

Discussion

Reinterpretation of Finnmarkian deformation on western Sørøy, northern Norway: a reply

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We thank Sturt & Ramsay (this vol.) for underlining some of the aspects of our interpretation (Krill & Zwaan 1987) that are the most problematic and in need of further study. They summarize and then refute our arguments in three parts, to which we reply below.

Concerning the stratigraphy of Sørøy (part i), our hypothesis does not imply a discontinuous sequence. We first seriously questioned the model of Finnmarkian orogenesis because it required the Nordreisa sequence to be discontinuous, with a break between the Silurian fossiliferous strata and the Finnmarkian-deformed and -metamorphosed strata below (see Ramsay et al. 1985; Roberts 1985). Although we would like to correlate the Nordreisa and Sørøy sequences, our hypothesis would allow both sequences to range from the Late Precambrian continuously up into the Silurian, without the break required by a Late Cambrian–Early Ordovician orogenic episode in these rocks.

To complete the partial quote by Sturt & Ramsay (this vol.), we wrote that ‘the stratigraphies on Sørøy and Nordreisa again might be correlated; if so, the Falkenes marble is too young to have undergone Finnmarkian deformation or to have been intruded by rocks of the Seiland province, as earlier interpreted (Speedyman 1983)’. Clearly this was only our view, and not proven in any way. We have not checked the field relationships in the Husfjord area, and we still wonder whether the highly deformed contact between the gabbro and the upper parts of the stratigraphy could be re-interpreted as unconformable or tectonic. Our earlier view may well be wrong, but neither it nor the continuity of the Sørøy stratigraphy are significant in the present discussion.

Concerning the relationships between folds and dikes (part ii), we are sorry that Sturt & Ramsay (this vol.), and possibly others, have taken our statements to mean that ‘Dyke and fold relationships on W. Sørøy show unequivocally that the dykes are pre-fold and hence pre-tectonic’. It is correct that we interpret the dikes as pre-dating the folds (the regional folds, not the folds and more chaotic structures in the contact aureoles), but this interpretation cannot be shown unequivocally by any structural relationships. Unfortunately, it is never possible to prove that deformed rocks were completely unfolded when a series of igneous rocks intruded. On the other hand, it should be quite simple to prove that earlier folds did exist, if they did, yet this has not been proven to our satisfaction by any of the published descriptions of the Seiland Igneous Complex, including the current discussion. The six photographs presented by Sturt & Ramsay (this vol.) are similar to figures published earlier (e.g. Fig. 2 in Sturt & Ramsay 1965), and they are all from the contact aureoles (Figs. 1a, 1d, 2, and 3 are from the inner part of the Hasvik aureole, and Figs. 1b and 1c are from the Breivikbotn aureole). These figures convincingly show that folds and blastic migmatites are transected by relatively late dikes. If such structures could be found cut by the dikes outside the contact aureoles, our hypothesis would be clearly disproven.

Outside the aureoles, the dikes may appear to cut foliations, as observed by Sturt & Ramsay (this vol.). Because of the heterogeneous deformation and the competence contrasts between psammite and diabase, we cannot accept their interpretations that these structures are

related to F1 or F2 folds. The various possible interpretations of such structures could best be discussed in the field, either in Sørøy or in the more accessible Oppdal district (Krill 1983, 1986), where foliations also appear to be truncated by dikes that are now interpreted as pre-orogenic.

Concerning our interpretation of flow-folds in the migmatitic aureoles (part iii), we think that these folds formed when first in contact with the hot plutons, and were transected by dikes during later stages. We did not look closely at the contact migmatitic rocks during our brief study on Sørøy, but we have more experience with such structures in the Nordreisa area (Zwaan in prep.). Although some of the fold structures in the aureoles, such as those presented by Sturt & Ramsay (this vol.), may have the appearance of typical regional-deformation folds, they grade rapidly into disrupted chaotic structures, suggesting that they are related to contact melting and local stress fields, and not to regional metamorphism and deformation. We called these structures flow-folds, but they could more precisely be called 'viscous folds', as discussed by McLellan (1984). Her work shows that when layered rocks contain a small melt fraction, large ductility contrasts between layers may produce folds that do not have regional significance. Since some of these structures can mimic regional-deformation folds, we cannot accept any folds in the migmatitic contact aureoles or xenoliths as proof that the rocks were folded before the Seiland magmatism. Little is known of structures associated with magmatism in deep levels of a rift environment, but one might expect that extensional foliations and other ductile structures would be common.

We do not think that Sturt & Ramsay's Comment weakens our hypothesis, nor do we believe that our hypothesis should be accepted uncritically. We hope that the most important disagreements in our contrasting interpretations are now clearly stated, and can help guide further research leading to an improved model.

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