NORRBOTTEN EXPLORATION AB' s EXPLORATION IN WEST-NORWAY BETWEEN TRONDHEIM AND STAVANGER, 2010

Søyset: tectonic contact between massive sulfide and gneissic gabbro.

Peter Wulff, Norrbotten Exploration AB, October 24th, 2010

CONTENT

1.1 INTRODUCTION

Norrbotten Exploration AB's fieldwork in the Hardanger Fiord area in 2009-10 demonstrated that many Norwegian occurrences are underexplored or unexplored.

The Norwegian Geological Survey (NGU) maintains a website (www.prospecting.no) with information about the country's 4300 registered mineral occurrences. About 60 occurrences in the area between Trondheim and Stavanger were selected. Common to them is that they are under- or unexplored, and that they (with the exception of three) never had been analyzed for precious metals. Basic information about them was gathered in the archives of NGU and Direktoratet for Mineralforvaltning (former Bergvesenet). There was no information in the archives about many of the visited occurrences - not that this necessarily imply them being insignificant – see e.g. Søyset or Gjerdvika.

The field work was carried out from August the 20th to September the 20th, i.e. 31 days. About 8 days of incessant rain led to the loss of of several field days. The emphasis was exclusively on locating the occurrences (usually the biggest task), take a few samples, draw a basic map when necessary, and write a few lines about the most basic features, i.e. type-classification, mineralogy, alteration etc. etc. More detailed work can come later, if justified.

In total 35 occurrences were located while 15 were not (fig. 1.1A), and along the way 10 were discarded for other reasons. The 35 occurrences span a wide range of generic types: vein-type, magmatic, VHMS and exhalative iron.

The representability of the 125 samples is impossible to know. Most of them are from waste dumps, i.e. they may be lower in copper than the occurrences they came from since most of them were mined for copper. Generally I tried getting samples from most of the old workings and of different types. Low-grade samples were mostly avoided as there is no reason to "kill" occurrences already at this first stage.

If some one in Sweden found an outcrop like e.g. Søyset, she would easily win first price in that country's mineral hunt competition, and could subsequently sell her find for no small sum - as did the two Jämtland-women who found the Storkullen occurrence. Occurrences rivaling Storkullen are among the 35 occurrences visited during this work, and many of them would, had they been in Sweden, be geophysically surveyed and subsequently drilled. This is to say, that what is expensive and difficult to come across in Sweden, is up for grabs in Norway.

2.1 FLATSKARVÅSEN

The occurrence is situated in a boggy area at UTM E603100E, N6934100. The three, shallow and waterfilled test pits targeted some dm-m wide and steeply dipping rust zones striking approximately 20º. The rust zones are within c. 35 m of stratigraphy most of which is basalt. Outcrop is scanty in the strike directions. In total some 25-30 m3 have been quarried in the test pits. More than 80% of the dumps consists of schistose and more or less chloritized basalt which sometimes has some pyrite and chalcopyrite. Else there is what may be is an alteration zone developed in (maybe) a felsic rock. This type sometimes has significant impregnation or veining of pyrite, pyrrhotite, chalcopyrite, and possibly sphalerite (sample 563206). Massive ore is rare and was only seen in the scattered waste dumps. Maybe the little massive ore (sample 563205) once found has been brought to the relatively large Gruvåsen mine 1.3 km to the East. Flatskarvåsen looks like a VHMS-related alteration zone.

Figure 2.1A: Flatskarvåsen, rusty quartz with uneven dissemination of pyrite>chalcopyrite.

Two samples: 563205-6.

Flatskarvåsen	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	Co ppm	S %
563205	4.16	5.2	1.4	0.00	7	165	14	6	32	1280	27
563206	0.80	1.9	1.2	0.01	5	89	2	<5	10	456	8

Older samples (NGU)

Flatskarvåsen	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	Co ppm	S %
HE0154.01	4.81	8.4	4.2	0.01	n.d.	97	24	27	31	1143	n.a.
HE0154.02	0.91	3.1	2.6	0.02	4	15	26	9	15	431	n.a.
HE0154.03	2.38	4.5	2.5	0.01	5	442	36	18	19	2824	n.a.

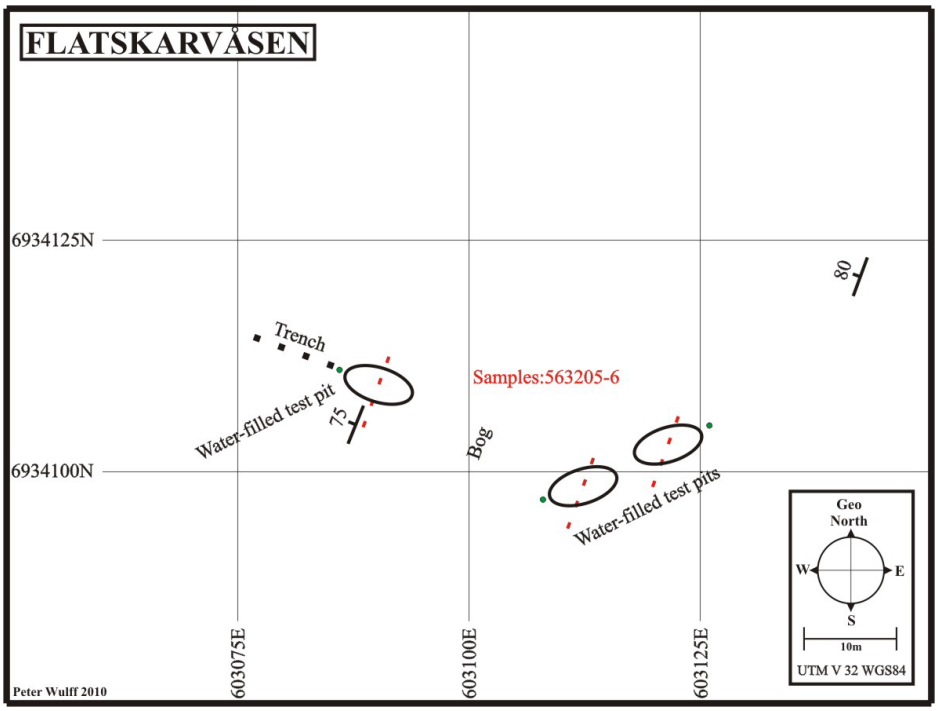

Figure 2.1B: sketch of the old workings at Flatskarvåsen.

2.2 MØLLERGÅRD

According to locals, one of which was an amateur geologist, there is no test pit at Møllergård. Instead I was shown a rusty outcrop at the coast at UTM E537302, N7071210. The rust comes from some basalt-hosted, cm-wide layers of fine-grained magnetite with traces of pyrite. It appears to be exhalative and is of no interest. There is a minor collection of local rocks at Møllergård museum.

One sample: 563207.

Møllergård	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563207	0.01	<0.5	0.0	0.01	11	9	4	9	26	1

2.3 GJØLGASÆTER

No locals, including an 89 year old who had lived his whole life near Gjølgasæter, knew of or had ever heard of a test pit or any kind of mineralization at Gjølgasæter. The local amateur geologist mentioned above had been involved in collecting some of the exhibited rocks in the Møllergård museum, and he knew of a mineralized roadcut near Gjølgasæter. It consisted of a basalt-hosted, 10-12 cm thick and irregular qz-vein (74º/80ºS) with some pyrite. The immediate hanging wall was pyritized and very silicified. It is of no interest.

One sample: 563208.

Gjølgasæter	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563208	0.02	<0.5	0.0	0.0	7	<5	<2	<5	5	2

2.4 OFSTAD 1& 2

A local showed me old workings at two places, here called Ofstad 1 and Ofstad 2.

At Ofstad 1 (UTM E545124, N7024839), between a garage and a house, is a shaft which today has been filled with rocks and soil. The shaft is about 20 m from the coast and 10 m above sea level. The owner (Bjørn Almli) said that before the shaft was filled, one could see the tide in the bottom – i.e. fractures in the rock saw to that the water level in the shaft was the same as in the fiord. Right at the shaft is an outcrop

with a c. 20 cm thick and feldspar-rich quartz vein (18º/34ºE) with plenty pyrrhotite. The host rock is a biotite-amphibole-gneiss. There is a rather large and overgrown waste dump between the shaft and the sea, and maybe another on the other side of the garage. Finding mineralized material in the dump is easy, and some of it is of rather high grade with respect to copper. Both the gneiss and the quartz carry sulphides which often occur as fracture-fillings. A local woman said that she had heard that the miner rowed the ore over to the other side of the fiord where the Løkken mines had some kind of plant. One of the samples has 12.7% copper, but that was expected. The sample of massive pyrrhotite has >50% Fe – the highest iron-content of all the 125 samples.

Four samples: 563209-12.

Ofstad 1	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563209	0.43	81.5	12.7	0.5	74	<5	2	<5	21	21
563210	0.27	2.5	0.1	0.0	21	<5	9	5	>50	38
563211	0.04	13.0	2.3	0.1	9	<5	12	<5	20	13
563212	0.35	14.6	2.3	0.1	15	<5	<2	<5	24	16

Figure 2.4A: Ofstad 1, durchbewegung texture, pyrrhotite>chalcopyrite in mafic matrix.

Ofstad 2 (UTM E544686, N7024765) is in a dense pine forest so GPS accuracy may be *slightly* reduced. It appears that only the soil has been removed and that there has been no blasting. The target was a coarse-grained quartz-vein (which wasn't seen in outcrop) with less chalcopyrite than the quartz-vein at Ofstad 1. No sulphide was seen in the gneissic host rock.

One sample: 563213.

