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The Eurekan West Spitsbergen Fold-and-Thrust Belt on Brøggerhalvøya

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The northernmost segment of the West Spitsbergen Fold-and-Thrust Belt on Spitsbergen (Fig. 1a) is exposed on Brøggerhalvøya (Fig. 1b). There, the trend of the fold belt turns from a NNW-SSE direction between Sørkapp Land and Oscar II Land into an almost E-W direction and is truncated to the west by the eastern boundary fault of the Forlandsundet Graben (Fig. 1b). The tectonic transport directions and vergences of the folds are toward the northeast and north which is different to the general east-northeast transport directions in the southern continuation of the fold-and-thrust belt in Oscar II Land and south of Isfjorden. The Eurekan deformation on Brøggerhalvøya is dominated by mostly SW-dipping thrusts forming a stack of nine nappes with tectonic transports to the NE and locally to the N (Fig. 1b; Piepjohn et al. 2001b; Saalmann and Thiedig 2001, 2002). Near the coast of Kongsfjorden and in the western part of Brøggerhalvøya, the lower five nappes (Garwoodtoppen, Kongsfjorden, Kvadehuken, Kjærfjellet, Ny-Ålesund nappes) repeated the post-Caledonian succession and are characterized by flat-and-ramp geometries. In the southwest, the upper part of the nappe-stack consists of four nappes with steeply SW-dipping listric basal thrusts which almost entirely consist of basement rocks (Nielsenfjellet, Bogegga, Trondheimfjella, Moefjellet nappes). The Caledonian basement rocks and the post-Caledonian sedimentary rocks are folded and thrust-faulted together indicating thick-skinned tectonics. The second large-scale structure, characteristic of the Eurekan deformation on Brøggerhalvøya is represented by a kilometre-scale, NE- to N-vergent fold structure which is similar in size to the ENE-vergent folds in the central and southern segments of the West Spitsbergen Fold and-Thrust Belt (e.g., Braathen and Bergh 1995; Braathen et al. 1995; Manby and Lyberis 2001; Piepjohn and von Gosen 2001; von Gosen and Piepjohn 2001). This fold structure has been overthrust by the Nielsenfjellet nappe in the central part of the nappe stack.

Based on a simple line-length balancing of the nappe-stack along a cross section through Kjærfjellet and Scheteligfjellet, an average 60% shortening was estimated, corresponding to

