

A reply. Western Karmøy, an integral part of the Precambrian basement of south Norway

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In his comments to my paper (Birkeland 1975), Geis has serious objections to two points in my paper, viz. (1) the intrusive character of the so-called saussurite gabbro, and (2) the allochthonous nature of the Karmsund syncline.

(1) In my opinion, there are weighty arguments in favor of considering the saussurite gabbro as representing a true intrusive rock (Reusch 1888, Goldschmidt 1921, Kvale 1937, Kolderup, C. F. & Kolderup, N.-H. 1940). Contrary to this generally accepted view, Geis is putting forward his own conception, i.e., that the rock concerned (renamed “amphibolite” by him) may represent a strongly metamorphosed basic lava of the same or a similar type from which the greenstone of the actual area originated (Geis 1961, 1962, 1965, 1968). At the time when I wrote my article, I was unaware of Geis’s papers where he discusses this topic. But having read all of them, I see no reason to change my view on that matter. On the contrary, I shall maintain the old conception of the saussurite gabbro, which, I hope, will appear from the following short description of the said rock and its relation to the greenstone. For this purpose, two regions of the saussurite gabbro-greenstone complex have been selected.

The first region, lies to the southwest of Koppervik, and between Stangaland and the valley east of the mountain Storesåt greenstone is the only outcropping rock. However, when ascending on the eastern slope of the mountain, minor bodies of saussurite gabbro appear, usually in the shape of sills, and these sills gradually increase in number towards the top. The final outcome of this lit-par-lit intrusion mechanism is a composite rock made up of a system of thinner and thicker, subparallel sill-shaped masses of saussurite gabbro and intercalated layers of greenstone. The gabbroic sills are essentially concordant with the major structure of the region. Westwards, this composite rock faces a large, elongated, NNW-SSE-oriented body of massive saussurite gabbro. Similar conditions also prevail farther south. But in addition to the rocks already mentioned, small lenticular bodies of serpentinite occur, three of which have been located on the east side of the lake Buasdalsvatn, not far from the boundary surface towards

the basement. The ultrabasic bodies, lying as inclusions in the saussurite gabbro, most likely represent the result of an accumulation of early crystals (originally of a peridotitic composition) that took place in a shallow magma chamber, before the intrusion of the gabbroic melt into the basic lava flows of the geosyncline.

The second region lies north of the inlet Veavågen, northwest of Koppervik. As in the southern region, the two metabasite types are separated by a boundary zone. This one, however, being distinctly transitional in character, is made up of a disordered aggregate of irregular bodies of saussurite gabbro and disconnected masses of greenstone, which eastwards passes gradually into a broad zone of low-grade basic metasupracrustals. The saussurite gabbro, which normally is a medium-grained rock, may locally attain a very coarse-grained texture, with up to 6 cm long prisms of a dark amphibole set in a crisscross granular aggregate of saussuritized plagioclase. Sometimes, the saussurite gabbro may show banding. This structure was observed at Ytraland, in a road-cut near the shore, where 0.5 to 1.0 m thick layers of a light-colored, strongly foliated rock varying between anorthosite and anorthosite gabbro in composition, alternate with bands of normal saussurite gabbro. Structures of this kind have been explained by Bowen (1928) as due to "slow crystallization, with the attendant opportunity for crystal sorting, auto-intrusion, further crystal sorting and so forth". The question now arises whether it is reasonable to think that such banded structures can be explained in terms of a metamorphism which increases to the southwest. I am convinced that the question has to be answered negatively.

(2) Appealing to some older geologic literature (Sørbye 1948, 1954), Geis seems to be inclined to postulate a Caledonian age of the gneissic rocks lying to the east and west of the Karmsund syncline. This contention has not been confirmed by my own field investigations in the same regions. Moreover, Geis visualizes the Karmsund syncline as part of a larger geosyncline that extends from a point north of Stavanger, over Karmøy – Bømlo – Stord – Tysnes into Hardangerfjorden, in which the phyllite and the low-grade basic metasupracrustals together with other schists were deposited. Also in this respect, his idea of the tectono-stratigraphic development of the Caledonides in the region under consideration seems to be rather outdated (Heier et al. 1972, Andresen et al. 1974).

The Karmsund syncline is strongly asymmetric with a tabular mass of saussurite gabbro along its western flank and greenschist as the predominant rock on its eastern limb. Of particular interest in this connection is the position of the small bifurcate area of green polymict conglomerate and associated sandstones occurring a little east of Skudeneshavn, at the southeasternmost end of Karmøy. To the west, the conglomerate-sandstone formation is resting directly on the granitoid gneisses of the substratum. To the east, it borders on the saussurite gabbro-greenstone complex of the Karmsund syncline. This calls for some explanation. The said sedimentary

series is demonstrably younger than the metabasites, as well-rounded fragments of the latter have been found in the green conglomerate of this series. Moreover, since the green conglomerate is devoid of clastic fragments of the granitoid gneisses of the substratum, the conclusion seems inescapable that the present environments of the members of the Upper Ordovician sedimentary series are not identical with the depositional environments of these sediments. This line of thought constitutes the basis of the hypothesis that the Karmsund syncline is forming a separate nappe sheet which is in immediate contact with the Precambrian basement.

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