FOLLDAL PROJECT

Field Report, Summer 1982.

The idea of this short report is to try and put many thoughts into clearer prospective and help perhaps with general prospecting techniques, and better still locate favorable mineralized horizons with the aid of large scale geological mapping, rock types and their stratigraphic location, and the recognition of repetative zones of mineralization within folded sequences. This, I hope, will locate some desireable areas for continued exploration in the futur.

Rock types and general Characteristics

I will work from east to west describing the oldest rocks first through to the younger types.

1) Ultramafic-mafic sequence- include the coarse grained peridotites and dark green, fine grained dunites. Some places show good differentiation into gabbro and at times diorite. Zones have been serpentinized especially noticeable around the Fasten exposures. These rocks generally include a high background of magnetics and can be traced fairly accurately with the help of the air-borne EM-MAG data.

2) Quartz mica schist and greenstone, with minor greywacke, graphite schist, and conglomerate - easily recognized as generally a schistose unit fairly high in quartz content, along with massive greenstone with flanking sulfide rich graphite schists, and minor beach pebble conglomerate. Other rock types such as arkose, quartz chlorite schists, and some derivatives of the mafic volcanics are seen but are very limited.

3) Volcanic sequence

A) Mafics - include greenstone, greenschist, mafic tuffs, and volcanoclastics. These are the most dominant rock types in the volcanic belt. Minor dacite has been seen although these are most probably the result of differentiation.

B) Felsics - include felsic tuffs(or better known as keratophyre), quartz eye rhyolite, and minor derivatives of this family.

C) Schists - mostly found as small horizons of quartz biotite schist intermixed with graphite schists, chlorite schists, silicified graphitic sediments and minor discontinueous mafic and felsic stringers within the sediments

4) Phyllites - unit is characteristically dark black to grey black, usually showing well developed crenulation cleavage. The unit is generally massive and includes minor quartz and quartz feldspar carbonate veinlets. Selected zones contain high percentages of graphite with associated pyrite and pyrrhotite. Unit does show a limited schist like habit but these zones are very small and are usually restricted to contact zones with either the volcanic sequence or the over lying calcareous mica schists.

5) Calcareous mica schists and quartz mica garnet schists - these rock types are very extensive in the north west sections of the project area, and can be easily recognized as having small calcareous zones in the schists grading westerly into more of a quartz rich sediment. Small lenses of graphite schists are also present and contain minor associated sulphide in the form of limonite.

6) Amphibolites - generally dark greenish black somewhat coarse grained and may be found to grade into greenstone sections. They are associated closely with heavy concentrations of magnetite and pyrrhotite along with a garnet cummingtonite magnetite assemblage. These loosely termed iron-formations may also have very minor graphite within the matrix. Zones from drill core have also shown almost pure biotite schists with large garnet crystals throughout. These zones have been located within the greenstone/ amphibolite flow rocks in close association with sulphide mineralization.

7) A number of quartz diorite intrusive sills can be seen throughout the project area but these are generally associated with rocks of the volcanic sequence or in certain cases the phyllites and calcareous mica schists that lie stratagraphically above the volcanic sequence. The quartz diorites are usually coarse grained, creamy white to light grey in color, and resemble at first sight similarities of an "Alaskite" of the granite family. Fine grained varieties of this rock are abundant.

Gabbros become increasingly more abundant towards the north east section of the map sheet and are found to be restricted to the lower quartz mica schist group structurally below the main volcanic sequence. They are also found in older rocks as one moves more towards the east. Towards the north and on to the upper part of the Dalsbygda map sheet they have been mapped as intruding the volcanic belt. The gabbros have a very coarse grained appearance, dark greenish black in color and may include fine grained varieties of diabase and diorite.

The following gives an account of the possible original rock type before various degrees of metamorphism.

Primary rock type	Medium - grade metamorphism	High - grade metamorphism
Chert	siliceous schist	quartzite
Rhyolite tuff	quartz - feldspar sericite gneiss	quartz - feldspar gneiss
Andesite tuff (chlorite schist)	biotite-quartz-chlorite schist	biotite- quartz gneiss
Basalt (chlorite schist)	epidote - amphibolite	amphibolite (gneiss)
Turbidite sequence (deep water)	quartz - plag- biotite schist (±garnet±staurolite ±graphite)	gneiss form
Arkose and quartzites (shallow water)	quartz - plag - kspar - biotite schists (±magnetite ± garnet)	gneiss form
Calcareous and pelitic horizons (shallow water)	hornblende - garnet plag gneiss	more hornblende rich

The rocks of the project area are generally low grade and at times have retained much of their original form although the "Gula group" towards the west section of the project area show a much higher degree of metamorphism.

