Contributing Remarks to M. Gustavson's Paper: The Caledonian Mountain Chain of the Southern Troms and Ofoten Areas, Part III

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Gustavson (1972), in his interpretation of the structural history of the Ofoten area, described NE-SW trending folds to be refolded by a major co-axial synform (the Ofoten Synform) and also cross-folded on NW-SE axes. The thickening and thinning of the pretectonic sulphide orebodies in the central part of the Ofoten Synform appear to be related to the two co-axial fold phases. Subordinate cross-folding also led to local thickening of the ore units. Cross-folding in other parts of the area may have created important traps for mobilized ore material of pre-tectonic origin.

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M. Gustavson, in his paper: 'The Caledonian Mountain Chain of the Southern Troms and Ofoten Areas, Part III: Structures and Structural History, *Norges geologiske undersøkelse 283*, 56 pp., 1972', has retraced the tectonic development of the so-called Ofoten Synform. It is established that its actual appearance as a great, open basin occurred during the fold phase which he terms F_2. The recognition of a separate, previous fold phase, F_1, locally has implications for the interpretation of the geometry of the orebodies of the area.

In the Ofoten Synform there are many occurrences of ore types of indubitable pre-tectonic origin (Foslie 1949, Juve 1967, Gustavson, Juve & Vokes 1970). Because of the relatively greater mobility of the ore minerals during the dynamometamorphism, these ores have been remodelled into patterns of thickening and thinning which were strictly governed by the consecutive fold movements. The present writer investigated the zinc and lead deposits which are contained in the uppermost members of the stratigraphy of the Håfjell Syncline on the southern side of Ofotfjorden (Juve 1967). Folds were largely observed on two scales:

Great, open folds forming the regionally conspicuous synformal structure.
Smaller folds with amplitudes from decimetres to more than ten metres.

Most of these folds have an open form, but there are local transitions to tighter structures. Completely isoclinal folds are found, some of which are recumbent, with relatively flat-lying axial planes. This structural type is also a typical feature in the quartzite along the ore zone of the Skårnesdalen claims and is seen on the map (op. cit., p. 11) in the limestone 'tongues' in the hinge zone of the major synform.

The measured directions of fold axes, rodding of quartz, garnets and sulphides are in all localities within the claim areas parallel with the so-called 'main fold direction'. Small horizontal deviations were never asscciated with any possible earlier fold phase. However, systematic undulations in plunge were interpreted as the result of large-scale 'cross-folding' with a NW-SE trend, whose timing was not ascertained. This folding apparently consists of a series of repeated monoclines to which local thickening of the orebodies could be related (op. cit., p. 19). It is of importance to investigate if this type of folds in other areas could imply potential ore thickening patterns of greater importance than those already studied. Regarding the 'main folding' of the

