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Report
on Grimeli

?? translation of iapp 870 ??

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Report on the
Grimeli copper deposit

Introduction: The Grimeli copper field is on the Stavenes Peninsula in Søndfjord (south Florø Island) in Sogn and Fjordane County in Norway. The field is located on the north side of the peninsula near Grimeli, where it begins approx. 500 metres from the beach at a height of about 50 metres above sea level. The terrain here quickly rises to a height of some 750 metres a.s.l. A handful of fishermen live here on small farmsteads. The deposit has been in operation— how far back is hard to say—though nevertheless as late as 1800-1875. A smeltery was in existence then. As far as it is possible to tell, at least 100,000 tonnes of ore must have been produced for smelting. The fact that operations had to be suspended is certainly rooted in the lack of geological insight.

A newly constructed road now leads from Grimeli in the immediate vicinity of the mine right across the Stavenes Peninsula to Stubseid on the south side of the peninsula; the road is about 5 km long. On the south side there is a good harbour, free of ice all year round.

The whole Stavenes Peninsula consists of regional metamorphic slates, probably from the Cambrian-Silurian period. No precise dating of the period can be given as no fossils have been found. The slates run east-west with great regularity for many kilometres. The incline is also highly regular, approx. 60° northwards across the entire area. In this slate the copper field now occurs as a typical injection, i.e. as a sulphidic copper fusion sandwiched between the strata of slate. The field dips and falls like the surrounding slates. The deposit has drifted more than 500 metres east-west and on the mountainside can only be observed by means of local bending interrupted in the slate. To the west the lode can no longer be traced; however, it is not unlikely to go further. Eastwards and above the "Upper Mine" there are four trial pits in the direction of the Vågene Mine. The terms Upper and Lower Mine do exist, and these doubtless represent the same injection in the same geological horizon. The old mine maps appear to show an incline of about 60° in the field. However, local disturbances may have been responsible for bringing about these ore limits. Yet the injection scarcely arose vertically, having probably risen up from depth – whether from the west or the east is impossible to determine. The most favourable, of course, would be a shallow dip to the east. Multi-millions of tonnes would then be reached. Until further notice, however, I am working on the assumption of a 60° dip.

Looking at the way the deposit outcrops, the local disturbances and the bending of the slate, and comparing these with the genesis (sulphidic fusion squeezed up from depth), it is possible to understand why operations to date essentially took place in the upper part of an injection. Oddly enough, the exact opposite was the case with the pyrite field I surveyed in 1910-14. The bulk of the deposit had been taken away by erosion, as could clearly be seen and calculated. About one million tonnes were left, however. Now, this deposit very clearly branches upwards, fusions are partly squeezed into parallel layers as well. This manifests itself quite clearly in the case of the Lower Mine. These branch-offs, some of which are known as blind lodes, unite at depth. In addition, all these branch-offs contain mainly the more thin-bodied magnetic pyrite, which penetrates the fissures more easily. I have now learned that in the case of the Norwegian copper mines the richest and least thin-bodied ore occurs in the central part of the fields, while in the outcrop (on the sides) the more thin-bodied magnetic pyrite mainly occurs.

The West, and partly perhaps also the “Lower” mine, where the copper content is relatively low (plentiful magnetic pyrite), is scarcely going to be the principal mine, but only part of the field—to the west. In my view the bulk of the field must be sought further east beneath the "Upper Mine". This is where the copper-rich central parts of the injection, i.e. the field proper, are likely to be.

Description. I shall begin with the lowest and most westerly part of the lode – closest to Grimeli – the so-called "West Mine". There is a towering hill here, in the fenced-off field, on which the lode has lain like a cake. Open-cast mining was once conducted here, and several thousand tonnes must have been mined. The large earth masses found here, the consideration shown for the fenced-off field and the onerous flooding are bound to have contributed to the fact that no deep mining has been commenced. It was probably planned to work beneath the "West Mine", working from the "Lower Mine" once the latter had reached a suitable depth. In the "Lower Mine", as already mentioned, the lode has been lost. Consequently, part of the "West Mine" has been ignored. A new, small gallery – operated in 1916-17 through the fenced-off field, about 40 metres long and at right angles to the stratum beneath the cave to the surface—shows ore everywhere, partly compact pyrite layers, partly impregnation. Back then there was no knowledge of the parallel lode in the "Lower Mine", otherwise the master gallery would have continued being worked in order, if possible, to intersect two parallel ore lodes or layers here as well.

The "West Mine" is separated from the "Lower Mine" by a large moraine-filled gorge through which a small stream flows, though this swells to a great size during floods. At depth one will be rid of the moraine and the inconveniences caused by the water, and the ore lodes

from both mines probably converge here. The so-called "Lower Mine", which forms the nearest ore-rich section to the west, used to be the main mine, and judging by the large mine chambers, significant volumes of ore must have been mined. The thickness here must have been 6-8 metres or perhaps more. The expensive ground-level study also points to a rich mine higher up—rich if not in copper then at any rate in volume. The ore will undoubtedly recur at depth—the disturbance is local only. Going further downhill, the first encounter is with the large local folding in the slate—in the drift and dip alike—where the ore has either been squeezed out or has simply been unable to penetrate. However, there are also small veins and impregnation bands present, running towards the "Lower Mine". Local disturbances are also present here, but more recent studies show that at depth the lode runs with greater regularity, steeper pitch and increasing thickness. In the lower, new gallery the ore has a thickness of 2 metres, being pyrite containing at least 5% Cu. In the inner, east part of the Upper Mine, where too much headway was previously made southwards, rich ore containing approx. 10% Cu made an appearance, in addition to an impregnation zone, which may hint at larger masses at depth.

All in all, the Upper Mine is the most advantageous in my opinion, even though the thickness here is not as great as in the "Lower Mine" until a greater depth is reached.

At surface east of the "Lower Mine" the lode is lost, or rather it branches off. The terrain is partly covered. Incidentally, in my view nothing can be expected so high up. Further down, on the other hand, there is no ruling out that the lode runs considerably further to the east. I would like to mention that approx. 7 km further east and probably in the same geological horizon there is another copper mine, Vågene.

Calculating ore bodies. Calculating provisionally with a lode length of only 300 metres, deducting the part between the Upper and the Lower Mine where the ore was wedged in, and further computing only 2 metres' thickness in the West and Upper Mine, and only 5 metres for the lower one, i.e. an average lode width of 3 metres, we get an area of 900 sq.m ore (perpendicular to the dip). Since part of the ore is impregnation ore (processing flotation ore) we estimate the specific weight to be 3.5, i.e. 3.5 x 900 = 3,150 tonnes per metre of subsidence towards the dip. Assuming a dip of about 60° and something of a fall-off strikewise, approx. 1,000 metres of workings can be reckoned on, i.e. a quantity of ore of 3,159,000 tonnes containing approx. 5% Cu.

This quantity is a minimum calculation. If a connection does exist between the "Upper" and the "Lower" mines, which is not unlikely at depth, and furthermore if there are larger local extensions to the ore sections, as has foreseeably been the case in e.g. the "Lower Mine",

and perhaps also a more favourable dip in the field, a total of approx. 10 million tonnes will be obtained as a minimum.

Oslo, Norway, 1 July 1935.

W.G. Tidemand (signed.)