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Rheologically controlled strain partitioning at a sheared contact of contrastingly metamorphosed crustal domains, Wedel Jarlsberg Land, West Spitsbergen

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The axial part of the West Spitsbergen fold-and-thrust belt exposes an uplifted metamorphic basement of the Hecla Hoek Succession. In the SW part of the Wedel Jarlsberg Land, between the Hornsund Fjord and Torellbreen Glacier, one of the most important sections of this succession consists of two metamorphic domains juxtaposed along a regional-scale shear zone. The southern domain consists of mostly amphibolite facies rocks uniformly showing Late Proterozoic, c. 650 Ma metamorphic ages (Majka et al., this session). The northern domain comprises greenschist facies rocks with twofold metamorphic imprint dated at 700-560 Ma and 540-420 Ma. The latter time span corresponds to the climax of the Caledonian Orogeny in the area.

The contact of both metamorphic domains is represented by c. 2 km wide Vimsodden-Kosibapasset shear zone (VKZ), containing a heterogeneous array of structures formed during ductile shear deformation. The NW-SE trending shear zone is characterized by steep to vertical foliation dipping to the SW and, less frequently, to the NE and abundant low-temperature mylonites derived from various supracrustal rocks. A strong stretching lineation trends NW-SE over the whole VKZ and frequently plunges to the SE and SSE at a low to moderate angle. In places, the lineation plunges to the NW and SE to define a series of culminations and depressions. This sinuosity of lineations defines large-scale whaleback pattern consistent with a dominantly subhorizontal and approximately NE-SW-directed contractional strain axis.

The VKZ straddles the contact of contrastingly metamorphosed domains, but for most part is located within the northern greenschist-grade metamorphic block. The greenschist-grade block side of the shear zone is characterized by shallow to moderately SE-plunging lineation associated with spectacular sinistral kinematic indicators. The deformed pebbles from metaconglomerates reveal mostly an oblate shape indicative of the general flattening type of finite strain. Towards the NE, the mylonitic fabric of the VKZ abruptly grades into a lower strain fabric of the northern domain, deformed under the same metamorphic conditions. In contrast, the penetrative fabric of the VKZ cuts across and overprints the older structural grain of the southern domain. A narrow few hundreds metres wide band of the southern domain is incorporated into the VKZ. These rocks were subjected to pervasive shearing and mylontization, accompanied by retrogressive metamorphism. They are characterized by lineation steeply inclined to the S and an approximately symmetric fabric. The extremely elongated prolate pebbles from the metaconglomerate indicate intense coaxial strain of constrictional type.

A structural pattern of the VKZ is indicative of a bulk sinistral strike-slip to oblique-slip shear strain under greenschist facies conditions. The coexistence of wrench- and contraction-dominated domains suggests strain partitioning typical of transpression zones. In the VKZ, however, the observed partitioning is clearly controlled by contrasting rheologies of the two juxtaposed crustal domains. The more rigid amphibolite-grade domain suffered contractional strain, characterized by subvertical extension, whereas the rheologically weaker greenschist-grade domain was dominated by sinistral wrenching. The architecture of the VKZ reflects thus directly the mechanical heterogeneity of both the adjoining crustal blocks.