Ofstad 2	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563213	0.12	4.5	1.3	0.02	3	<5	7	<5	4	1

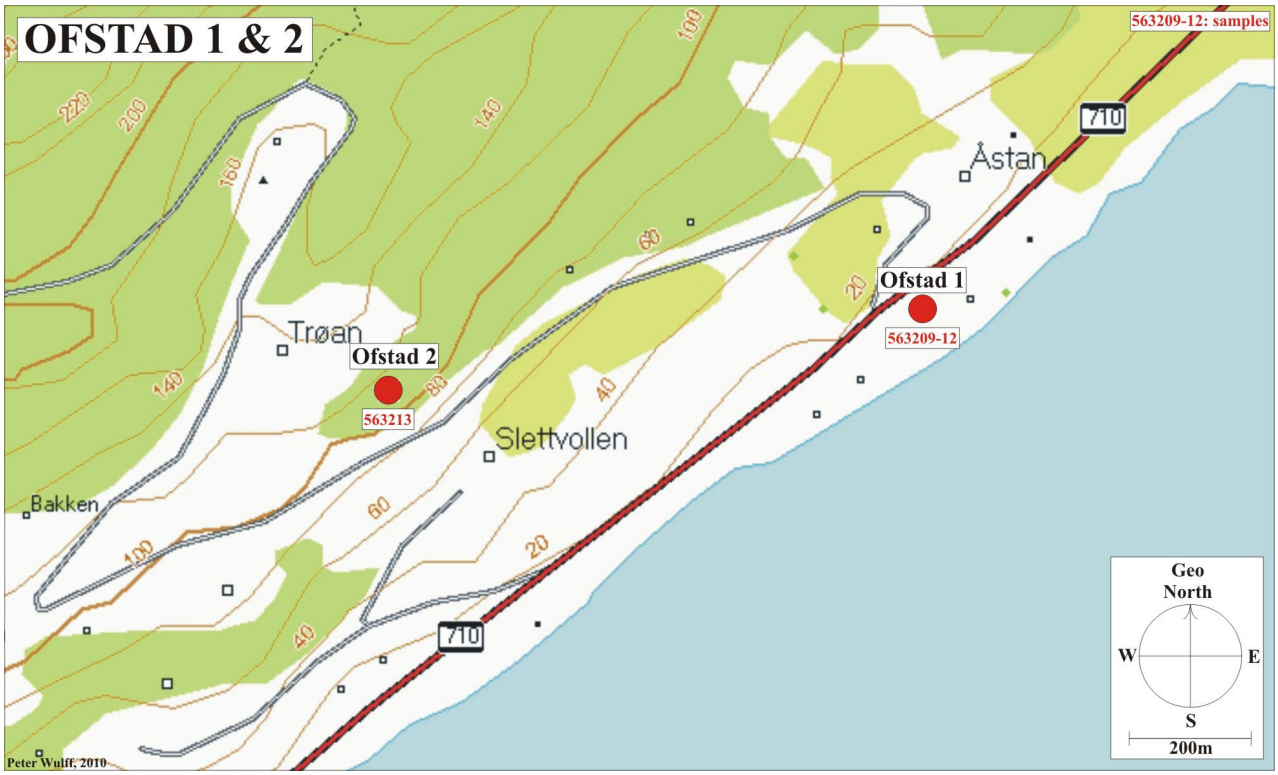

Figure 2.4B: the two occurrences at Ofstad.

2.5 KARLSVIKA

This occurrence, if it exists, is very remote. Karlsvika is a small bay but the supposed coordinates of the occurrence are far away and at 400 m above sea level. There was nobody to ask in the two houses at Karlsvika so I rapidly gave up finding the occurrence.

2.6 AVERØY

Averøy hosts a number of occurrences (figure 2.6A). Common to them is that they are hosted in amphibolite and consist of semi-massive to massive pyrrhotite ± chalcopyrite. The matrix of the semi-massive part of the mineralization is primarily amphibole, biotite and garnet. The names of the old workings are in some cases unclear so instead they are called Averøy 1-11.

These occurrences look like magmatic sulfides, and in addition to copper I erroneously expected them to have nickel and mayby gold and PGMs as well. Unfortunately they have nothing but copper and zink.


AVERØY
Figure 2.6A
Skarhaugskjærpet?
A11
563228-30
Dyrsetgruben
A9
A10
A8
563226-27
Test pit
(Not found)
Nektadskjærpet
(Not found)
Fagerfjeldgruben
A7
A6
A5
563222-25
563216-7
A2
A1
563214-5
563218-21
A3
A4
Vasdalsgruben
N6986000
N6985500
N6985000
N6984500
E424500
E425000
E425500
E426000
E426500
E427000
E427500
Geo
North
W
E
S
250m
UTM V 32 WGS84
Sample#: 563226
Peter Wulff 2010

Averøy A1
At UTM E424423, N6984250 is a test pit on a folded layer of semi-massive to massive pyrrhotite which probably is around 1 m at its thickest. There are 8-10 m^3 ore and waste rock in the dump.

Two samples: 563214-5.

Averøy A2
Close to Averøy 1, and at UTM E424502, N6984329 is a minimum 10 m long and waterfilled adit striking 154º. 10 m SE of the adit is a small test pit on a pyrrhotite layer not exceeding a thickness of 1 m. It seems that Averøy 1 & 2 targeted the same mineralization.

Two samples: 563216-7.

Averøy A3 & A4 (Vasdalsgruben)
At UTM E424775, N6984142 (altitude 566m) is the entrance to a strike drive on a c. 1 m thick layer (102º/52º) of pyrrhotite>chalcopyrite. At UTM E424800, N6984127 (altitude 588m) is the entrance to a stope which is connected to the aforementioned strike drive. The mineralization in the stope is irregularly shaped due to deformation, but overall it is a layer. A dm-wide rust zone continues for about 60 m towards SE. Averøy 3 & 4 is called Vasdalsgruben and should have produced the best copper ore after the Dyrset grube.

Four samples: 563218-21.

Averøy A5, A6 & A7 (Fagerfjell grube)
These old workings targeted a 1-1.5 m thick sulfide layer (10º/70º). Averøy A5 is a waterfilled adit at UTM E425489, N6984401 and 450 m above sea level. There is only little ore in the dump coming from this adit. At 470 m and above the adit is a 15 m^3 test pit (Averøy A7) at UTM E425467, N6984406. To the SSW is Averøy A6 which is a 70-80 m3 test pit (or small mine) at UTM E425457, N6984391 with plenty of ore in its dump. Averøy A5-A7 is collectively known as the Fagerfjell grube. A rust zone can be followed at least 200 m towards SW.

Four samples: 563222-5.

Averøy A8, A9, A10 & A11 (Dyrset grube)

Dyrset is by far the largest of the occurrences on Averøy - maybe as much as one hundred times bigger than the other occurrences. The distance between the outermost of the old workings is close to 500 m so there are most likely several individual sulfide bodies.

A sign at a small parking lot points towards the mine area. The first of the old workings (A11: UTM E427857, N6986310, 82 m.a.s.l.) is reached after a few minutes walk on a rust-colored dirt road with plenty of rusty ore in it. This may be the Skarhaugsskjærpet although it is much bigger than a test pit. About one meter of deformed, massive pyrrhotite outcrops at the entrance, and in waste dumps nearby are plenty of specimens with massive pyrrhotite and disseminated chalcopyrite in an amphibolitic matrix.

When following the sign one will reach large dumps on the hill side and a number of old workings – I probably didn't find the all.

A8 (UTM E427811, N6985893, 165 m.a.s.l.) is a waterfilled adit.

A9 (UTM E427787, N6985927, 179 m.a.s.l.) appears to be both an adit and a stope.

A10 (UTM E427775, N6985883 195 m.a.s.l.) also appears to be both an adit and a stope.

About one meter of massive, deformed pyrrhotite occurs at the entrances at both A9 and A10.

Figure 2.6B: Averøy A5, upper part of photo: ball-texture, pyrrhotite with rounded amphibole.

Figure 2.6C: Averøy A9, ball-texture, pyrrhotite>pyrite+chalcopyrite with rounded amphibole. Samples like this and figure 2.6B initially led me to regard the Averøy occurrences as magmatic.

Figure 2.6D: Averøy A11, garnet-amphibole gneiss with chalcopyrite & pyrrhotite.

Seventeen samples: 563214-30.

Averøy	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563214	0.01	<0.5	0.0	0.0	16	<5	<2	5	25	6
563215	0.02	1.2	0.1	0.0	19	<5	<2	<5	23	14
563216	0.02	1.2	0.0	0.0	12	6	<2	<5	33	21
563217	0.01	1.2	0.1	0.0	42	7	4	6	35	20
563218	0.07	11.9	4.7	0.3	76	<5	14	6	27	18
563219	0.02	3.5	1.3	0.0	15	<5	10	<5	43	30
563220	0.02	3.0	1.2	0.2	26	<5	11	<5	27	24
563221	0.03	4.3	2.1	0.3	36	<5	<2	<5	31	18
563222	0.01	<0.5	0.3	1.1	34	<5	<2	<5	39	24
563223	0.01	<0.5	0.2	0.2	8	<5	2	<5	33	17
563224	0.02	9.2	2.9	0.4	3	<5	<2	<5	20	4
563225	0.01	0.9	0.7	3.0	34	<5	<2	5	40	26
563226	0.06	4.5	1.4	1.4	43	<5	<2	<5	37	26
563227	0.10	7.6	1.8	0.6	31	<5	<2	<5	35	28
563228	0.09	<0.5	7.7	0.4	<2	<5	<2	<5	2	17
563229	0.02	1.4	1.6	0.1	5	<5	<2	<5	28	14
563230	0.01	<0.5	0.4	0.1	4	<5	<2	<5	30	17
Average	**0.03**	**4.2**	**1.6**	**0.5**	**25**	**<5**	**2**	**<5**	**30**	**19**

2.7 SILDVOLNES/SILDVÅGNES

I could not find this occurrence despite a local woman telling me where to look. Did notice, however, the same garnet-gneiss/amphibolite as the one hosting the Averøy occurrences.