Evidence for area not being overturned

Looking at the geology of this area it is difficult to imagine most of these rock units being overturned and generally retaining their uninterrupted strike length. It would seem more likely, if such an event did happen, that there would be a higher degree of faulting and perhaps a lesser degree of unit correlation. This was not found in the project area. Perhaps thinking along these lines was derived from over turned beds due to folding. This is the case up at Hilskifteåsen (Tynset map) where folding has repeated keratophyre and phyllite units in a tightly folded sequence with general dip towards the northwest.

Some other ideas against complete overturned sequence of rocks.

1) The strongest evidence is from the small conglomerate unit that can be found structurally below our main volcanic sequence. This conglomerate includes rounded pebbles of quartz mica schist, quartzites, and most importantly ultramafics, resembling that found in the ultramafic belt to the southeast. With dips generally to the west and northwest and the ultramafic belt located structurally below the conglomerate it would stand to reason that the rock types are indeed not overturned.

2) Pillow structures were found at rock exposures up at Solve-Lomsjøvola with their general configuration facing upwards.

3) Recent radiometric dating by Point et al. (1976) gives an age for the Hummelfjell formation as possibly Precambrian. This formation is rich in feldspathic quartzites and occupies the central areas of the Einunnfjell anticline. The unit can also be found boardering the south to southeast sides of the ultramafic belt discussed earlier.

Favourable horizons for sulphides and prospective areas

From general field observations this summer certain favourable zones appeared throughout the area which may boost next years study.

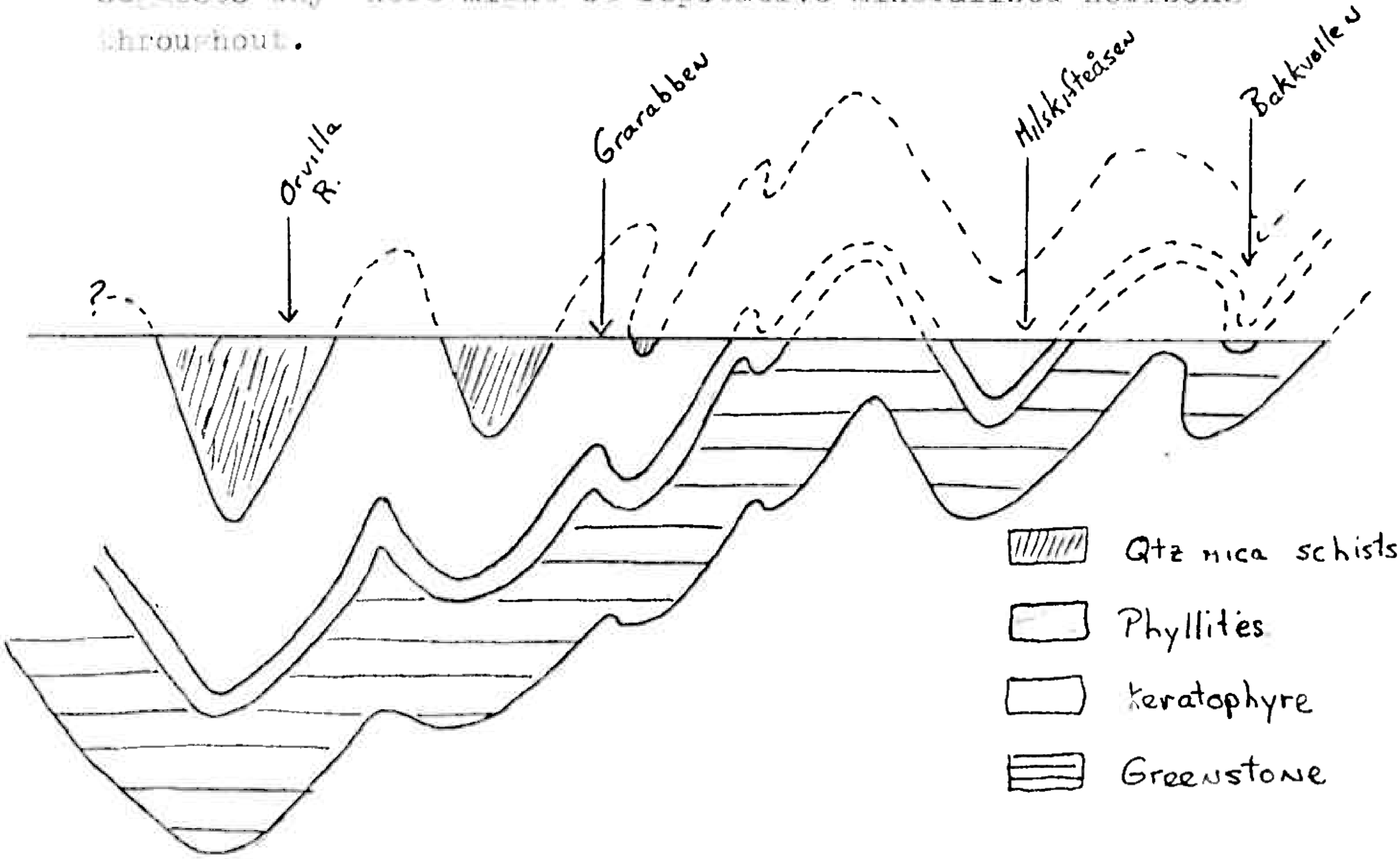
1) Mafic-Felsic contacts - these are prime targets as ore is usually capping felsic sequences. In some cases ore may also be associated with the close of a mafic sequence that is quickly followed by felsics. Examples are Sivilvangen, Fadalen2, Tonnvola, Knausvola, and Bakkvollen.