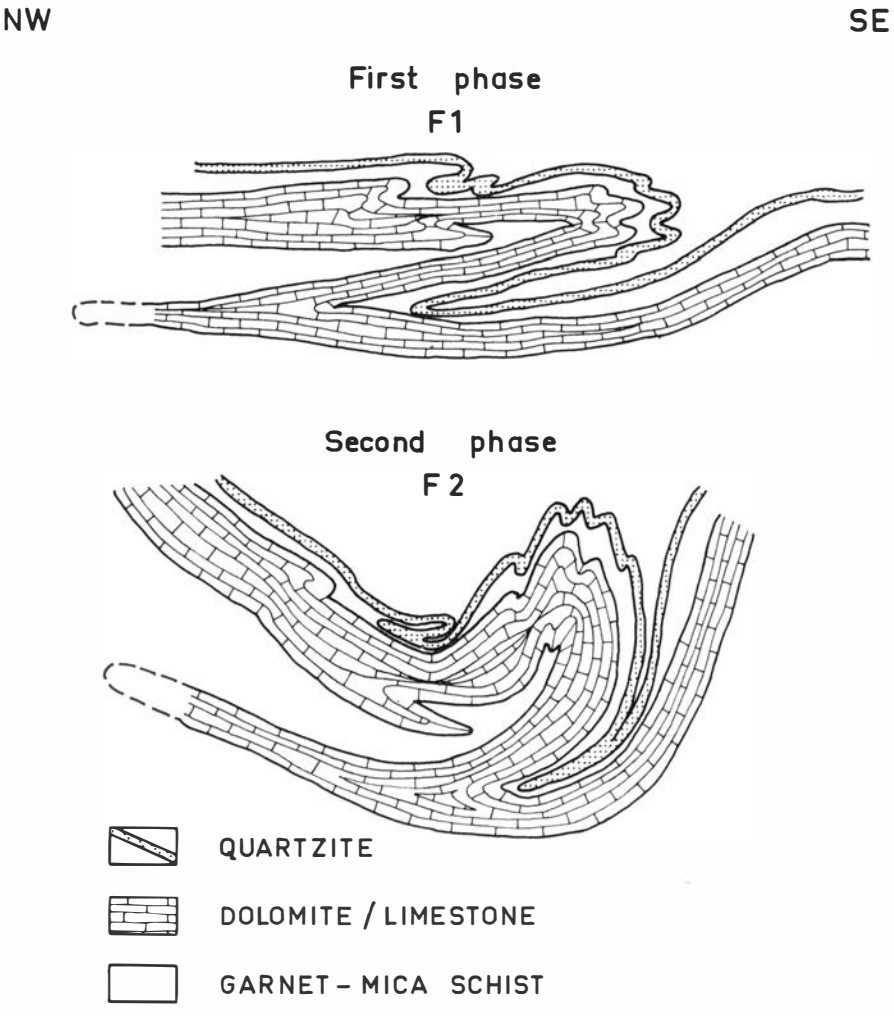

Fig. 1. Section perpendicular to the 'main folding direction' of the Håfjell Syncline. The movements can be subdivided into two co-axial phases.

Håfjell Syncline, some of the recumbent, isoclinal folds which are clearly deformed by the open type of folding could be interpreted as belonging to a previous fold phase. The schistosity, which is mainly parallel with the primary sedimentary layering, is, particularly in the quartzite, very seldom seen to penetrate the hinges of the early isoclinal folds.

Thus it did not seem logical in 1967 to treat the isoclines as a separate phase; they were interpreted as representing an early stage of one and the same 'main fold phase', or locally as tight, parasitic drag structures in the vicinity of the axial plane of the major Håfjell Syncline.

On a regional scale the angle between the respective axes of Gustavson's F_1 and F_2 phases is highly variable.

In the central part of the Håfjell Syncline the two phases are coaxial. According to this, the present author suggests that the complicated NE-SW 'main folding' of this area be subdivided into the two phases F_1 and F_2 as illustrated on Fig. 1.

This subdivision does not influence the original interpretation (op. cit.) of the geometry of the ores of pre-tectonic origin of the Håfjell Syncline. However, in other parts of the area where other fold phases may have been neglected, and particularly where their directions are not parallel to the main trend of the Ofoten Synform, an analysis of the thickening and thinning patterns of each member of the stratigraphy may reveal undetected traps for mobilized ore material of pre-tectonic origin. One pertinent example is the old pyrite mine of Bjørkåsen (exploited 1910-1964) in the south-eastern part of the area. The long axes (along maximum thicknesses) of the two ore lenses plunge SW, with a strike sub-parallel to the main trend of the Ofoten Syncline, the F_1 direction in that part of the area (Gustavson 1972: 30-31).

'Cross-folding', with axes plunging both NW and SE is observed in the upper part of the ore (Foslie 1926). These axes appear to be deformed by the main fold axes (F_1) and may thus be of pre-F_1 age in the terminology of Gustavson.

In spite of Gustavson's important contribution to the understanding of the regional geological development, direct correlation of contemporaneity of the observed tectonical events in different parts of the Ofoten Synform can still not be definitive.

In the search for orebodies in general and for ores which have been more or less mobilized during the dynamo-metamorphism in particular, the study of the fold phase chronology is important. The detailed study of known orebodies of pre-tectonic origin correspondingly contributes to the understanding of the structural development of their surroundings.

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