2.8 BEVRE 1 & 2

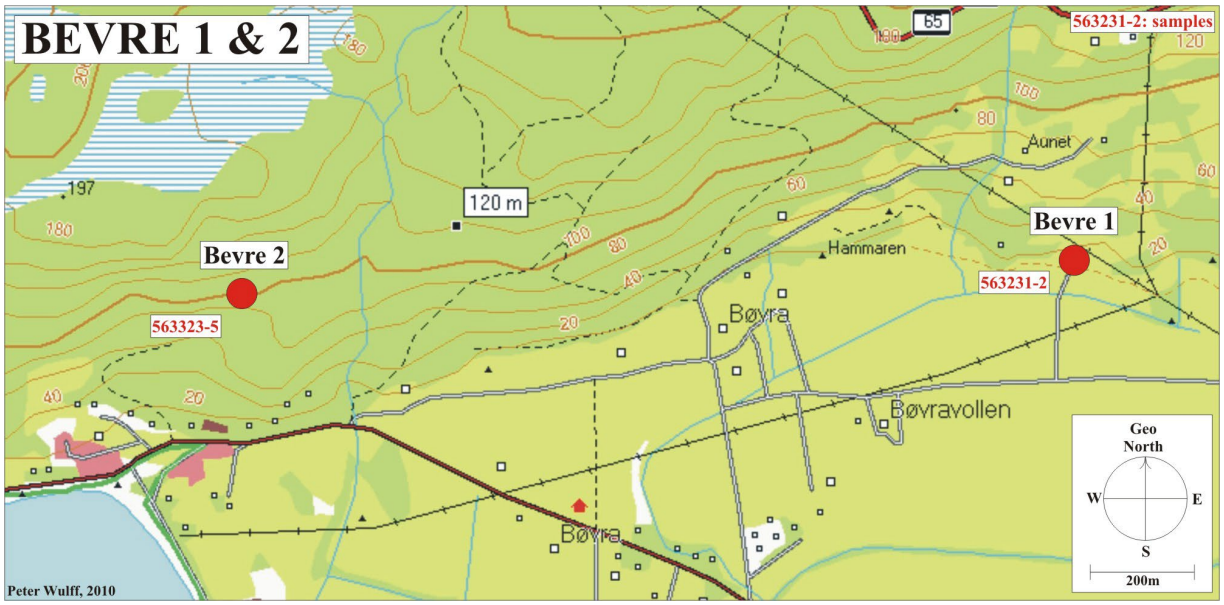

Figure 2.8A: the two occurrences at Bevre.

Bevre 1

A local helped me finding the largest of the two old workings (at UTM E484211, N6985083) which hides behind a house and is now a source of drinking water – nearby limestone keeps the PH high. There is at least (lower margin not seen) 2 m of semi-massive to massive pyrite (90º/30ºN) at the waterfilled winze which the owner says is 60 m deep – that's probably 60 m down dip. There is chlorite schist in the hanging wall, and a thin layer of sericite right at the contact. The ore is very hard due to its quartz content. Base metals were not noticed. There is no waste dump today as locals have used it for building purposes or road fill. Historical sources say that this occurrence can be followed for about 1000 m and that the ore runs 41% sulphur and 0.15% copper. Bevre 1 is a VHMS occurrence. The samples are totally devoid of valuable elements.

Figure 2.8B: Bevre 1, pyrite in quartz-matrix.

Two samples: 563231-2.

Bevre 1	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563231	0.05	<0.5	0.1	0.07	60	525	<2	<5	29	32
563232	0.02	<0.5	0.0	0.04	37	505	<2	<5	29	28

Bevre 2

Some 1600 m to the west (UTM E482564, N6985025) is a 6 m^3 test pit. The mineralization (102º/65ºN) is semi-massive to massive pyrrhotite with plenty of rounded silicate-clasts – ball-texture. There is also cherty and very hard gneiss (?) with garnets and some pyrrhotite. This occurrence doesn't resemble the one at Bevre 1. Bevre 2 appears to be a tectonised VHMS occurrence. The samples have nothing of value.

Figure 2.8C: Bevre 2, ball-texture, pyrrhotite with rounded fragments of host-rock and quartz.

Three samples: 563233-5.

Bevre 2	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563233	0.01	<0.5	0.0	0.01	35	534	<2	<5	33	22
563234	0.01	<0.5	0.0	0.05	12	18	<2	<5	27	11
563235	0.01	<0.5	0.0	0.02	53	414	<2	<5	40	25

2.9 SØYSET

This interesting occurrence is about 350 m SSW of the old Søyset farm. A recent widening of a tractor road passing the old workings have resulted in a fresh, continuous road cut with really spectacular outcrops of the tectonised occurrence. The occurrence consists of massive pyrrhotite and pyrite with lesser chalcopyrite and can be followed along the road for 90 m. Due to pinches and swells its thickness varies from 10 cm to more than one meter. The host rock amphibolite which sometimes has garnet – not unlike the amphibolite on Averøy. Oddly, there is a "Jættegryde" in the footwall. Another peculiar feature is the 3 m high, irregular mass of pyrite and pyrrhotite that have been squeezed into the neck between two boudins. As was the case with the Averøy-occurrences, I initially interpreted Søyset as magmatic but was brought back to reality when the results came in – there is only copper and zink in the samples.

Figure 2.9A: Søyset, sample 563239, ball-texture, chalcopyrite>pyrrhotite with rounded/cataclastic fragments of host-rock.

Five samples: 563236-40.

Søyset	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563236	0.01	5.3	1.2	1.4	139	<5	<2	<5	38	26
563237	0.04	93.6	15.5	1.2	30	<5	<2	<5	30	27
563238	0.00	<0.5	0.2	2.3	4	<5	<2	<5	>50	37
563239	0.01	10.4	2.4	0.3	68	7	<2	<5	9	5
563240	0.00	5.0	1.3	0.8	19	<5	<2	<5	40	31

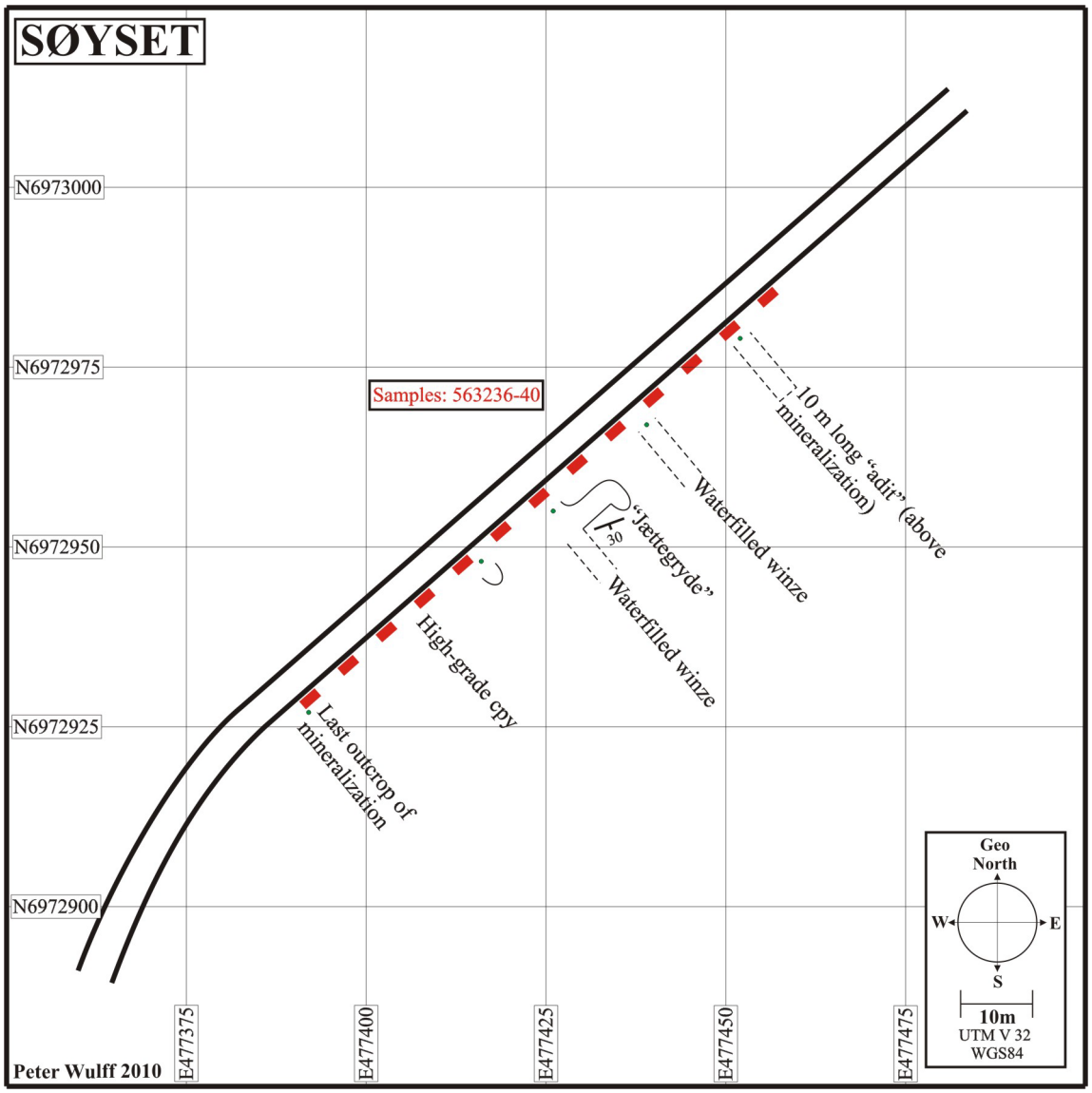

Figure 2.9B: old workings and mineralization at Søyset.

2.10 VASSENG

I did not find this occurrence. There is several meter of overburden in the nearest surroundings so NGU's coordinates are either very wrong or there is no occurrence.

2.11 TOÅA

In an old report it is said that this copper occurrence is in a creek coming down on the valley floor between the farms Ørsal and Øien. I walked in 5 creeks and rivers fitting the description and found nothing. A farmer running both the aforementioned farms said that he had never heard about any copper mineralization or test pit on his property.

