The Rjukan Proterozoic rift basin, its basement and cover, volcanic and sedimentary infill, and associated intrusions

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Stratigraphy. The classic stratigraphy of the Telemark Supracrustals worked out by Dons (1960) distinguished three groups of metamorphosed rocks separated from one another by major unconformities: the Rjukan Group (oldest), the Seljord Group, and the Bandak Group (youngest). In addition, Dahlgren (pers. comm. 1996) has established a fourth group, the Heddal Group, concordantly overlying the Seljord quartzites, and older than the Bandak Group.

Areal extent. Our mapping northwards from the Rjukan area confirms the stratigraphy established by Dons and Dahlgren. All four groups have been followed northwards to the Caledonian front at Reineskarvet (Figs. 1a,b,c).

Basement. The boundary relationship between the Telemark supracrustals and the underlying and surrounding gneisses and granites has been a matter of discussion in Norwegian geology for over 100 years. We have now found the basement to the Rjukan group, the Gøyst Complex, in the Uvdal area and just east of the Mandal-Ustaoset Fault Zone. The Gøyst Complex consists of dark-coloured supracrustal gneisses typically with rusty weathering, and in many places developed as schlieric migmatites. The gneisses are intruded by fine-grained grey diorites, and all are folded and deformed in a complex matter. There is a marked difference in the degree of deformation and metamorphism between the slightly deformed Rjukan rhyolites and the strongly deformed and metamorphosed, migmatitic rocks of the Gøyst Complex. This Complex represents a true basement upon which the Rjukan rhyolites have been deposited.

The Rjukan volcanic rocks. A thick sequence of metamorphosed acidic lavas and tuffs is overlain by metamorphosed basic lavas and tuffs. They were deposited in a rift basin limited by the Mandal-Ustaoset Fault Zone in the west (Sigmond, in Tobi & Touret 1985), and a possible fault also in the east. The eastern boundary is drawn along the easternmost outcrops of the Rjukan volcanites (Fig. 1a).

The Uvdal plutonic belt. On the 1:1 M geological map of Norway (Sigmond et al. 1984) the Uvdal-Geilo area has been presented as a belt of gneisses with a zone of Telemark supracrustals on each side, a picture which could easily be thought to represent a folded orogenic belt. Our mapping has shown that this is not correct. There is just *one* broad belt with Telemark supracrustals, mainly Rjukan rhyolites, with a central area from Uvdal to Geilo consisting of younger plutons intruding the rocks of the Rjukan Group, partly also the Seljord Group, a few granites probably also the Bandak Group. The plutonic rocks range from gabbros to granites (Fig. 2). A special suite of intrusive rocks, the Grotte Suite, consisting of diorites, quartz diorites, tonalites and granodiorites, have U-Pb ages of around 1509 Ma (Ragnhildstveit et al. 1994). Their age and field relations indicate that they could be connected with the magma- and riftforming event that led to the eruption of the acidic Rjukan volcanites. The U-Pb age of a Rjukan rhyolite has been determined to be around 1514 Ma (Dahlgren, pers. comm.) and 1511 Ma (Sigmond & Tucker in prep.)

The Seljord and Heddal Groups. After this period with active rifting and volcanism there followed a long quiet period with almost complete levelling of the old landscape. The deposition of the pure quartzites of the Seljord Group took place mainly in an epicontinental shelf environment. The Heddal Group was deposited in an environment where some volcanic activity took place. The sediments of these two Groups cover a larger area than the Rjukan volcanites and have an eastward areal extension independent of the earlier rift basin (Fig. 1b), a fact supporting the drastic differences in depositional and tectonic environment during the deposition of the rocks of the Rjukan and Seljord Groups.

The Bandak Group. The rocks of the Bandak Group have been deposited with an angular unconformity on the older folded and eroded groups The rocks are metamorphosed immature sandstones, breccias and conglomerates with layers of basic and acidic volcanic rocks. The rocks along the western boundary were deposited along an active fault margin (the rejuvenated Mandal-Ustaoset Fault Zone), while the eastern boundary from Numedal to Tinnsjøen is a post-depositional fault. Thus, the Bandak Group could also have been deposited in an intracontinental rift basin.

The Rjukan Rift Basin. The depositional environment of the Telemark supracrustals has been discussed by many authors. The field relations revealed by our new mapping, with the very large volumes especially of acidic volcanic rocks within fault boundaries, clearly indicate that the Rjukan volcanic rocks were deposited in a rift basin.

This basin is of much the same size and has the same N-S extent as the Permian Oslo Rift (Fig. 2). The Rjukan rocks were intruded by numerous igneous rocks (Fig. 2). Some of them, e.g. the Grotte suite, were probably connected with the rift-forming event, while others, especially the large granites, are

