine-grained symplectite of cordierite and quartz. The breakdown texture formed during decompression and cooling.

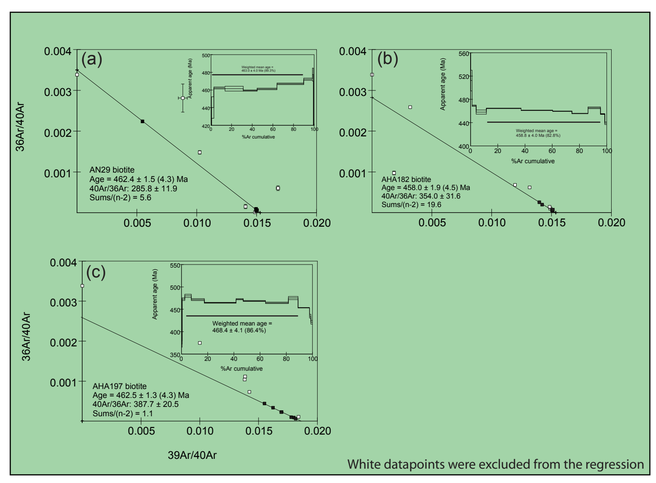
P-T path

The clockwise P-T evolution of the pelitic gneisses are divided into four stages (Engvik & Elvevold, 2004); (1) early, high-P stage characterized by Grt+Ky+Rt assemblages, (2) a peak metamorphic phase which typically is characterized by Grt+Sil+Spl+Qtz, (3) post-peak decompression which caused formation of Crd and melt, (4) late alteration related to late-magmatic fluid infiltration (Engvik et al. 2003). Extensional structures developed under ductile towards more brittle conditions, combined with the decompressional P-T path indicate tectonic unroofing of the high-grade complex. We relate the exhumation of the area to a late-orogenic collapse of the Pan-African orogen.

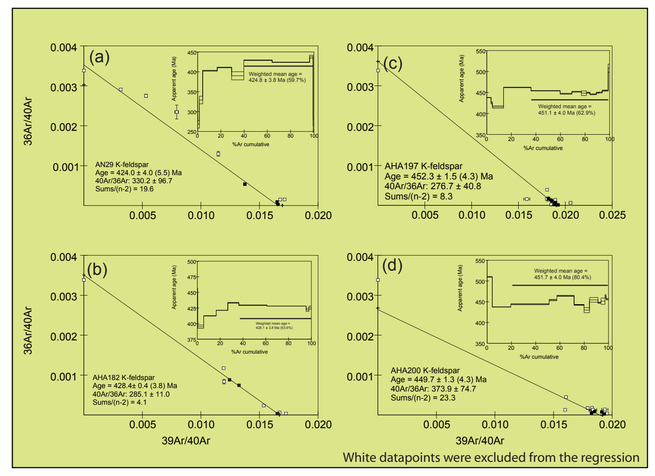


$^{40}Ar/^{39}Ar$ geochronology





$^{40}Ar/^{39}Ar$ release spectra and inverse isochron plots are obtained for hornblende, biotite and K-feldspar. The ages range from 485 to 420 Ma and reflect Pan-African cooling during extension and exhumation. The $^{40}Ar/^{39}Ar$ ages indicate an initial rapid cooling rate of c. 10 °C/Ma between 480-460 Ma, followed by a slower cooling of c. 3 °C/Ma. The cooling history, which is reported throughout East Antarctica, is consistent and indicates that the East Antarctica occured as a large homogenous craton in Early Paleozoic.



References
Paulsson 2003, PhD thesis, Litholund theses, No 2, Lund University
Engvik et al. 2005, Journal of Structural Geology, 27, 839-854
Engvik & Elvevold 2004, Geological Magazine, 141, 1-12

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