2.12 LØKEDAL

This copper mineralization (UTM E384218, N6921122) is in a steep hillside and easily seen from the tractor road passing it underneath. The old workings include a small stope and two, possibly three, test pits, all within about 15 meters. The copper-sulphides include chalcopyrite, bornite and possibly chalcosite which all occur as dissemination in felsic gneiss, in dolerite (or its altered equivalents) and in quartz-veinlets. Pyrite is common too, and malachite-staining is widespread. The total thickness of the copper-mineralization is about 7 m at the stope but much of these 7 meters are almost barren. Alteration includes silicification, chloritization, amfibolitization, biotitization and carbonatization, and probably more as the

mineralization is rather heterogenous. Much of the mineralization is sub-horizontal and strike and dip varies much. On the left side of the stope's entrance is a sheared, amfibolitized and diopside-altered dolerite which I think caused the mineralization. One of the samples has 26.5 ppm gold, 233 ppm silver and 6.2% copper – rich ore. Unfortunately the other samples have only little gold.

Figure 2.12A: Løkedal, brecciated feldspar with chalcopyrite, bornite, sphalerite and pyrite.

NGU's geologist Aare Korneliussen investigated Løkedal in great detail but never analyzed his samples for gold. There is up to 3% zink in some of his samples. Korneliussen also found a test pit about 1 km NW but I could not find it.

Four samples: 563241-4.

Løkedal	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563241	26.50	223.0	6.2	0.2	180	<5	32	<5	5	5
563242	0.25	25.2	3.1	1.2	187	<5	31	6	8	4
563243	0.95	51.7	2.4	1.0	280	<5	51	<5	5	2
563244	0.23	25.5	3.0	0.5	151	<5	11	<5	8	3

2.13 LYSHOL

This mineralization (UTM E377959, N6922202) is on the western side of a creek and is easily located as someone has put up a sign saying "koparhole" at the tractor road passing above it. The mineralization (104º/40ºS) is hosted in a dolerite and is only a few centimeters thick. It has been test mined in a 5 m long strike drive. The sulphides comprise pyrite, chalcopyrite and bornite which occur as fracture-filling in the dolerite. In total there is very little of interest at Lyshol.

One sample: 563245.

Lyshol	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563245	0.01	<0.5	0.1	0.02	5	<5	<2	<5	15	4

2.14 SANDFJELLET

When driving south on scenic Trollvegen one notices a number of large rustzones on the slope of an unvegetated mountain called Sandfjellet which is an anorthosite. It is unclear what the rustzones are and no visible mineralization was found. Samples of sand having accumulated at the outcrops were taken at five of the larger rustzones. The relatively high contents of chromium and nickel were unexpected.

Five samples: 563246-50.

Sandfjellet	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	Cr ppm	Ni ppm	Mg%	S %
563246	0.00	<0.5	0.0	0.0	<2	11	3	<5	3.4	819	1130	13.3	0.02
563247	0.00	<0.5	0.0	0.0	<2	<5	<2	<5	3.6	914	1150	14.3	0.03
563248	0.00	<0.5	0.0	0.0	8	9	<2	<5	4.3	1235	1670	20.1	0.02
563249	0.00	<0.5	0.0	0.0	6	7	<2	<5	6.3	2040	2070	21.4	0.04
563250	0.00	0.5	0.0	0.0	6	<5	2	<5	5.5	1765	1910	22.1	0.03
Average	**0.00**	**<0.5**	**0.0**	**0.0**	**4**	**6**	**1**	**<5**	**4.6**	**1355**	**1586**	**18.2**	**0.03**

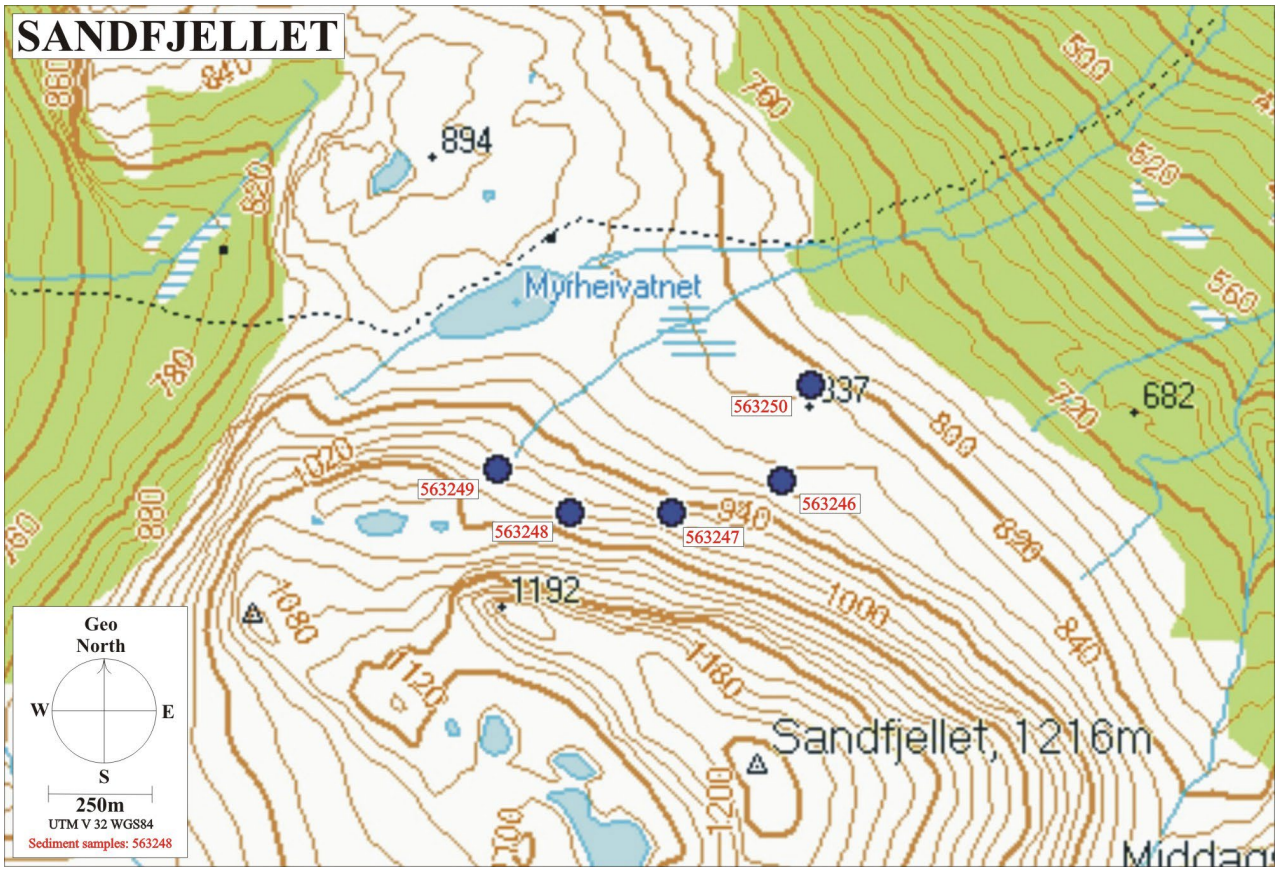

Figure 2.14A: map showing sample locations at Sandfjellet.

2.15 HILDENESET

I found nothing at Hildeneset and there were no locals around to ask. The local rock is a neatly porphyroblastic felsic rock suggesting that Hildeneset, if it exists, is epigenetic.

2.16 VÅGENE

The occurrence is easily seen from road 609. It has been mined or test mined in 6 old workings. There is relatively little ore in the dumps – probably because the thickness of the mineralization, at least where I could see it, nowhere exceeds 50 cm, and more often is less than 10-20 cm thick. The ore consists of pyrite

and/or pyrrhotite with more or less chalcopyrite and sphalerite. It is sheared and has incorporated plenty of schlierens of chlorite-schist. Host-rock is basalt. Vågene is clearly a VHMS and as it is in the Solund-Stavfjord ophiolite, it is a Cyprus-type VHMS. In line with its class, there is almost no gold in the samples.

Figure 2.16B: Vågene, ball-texture, pyrite>chalcopyrite+sphalerite with rounded fragments of host-rock.

Six samples: 563251-6.

Vågene	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563251	0.03	7.7	1.4	0.3	520	71	15	<5	28	30
563252	0.06	21.4	4.8	2.6	232	49	8	<5	36	32
563253	0.06	26.4	6.2	2.8	200	44	34	<5	36	30
563254	0.04	14.0	2.2	4.0	135	27	34	<5	27	28
563255	0.12	31.6	3.3	1.8	153	64	22	<5	32	31
563256	0.08	24.4	1.4	5.3	171	39	5	<5	23	28
Average	**0.07**	**20.9**	**3.2**	**2.8**	**235**	**49**	**20**	**<5**	**30**	**30**

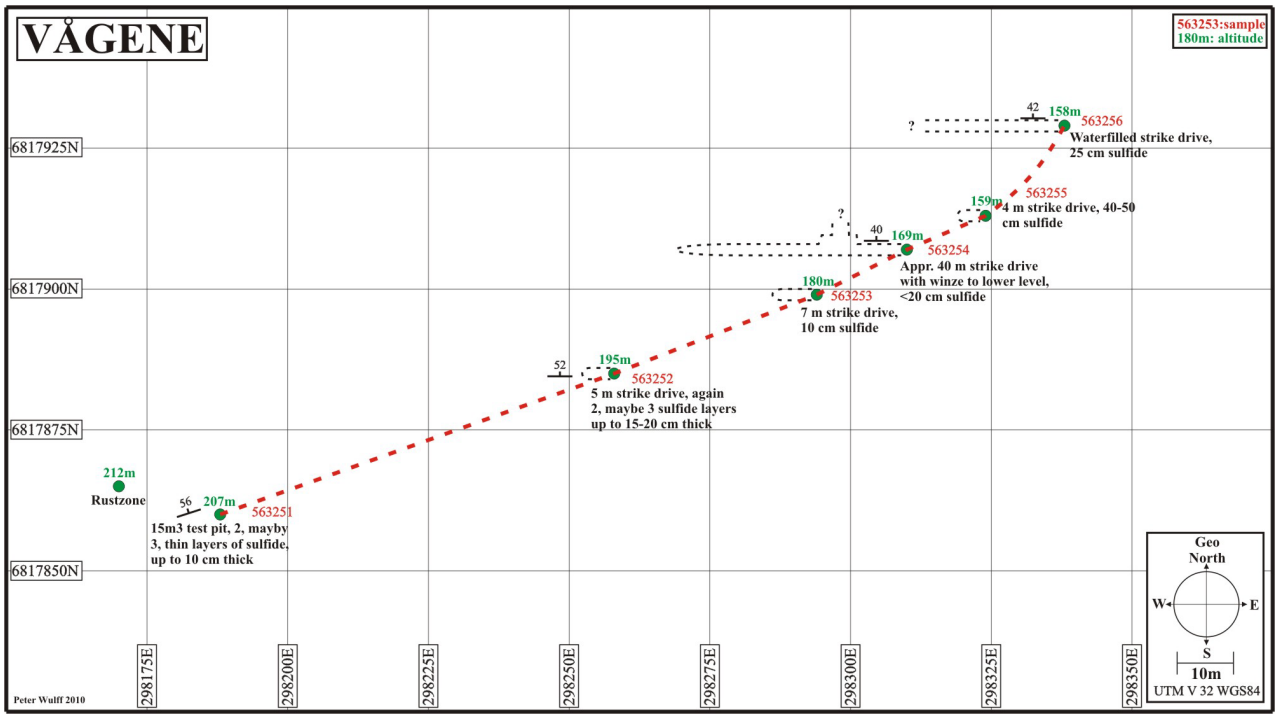

Figure 2.16B: map of the old workings at Vågene.