2) Down dip of graphite zones- graphite zones along with siliceous graphitic sediments can usually be used as marker horizons seperating the mafic and felsic rocks. (This is not to say they don't also seperate individual felsic or mafic flows.) The formation of these graphitic beds was the last stage of sedimentation resulting from volcanic activity. Deposition of ore preceeded the graphite and therefore it should be slightly deeper in the sequence.

3) Heavily folded areas- folded areas will multiply ore width and consequently make a possible mining operation much more viable. Folded structures towards the north end of the Tynset map sheet show excellent promise. It is thought that folding is generally very tight in this area and plunges slightly to the north. The following shows two particular areas of interest.

A) Tightly folded keratophyre units, generally very small in width, can be seen repeating themselves throughout. Examples are the keratophyres at Vingelen, Knausvola, and Nonsvola. The Bakkvollen area keratophyre may also be of the same unit. Any air-borne anomaly in this area should become a good target for investigation. Because Vingelen is most probably along the same mineralized keratophyre that shows heavy large scale folding it may be probable to locate the same unit in valleys and topographic lows to the northwest of the old Vingelen showings. The keratophyre will be closely associated with the dark grey/black phyllitic unit. Further to the north the volcanic unit becomes too deep for any type of exposure.

The following gives a rough account of the general type of folding that is thought to be within the Vingelen area, and suggests why there might be repetative mineralized horizons throughout.



(looking north northeast along top part of Tynset map sheet)

3) The eastern contact of the main volcanic belt on the Tynset map sheet may indeed be repeating itself , by folding, in the lower schistose units. These prospective areas should be restrictedto the vacinity of the proposed volcanic/schist contacts. Marker horizons include dark grey to black graphitic phyllites and graphite schists with associated greenstone. These graphite zones are well exposed to the south east of Vingelen and on the Tunndalen grid and may serve as a helpful guide for geophysical and geochemical follow-up next year.

4) Observation showed that many of the small keratophyre units had better potential for sulphide accumulation, as was seen at Tonnvola, Fadalen 2, Vingelen, Knausvola, and Bakkvollen. This is greatly dependent though on how one may map a rock series; either basically a felsic volcanic or greenstone.

5) Trondhjemite was also found in close association with sulphide zones and small geophysical conductors (Fadalen 1 Tonnvola, Bakkvollen) and perhaps the heat source remobilized the sulphides into particular zones surrounding the sill like intrusive.

Positive field signs for prospectors

1) Mafic/felsic contacts with small keratophyre units intermixed.

2) Pyrite zones and disseminations.

3) Heavy garnetiferous sediments in close vacinity to amphibolite contacts in the Gula group.

4) Highly folded areas.

5) Quartz eye rhyolite and large volcanoclastites.

6) Buried conductors.

7) VLF field strength approximately 50 - 60 above background forming large anomalous area. This could be roughly used to distinguish heavy graphite zones and disseminated sulphides.

8) Small EM anomaly down dip of large conductor.

9) Evidence of lead in rock outcrop or in geochemical sampling.

10) Albitization found in keratophyre zones.

11) Massive creamy quartz in a volcanic·environment showing almost a bedded form, with good strike length.

12) Chloritized and seritized schists.