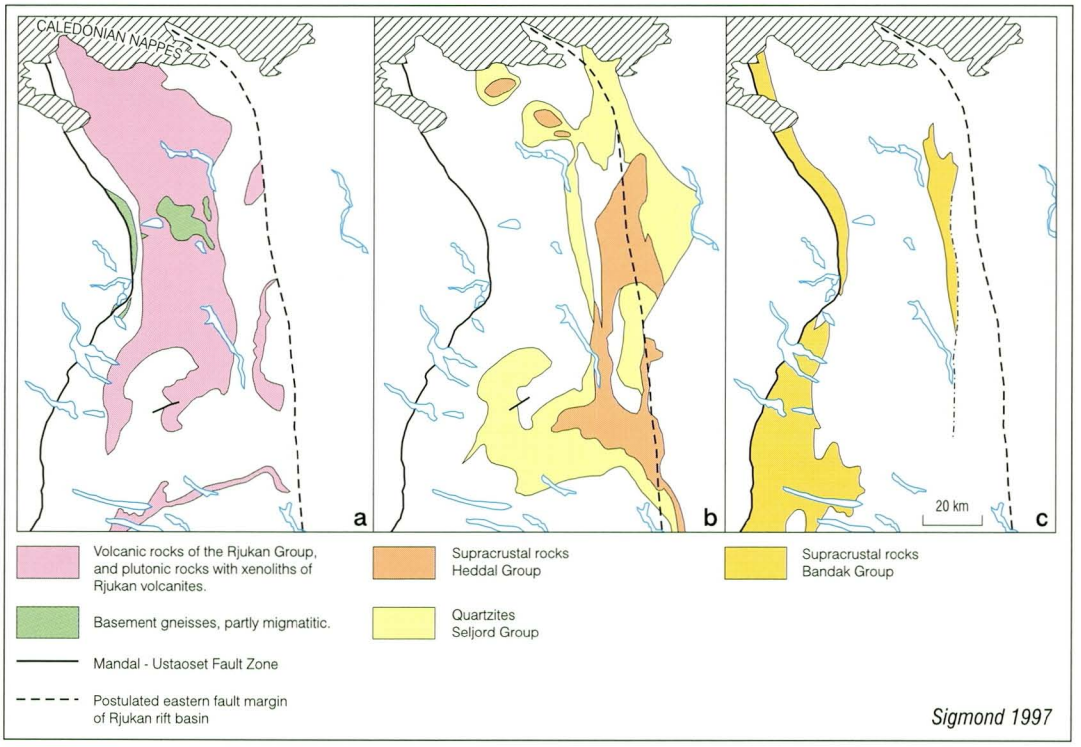

Fig. 1. Present exposed areas of the Rjukan, Seljord, Heddal and Bandak Groups.

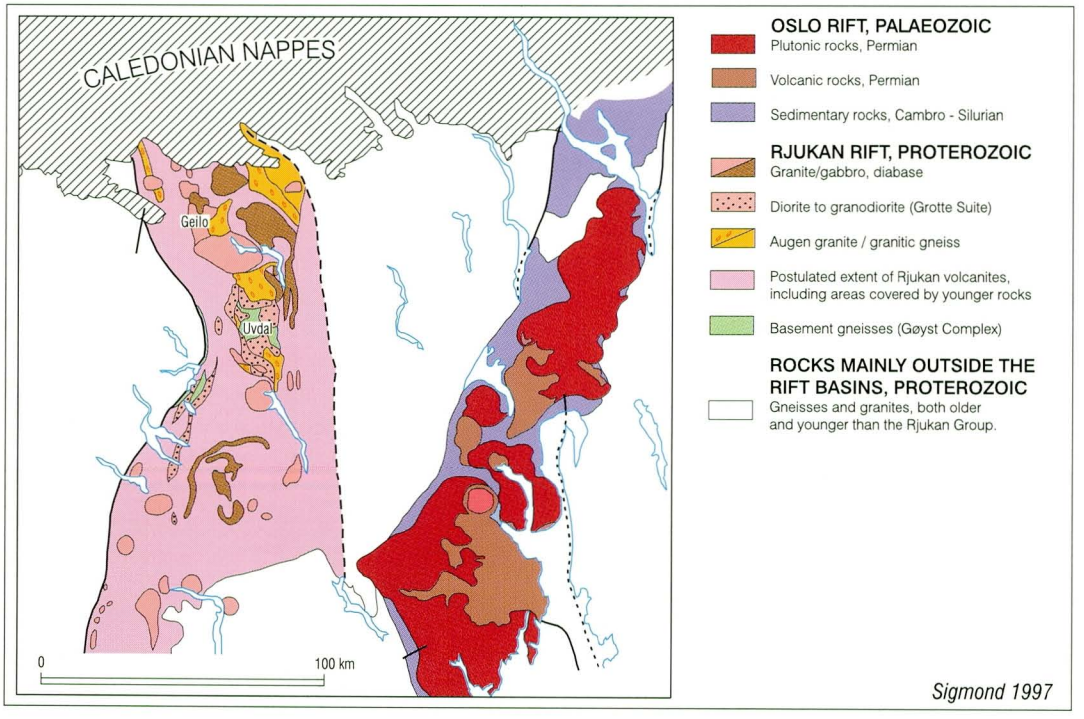

Fig. 2. The Rjukan Rift compared to the Oslo Rift.

most probably too young to be directly connected with this event. Furthermore, the new age determinations have shown that there is a gap of 360 million years between the deposition of the Rjukan rhyolites and the Bandak supracrustals. This indicates that the different groups in Telemark should preferably be treated and discussed separately, and the term Telemark Supergroup should be dropped. In discussing all four groups it is more appropriate to use the informal term Telemark supracrustals.

References

Dons J.A. 1960: Telemark supracrustals and associated rocks. In Holtedahl, O. (ed.) Geology of Norway. *Norges geologiske undersøkelse 208*, 49-58.

Ragnhildstveit, J., Sigmond, E.M.O & Tucker, A.D. 1994: Early Proterozoic supracrustal rocks west of the Mandal-Ustaoset Fault Zone, Hardangervidda, South Norway. *Terra abstracts. Abstract supplement No 2 to Terra Nova 6*, 15-16.

Sigmond, E.M.O., Gustavson, M. & Roberst, D. 1984: Berggrunnskart over Norge M 1:1 million *Norges geologiske undersøkelse.*

Tobi, A.C & Touret, J.L.R. (eds.) 1985: *The Deep Proterozoic crust in the North Atlantic Provinces*. D. Reidel Publishing Company, Dordrecht, Holland, 603 pp.