2.17 GRIMELI

Mining at Grimeli dates back to at least 1750. Grimeli was mined several times for its copper and was a relatively large operation until around 1920 when it finally closed. NGU has plenty of reports about it.

Ten old workings were located during the hours spent at Grimeli, and there are probably a few more. They targeted two or three mineralized horizons of which the largest is at least 500 m long but rarely more than one meter thick, where remants of it outcrop. The ore is magnetic and consists of pyrrhotite and pyrite with some chalcopyrite, sphalerite and magnetite. It is tectonised and contains fragments of chlorite-schist and quartz. The southeastern rust-zone in which there is only a test pit, consists of quartz with low content of pyrite and chalcopyrite. Grimeli is a Cyprus-type VHMS occurrence.

A report from 1911 mentions an occurrence called Fjeldskaren on the peninsula's southside, 260 m above sea level.

Around 1970 Folldal Verk carried out investigations in the area and found a 300 m long and 5-25 m thick area with disseminated pyrite in "Ramnefjell north of Kviteneset in the Stong fiord" - I unsuccessfully looked for Ramnefjell on the map.

In 1980, the two NGU-geologists A. Korneliussen and M. Often estimated the tonnage (production and reserves) in Grimeli and Vågene at 1.5 and 0.7 Mt, respectively - they admit that their estimates are on the optimistic side.

The other Cyprus occurrences have about as much or more zink than copper, but Grimeli's zink-content only averages 0.5%. On the other hand, some of the samples have some cobalt – which is not unusual in Cyprus-type occurrences.

Figure 2.17A: Grimeli, fine-grained and weakly banded massive pyrite with chalcopyrite>sphalerite.

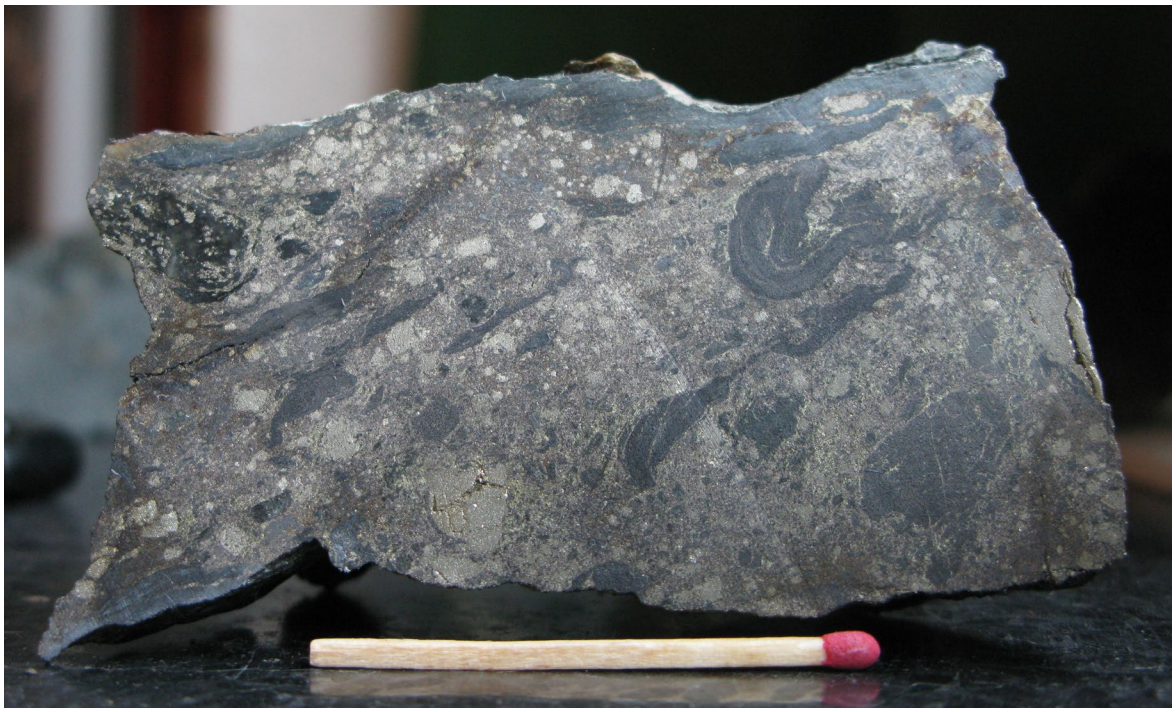

Figure 2.17B: Grimeli, durchbewegung- & ball-texture. Pyrite, pyrrhotite & chalcopyrite with deformed and rounded host-rock fragments.

Nine samples: 563257-65.

Grimeli	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	Co ppm	S %
563257	0.01	3.8	0.6	0.1	3	7	<2	<5	4	64	3
563258	0.02	16.6	8.7	3.3	24	<5	34	<5	17	96	14
563259	0.02	7.3	4.7	0.1	8	8	40	<5	43	919	25
563260	0.01	7.6	4.1	0.2	6	11	20	<5	47	1150	22
563261	0.02	11.2	5.7	0.3	8	7	46	<5	43	760	25
563262	0.01	3.8	2.9	0.1	16	10	<2	8	47	762	27
563263	0.02	3.0	2.7	0.2	18	5	<2	15	34	954	21
563264	0.01	<0.5	0.3	0.3	17	17	<2	15	45	1410	32
563265	0.01	0.7	1.1	0.3	21	<5	6	9	44	3010	37
Average	**0.01**	**6.8**	**3.4**	**0.5**	**13**	**9**	**29**	**7**	**36**	**1014**	**23**

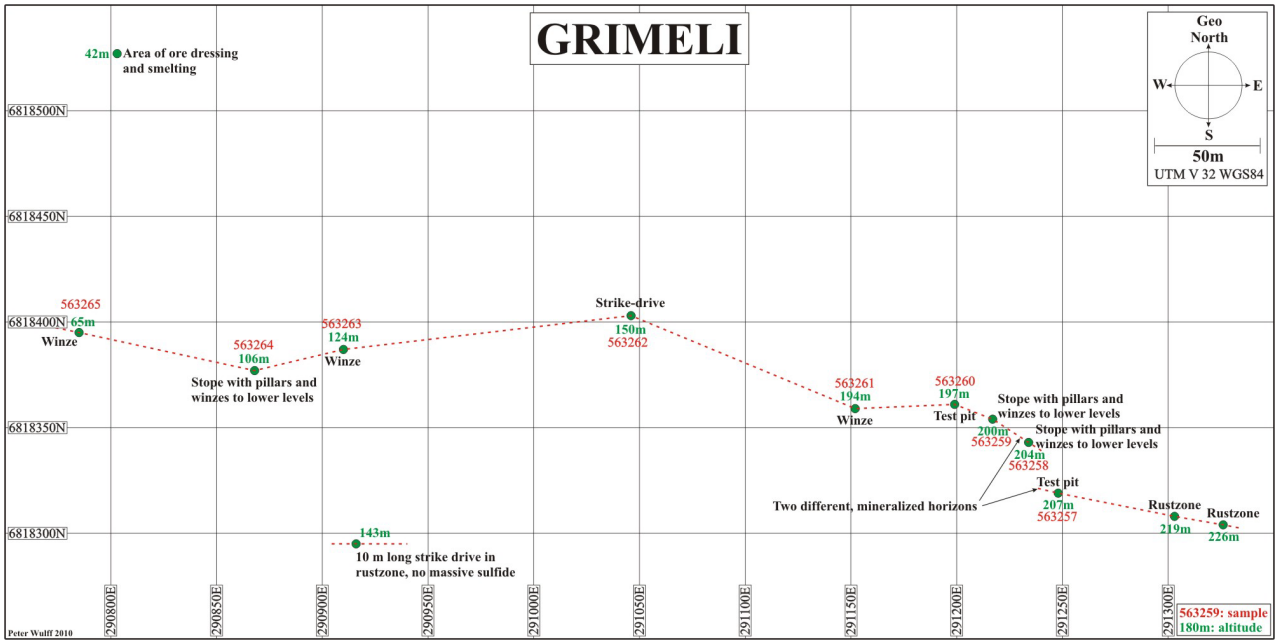

Figure 2.17C: map of the old workings at Grimeli.

2.18 GJERDVIKA

A local told me about a strike-drive at the sea and other, nearby old workings. The said strike-drive is easily located due to the rusty waste dump which partly has been thrown into the sea. Apart from basalt, the country-rock, the dump contains plenty of chlorite-schist with more or less pyrite and chalcopyrite. There is also massive pyrite with chalcopyrite and sphalerite, and banded magnetite-chert. There is pillow lava with three dm-wide rustzones (two have massive pyrite) in the roadcut above the strike-drive. Up in the dense pineforest are two more strike-drives, and at the foot of the hill two more one of which has a waterfilled winze inside. There is plenty of massive pyrite with chalcopyrite and sphalerite in the southwesternmost of the strike-drives. As shown in figure 2.18A, there are two semi-parallel occurrences one of which is at least 200 m long. Unfortunately, their thicknesses never exceed 60 cm and mostly only a few centimeters in the outcrops I looked at. The presence of gabbro or dolerite in the roadcuts a few hundred meters to the north suggests that Gjerdvika is a Cyprus-type VHMS occurrence. The samples have slightly more lead than the other Cyprus-type occurrences.