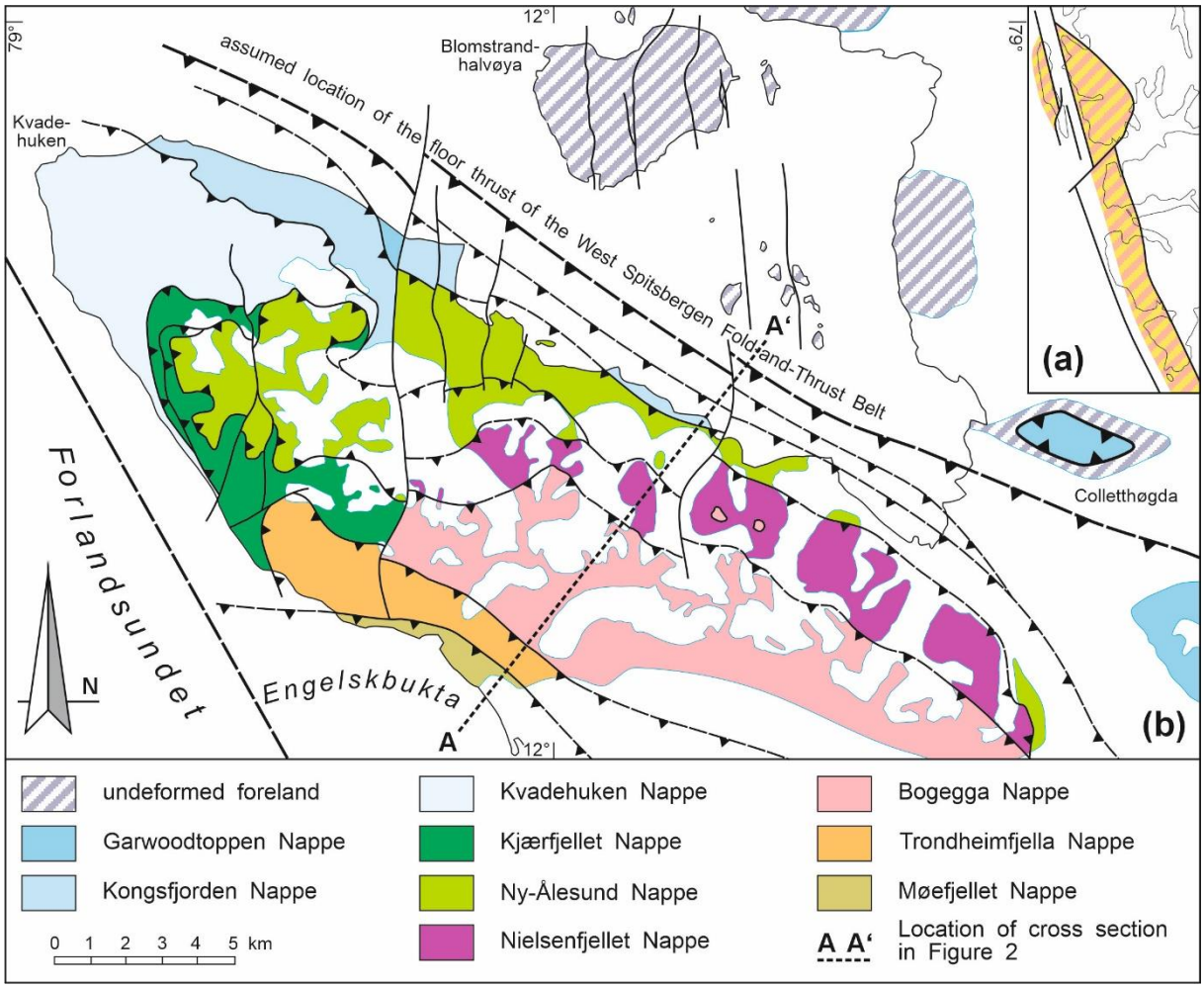

Fig. 1: (a) Location of the West Spitsbergen Fold-and-Thrust Belt between Sørkapp in the south and Brøggerhalvøya in the north; (b) Tectonic map of the NE-directed nine nappes or thrust sheets of the Eurekan West Spitsbergen Fold-and-Thrust Belt on Brøggerhalvøya (Piepjohn et al. 2001a, b; Saalmann and Thiedig 2001, 2002).

11–27 km (Piepjohn et al. 2001b) that, with an appropriate amount of shortening for the basement-dominated nappes represents one of the highest amounts of shortening within the entire West Spitsbergen Fold-and-Thrust Belt.

The formation of the West Spitsbergen Fold-and-Thrust Belt on Brøggerhalvøya can be separated into three stages (Saalmann and Thiedig 2001, 2002): The first stage (D1) was characterized by the structuring of thrust sheets along flats and ramps, predominantly involving post-Caledonian sedimentary rocks. This was followed by the second stage (D2) dominated by kilometres-scale folds (F2) involving the post-Caledonian sequence, the post-Caledonian cover succession and the D1-thrust sheets. During the third stage (D3), basement-dominated nappes were carried along listric thrust planes over the lower D1-part of the nappe stack truncating the F2 structure. The deviating vergences, despite the originally ENE-directed shortening during D2 also in this area, can be explained by the pre-existing basement topography causing oblique ramping on the sole thrust in Kongsfjorden and buttressing against the Nordfjorden High that was uplifted already in Paleocene times (Saalmann and Thiedig 2001).

The age of the Eurekan deformation and formation of the West Spitsbergen Fold-and-Thrust Belt on Brøggerhalvøya is still a matter of debate, although the geological situation in the Ny-Ålesund coal mine (Orvin 1934) and at Orvin Gorge west of Zeppelinfjellet (Piepjohn et al.