Figure 2.18A: Gjerdvika, massive pyrite with chalcopyrite and sphalerite.

Figure 2.18B: Gjerdvika, banded, fine-grained magnetite and quartz (metamorphosed ochre?).

Figure 2.18C: chloritized basalt with pyrite>chalcopyrite.

Six samples: 563266-71.

Gjerdvika	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563266	0.09	12.5	2.4	4.9	1030	210	12	12	38	44
563267	0.07	2.9	0.6	3.3	458	177	16	9	42	46
563268	0.17	20.7	3.0	0.3	307	14	<2	6	9	5
563269	0.05	7.5	1.7	2.9	598	135	12	7	31	35
563270	0.16	15.9	3.5	4.3	1785	398	29	5	38	47
563271	0.08	7.8	1.8	1.7	650	69	19	11	27	25
Average	**0.10**	**11.2**	**2.2**	**2.9**	**805**	**167**	**18**	**8**	**31**	**34**

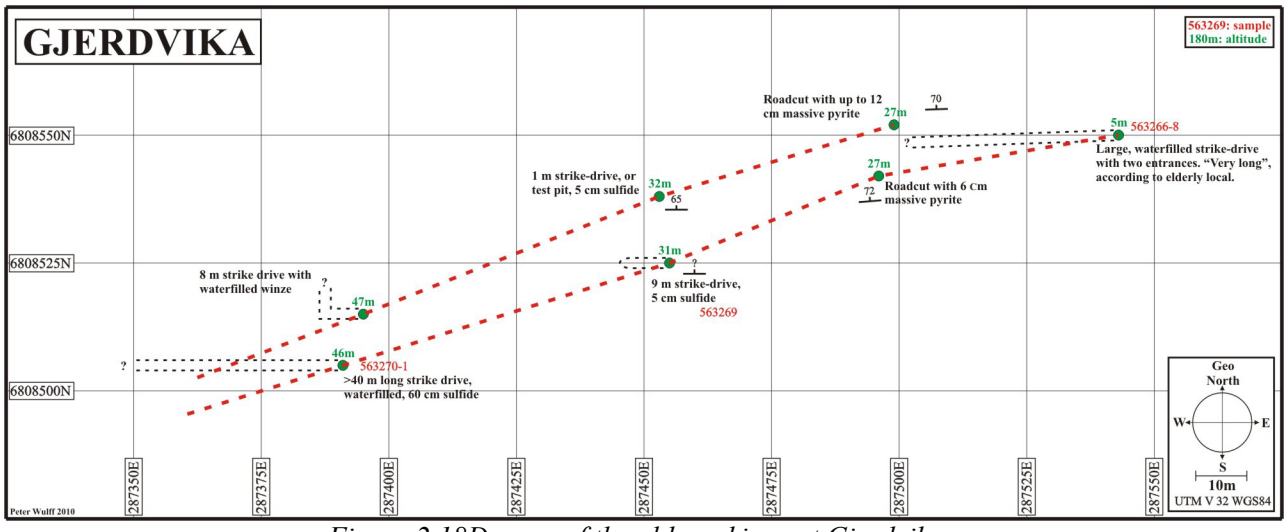

Figure 2.18D: map of the old workings at Gjerdvika.

2.19 MÆRKESVIKA

I found nothing at Mærkesvika. Elderly locals, who knew about the Vågene occurrence, knew nothing about old workings at Mærkesvika.

2.20 SVANØY

NGU has on Svanøy marked three occurrences called Svanøy, Sandkvien and Kvalstad. I located the Svanøy occurrence, an occurrence at Sandviken (which maybe is what NGU calls "Sandkvien") and an occurrence here called Kvalstadvatnet which is about 1 km from NGU's Kvalstad occurrence which I didn't find and no locals knew about. An old report mentions 60 test pits on Svanøy so NGU's Kvalstad is not necessarily the occurrence here called Kvalstadvatnet. In addition to the occurrences I've visited, the same old report also mentions mines (=gruber) at Moralsnupet, Kikeledet and Kvarstadmyren.

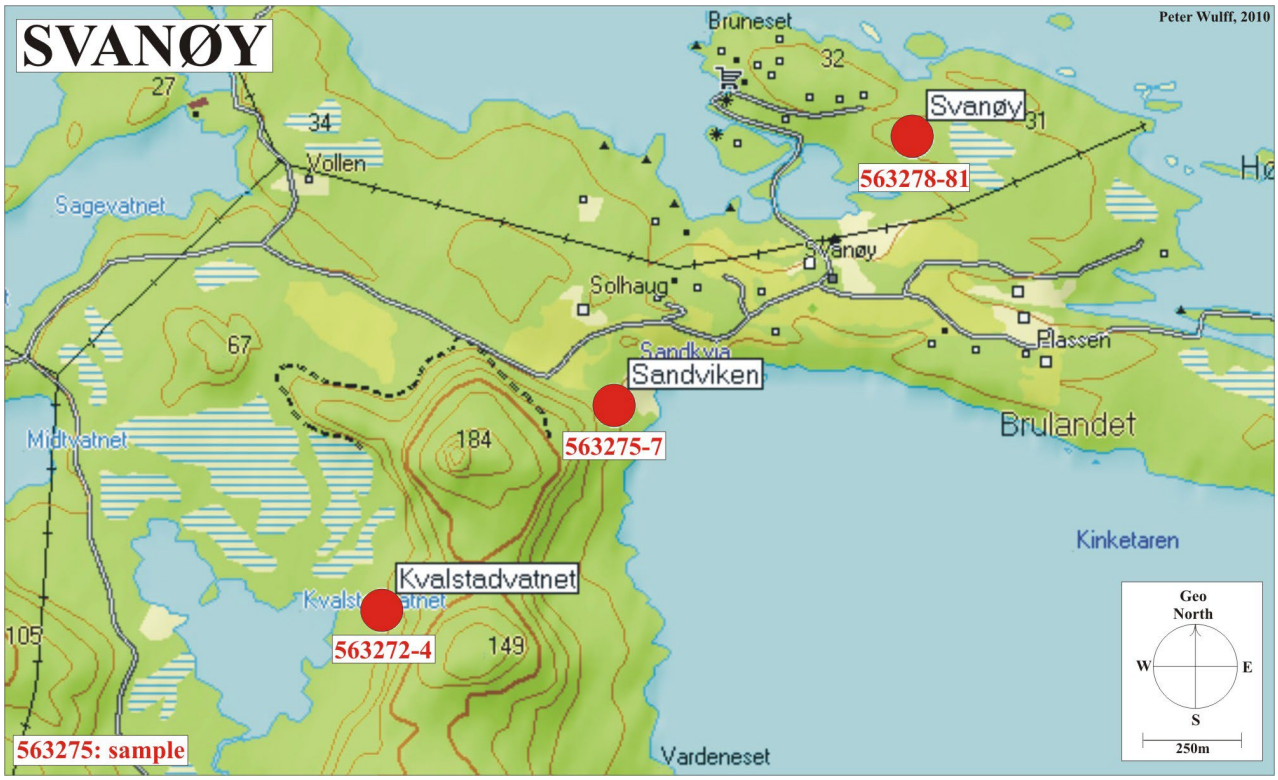

Figure 2.20A: the three occurrences visited on Svanøy. Their individual strike-directions are E-W.

The Svanøy deposit (or maybe deposits as there seems to be two separate ore bodies) is by far the largest on Svanøy and must have produced at least one hundred thousand tons of ore + waste. The old workings are numerous and I didn't try to survey them as my time on the island was limited to six hours. At UTM E294396, N6824183 is a large waste dump which at first didn't seem to contain much ore or mineralization as there are only few rusty rock. However, there is plenty of massive and disseminated mineralization which for some reason just doesn't rust. The massive ore consists mainly of pyrite with lesser amounts of chalcopyrite, pyrrhotite and sphalerite. There are also lots of pyrite, chalcopyrite and pyrrhotite as dissemination and fracture-fillings in chlorite-schist – probably the alteration zone.

Figure 2.20B: Svanøy, very deformed, mostly fine-grained pyrite>chalcopyrite+sphalerite.

Four samples: 563278-81.

Svanøy	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563278	0.09	33.2	4.5	4.2	561	67	6	5	35	40
563279	0.07	19.6	2.2	4.9	363	133	<2	13	37	44
563280	0.14	22.0	3.8	0.4	73	23	<2	7	23	18
563281	0.10	26.0	3.5	3.2	711	54	7	12	31	34
Average	**0.10**	**25.2**	**3.5**	**3.1**	**427**	**69**	**7**	**9**	**31**	**34**

2.21 SANDVIKEN

The ore types at Sandviken are the same as at Svanøy, but far more rusty. Host rock is schistose/chloritized basalt. At the roadcut of a new tractor road one sees the deformed character of the two, maybe three mineralized horizons none of which exceeds a few decimeters but can be rather copper-rich locally. Similar to Grimeli, also Sandviken has cobalt. It *appears* that the copper and zink contents are somewhat lower than in the other Cyprus-type occurrences mentioned in this report.

Three samples: 563275-7.

Sandviken	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	Co ppm	S %
563275	0.07	3.4	0.5	0.8	38	113	6	13	41	1290	45
563276	0.08	5.4	1.1	2.3	26	92	5	16	39	1310	38
563277	0.05	6.4	1.4	1.9	28	82	<2	12	42	667	45
Average	**0.07**	**5.1**	**1.0**	**1.7**	**31**	**96**	**3**	**14**	**40**	**1089**	**42**

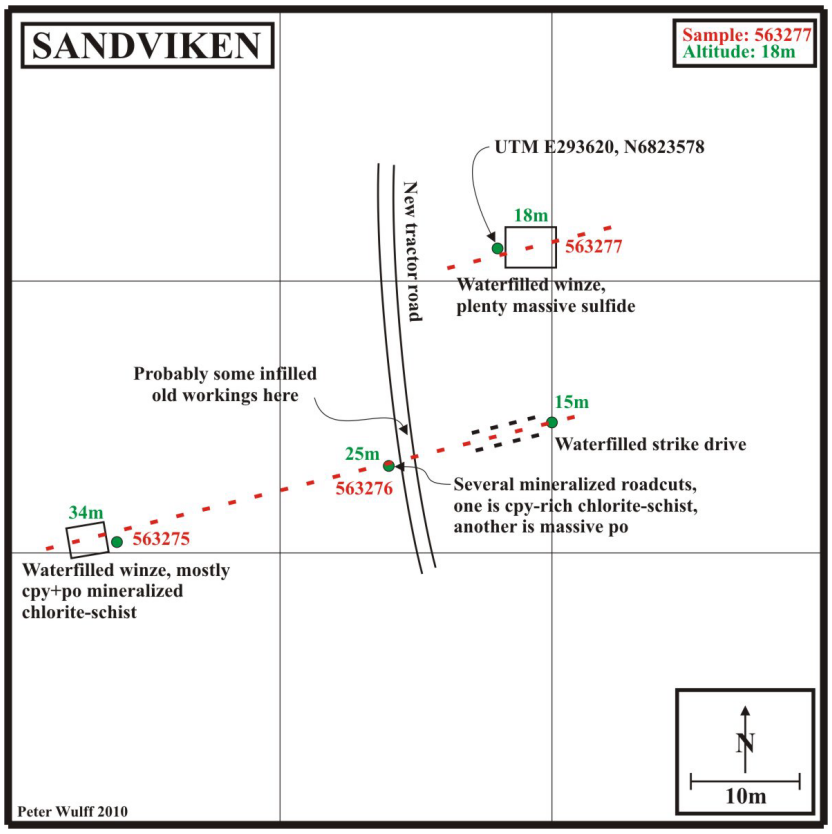

Figure 2.21A: sketch of the old workings at Sandviken.

2.22 KVALSTADVATNET

As is the case at Svanøy and Sandviken, there also seems to be at least two mineralized horizons at Kvalstadvatnet, and the ore types are the same, albeit with relatively more pyrrhotite, it seems. The largest of the old workings are waterfilled, pole-supported and unsafe. Did see, however, that the massive sulfides have been squeezed into dm-wide fractures in the chloritized, basaltic host rock. Overall the mineralizations strike E-W and dip to the north. The site is today a "Vildmarkslejr" with a fireplace built of ore and a wooden shack. Much of the massive ore has gone into a tractor road.

Three samples: 563272-4.

Kvalstadvatnet	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563272	0.13	9.4	3.3	4.1	74	43	<2	15	37	31
563273	0.08	4.6	1.0	1.6	33	62	<2	14	44	47
563274	0.04	6.6	1.6	7.2	25	13	<2	<5	21	16
Average	**0.08**	**6.9**	**2.0**	**4.3**	**44**	**39**	**<2**	**10**	**34**	**31**

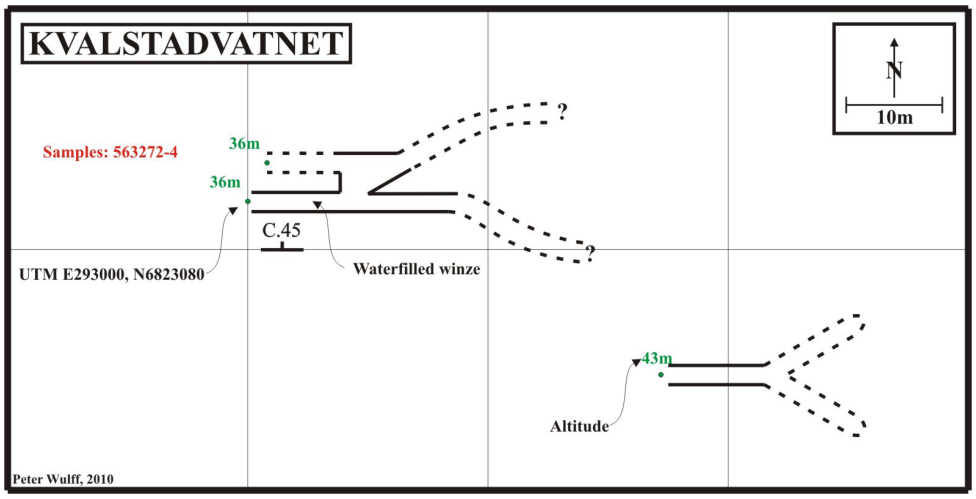

Figure 2.22A: sketch of the old workings at Kvalstadvatnet.

2.23 GAUPNE

The occurrence should be on a sub-vertical granite face, according to NGU's coordinates. Above the granite face is a rustzone which can be followed eastwards which was where I looked at it. It is a biotite-schist which locally has graphite layers with traces of pyrrhotite and pyrite. Above the small town Gaupne was something that looked like a test pit but was a natural cavity in the same biotite schist. So I found no mineralization at Gaupne.

2.24 KROKADALEN

At UTM E414118, N6801806, which is 5 m above and from the fiord, is a 5 m long and waterfilled winze in a rustzone. The roof looked like it could fall down so I did not use the hammer. The rustzone can be followed southwards and is a biotite-gneiss with nothing but traces of pyrrhotite associated with quartz-lenses. A similar rustzone occurs 500 m to the south along the road. So there is no real occurrence at Krokadalen.

No samples.

2.25 OFERDAL

Since 1992 one can *drive* to Oferdal, or Ofredal as it is called there. Nobody lives there and I saw nothing except felsic intrusives at NGU's coordinates, so gave up finding the occurrence – if it exists.

2.26 VELESVIK

A local from Vilsvik (=Velesvik) told me the exact location of the occurrence. The largest of the old workings is a waterfilled test pit, 4 m long, 2 m wide and at least 3 m deep. Along strike towards NE and SW are two very small test pits. These three test pits all targeted a very deformed and up to 40 cm thick (average about 10 cm) quartz-aplite vein hosted in dolerite dike which again is hosted in a banded gneiss. The vein (58º/80ºNW) can be followed for about 40 meter before it enters the sea in both ends. It does not reemerge on the other side of the small bay. The vein carries erratically distributed chalcopyrite and pyrite most of which occur marginally to the vein. The waterfilled test pit has mineralization in both its northwestern side and its southeastern side. There are three other but much smaller test pits and several other veins at the site. There is very little waste rock but some mineralized specimens lie around what may have been a "scheideplatz". As the occurrence is about 1.4 km west of Velesvik, one wonders if there is another test pit at Velesvik. The gold-content is insignificant.

Figure 2.26A: Velesvik, dolerite with chalcopyrite>pyrite-vein and K-feldspar-veinlets.

Three samples: 563282-4.

Velesvik	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563282	0.16	11.4	1.5	0.0	15	<5	<2	<5	9	7
563283	0.18	19.9	2.0	0.0	15	9	<2	<5	9	3
563284	0.80	73.9	8.2	0.0	14	6	2	8	15	12

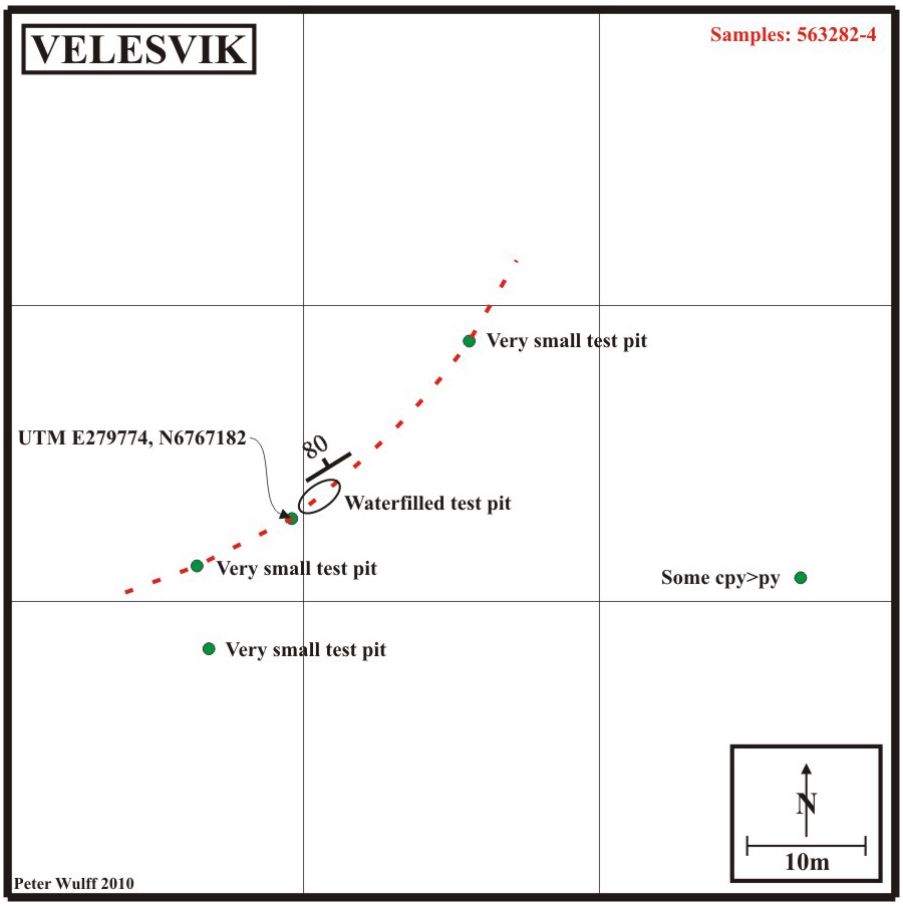

Figure 2.26B: old workings and mineralization at Velesvik.