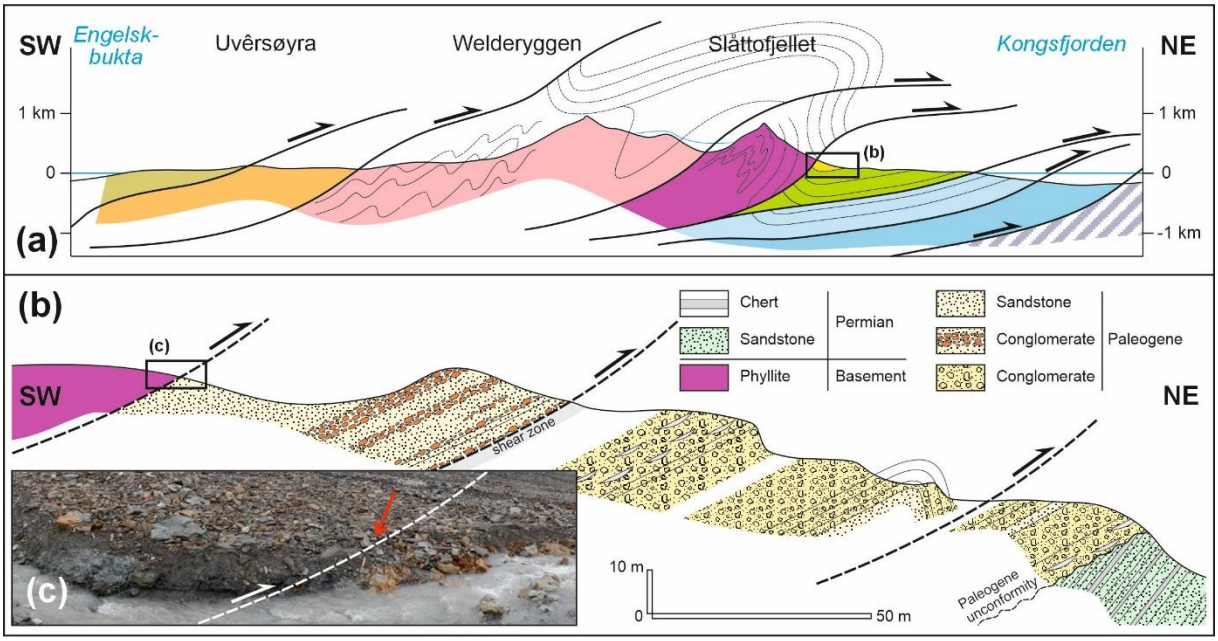

Fig. 2: (a) SW-NE-cross section through the Eurekan West Spitsbergen Fold-and-Thrust Belt on Brøggerhalvøya. For legend see Fig. 1; (b) Outcrop situation of folded Paleocene conglomerates and sandstones overthrust by basement phyllites of the Nielsenfjellet nappe, redrawn from Piepjohn et al. (2001a); (c) Picture of the contact between basement phyllites (left) and Paleocene sandstones (red arrow) exposed after the retreat of the ice of Austre Lovénbreen in the last few years.

2001a) indicates that the Paleocene deposits were involved. Due to the retreating ice of Austre Lovénbreen a new outcrop was recentely exposed east of Slåttofjellet (Fig. 2). There, a gently SW-dipping succession of Paleocene sandstones and conglomerates unconformably overlies Permian cherts and sandstones (Fig. 2b). Lyberis and Manby (1993) have argued that undeformed Paleocene deposits unconformably overlie imbricated (deformed) Permian rocks east of Ny-Ålesund indicating that the Eurekan deformation pre-dated the deposition of the Paleocene rocks. The tectonic situation in the outcrop at Austre Lovénbreen, however, shows that the Permian rocks are not more intensely deformed than the overlying Paleocene sandstones and conglomerates (Fig. 2b). In contrast, the presence of local, NE-directed thrusts and NE-vergent folds in several metres-scale in the Paleocene strata (Fig. 2b) supports that they were involved in the deformation after their deposition. This is supported by the geological situation in this area, which indicates that the phyllites of the Nielsenfjellet Nappe were carried northeastwards over the Paleocene Ny-Ålesund Basin of the Ny-Ålesund nappe (Fig. 2a–c). This indicates that the formation of the West Spitsbergen Fold-and-Thrust Belt on Brøggerhalvøya also took place during the first stage of the Eurekan deformation in the lower Eocene (Piepjohn et al. 2016).

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