2.27 GRØNSKARDET

At Grønskardet (UTM E292175, N6721679) is a 30-40 cm thick zone (15º/80ºW) with intense silicification and quartz-veining with more or less pyrite and chalcopyrite – about 5% sulfides I should think. Host rock is anorthosite. The mineralization has been test mined in a near-vertical winze into which locals has thrown some garbage. Below the winze, and most likely connected to it, is a waterfilled strike drive the entrance of which has been barred with waste-rock. There is nothing but copper in the samples.

At a nearby parking lot (UTM E292235, N6721616) is a similar and about 3 m thick rustzone which is mentioned as a "showing" in Bergmesteren's report from the mid-1880ties. Nearby (UTM E292177, N6721585) and at the same parking lot lie two boulder-sized, semi-massive and un-magnetic specimens of ilmenite.

Four samples: 563285-8.

Grønskardet	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563285	0.0	15.4	1.7	0.0	21	13	<2	<5	17	18
563286	0.0	15.5	1.4	0.0	25	7	<2	<5	7	7
563287	0.0	12.9	1.1	0.0	15	<5	<2	<5	7	7
563288	0.0	3.5	0.6	0.0	8	<5	<2	<5	6	6

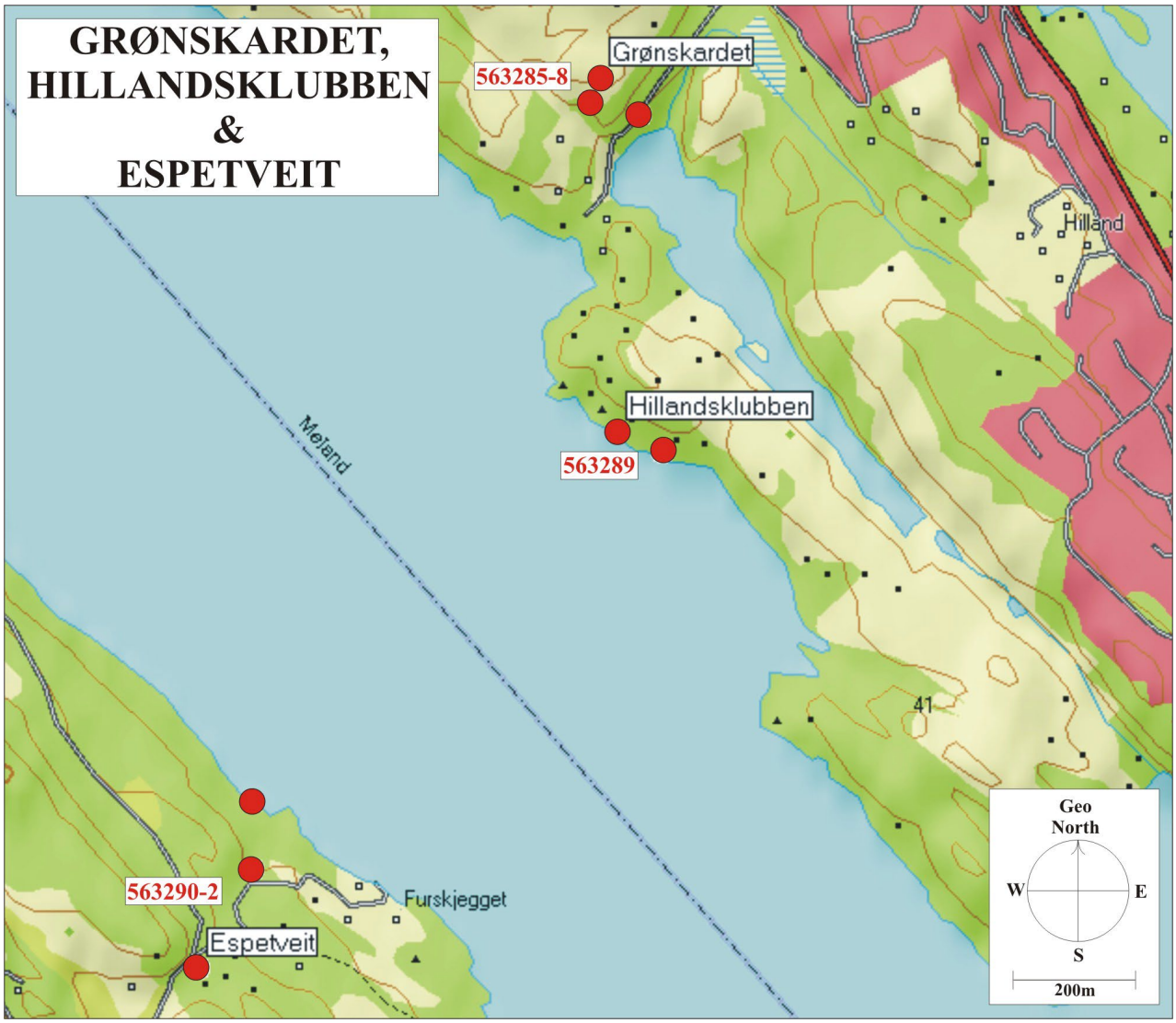

Figure 2.27A: map shoving the occurrences at Grønskardet, Hillandsklubben and Espetveit.

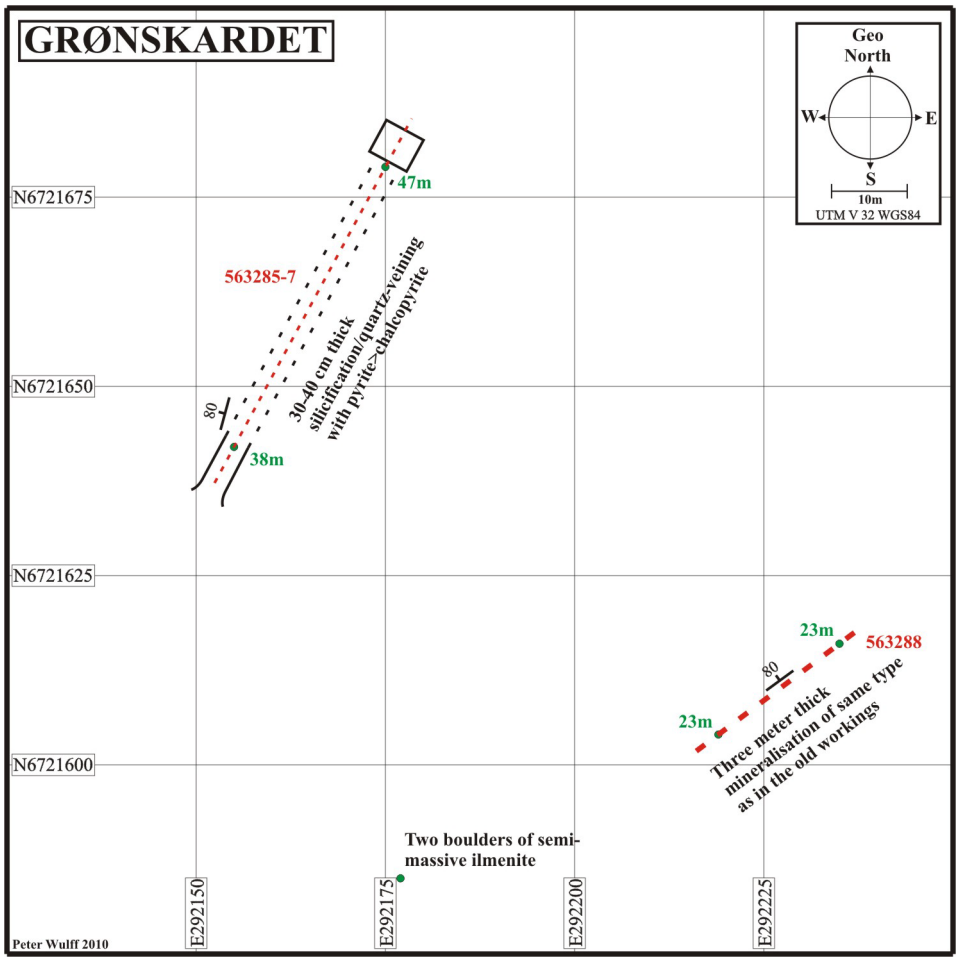

Figure 2.27B: old workings and a mineralized outcrop at Grønskardet.

2.28 HILLANDSKLUBBEN

The largest of the three old workings at Hillandsklubben is a winze (UTM E292169, N6721108) which today is hidden by a plywood construction that makes it inaccessible. Adjacent is a test pit with some irregular quartz-carbonate veins with a few percents of pyrite and chalcopyrite associated with dolerite. It looks hopeless. Similarly hopeless is a test pit at UTM E292240, N6721071 with identical mineralization. All these old workings are ½-1 m above sea level.

One sample: 563289.

Hillandsklubben	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563289	<0.001	6.7	1.2	0.0	4	<5	<2	<5	4	2

2.29 ESPETVEIT

There are three old workings at Espetveit. The one highest up (UTM E291443, N6720284) is a 70 m deep and near vertical winze that is also called Adelaide grube. It has been filled with waste-rock but three mineralized zones (c. 50º/64ºNW) can still be seen. One of them is of fairly high grade with respect to copper but as the roof is unstable no sample was taken. Ten meter from the coast and five meter above it, where a now obsolete power cable comes ashore, is another winze (UTM E291554, N6720509), called Jordan's grube. It is waterfilled and its rustzone is inaccessible because of a high fence. There is almost no waste-rock there but one sample of quartz with pyrite + chalcopyrite was taken. Between the two above winzes is a drift (UTM E291540, N6720437) that is not in a rustzone, so maybe it's an adit. The road nearest to the uppermost winze has recently been widened and in the fresh roadcut one sees at least 1 m thick mineralization (3-5% py>cpy) associated with alteration (of anorthosite) of a kind that doesn't seem to have been hit by regional metamorphism. It looks like a mylonite. There is nothing but copper in the samples.

Figure 2.29A: Espetveit, brecciated anorthosite with plenty chalcopyrite and minor pyrite.

Three samples: 563290-32.

Espetveit	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563290	0.0	52.8	3.9	0.0	98	23	<2	<5	15	15
563291	0.0	14.3	2.1	0.0	41	10	<2	<5	7	6
563292	0.0	4.4	0.3	0.0	18	19	<2	<5	13	15

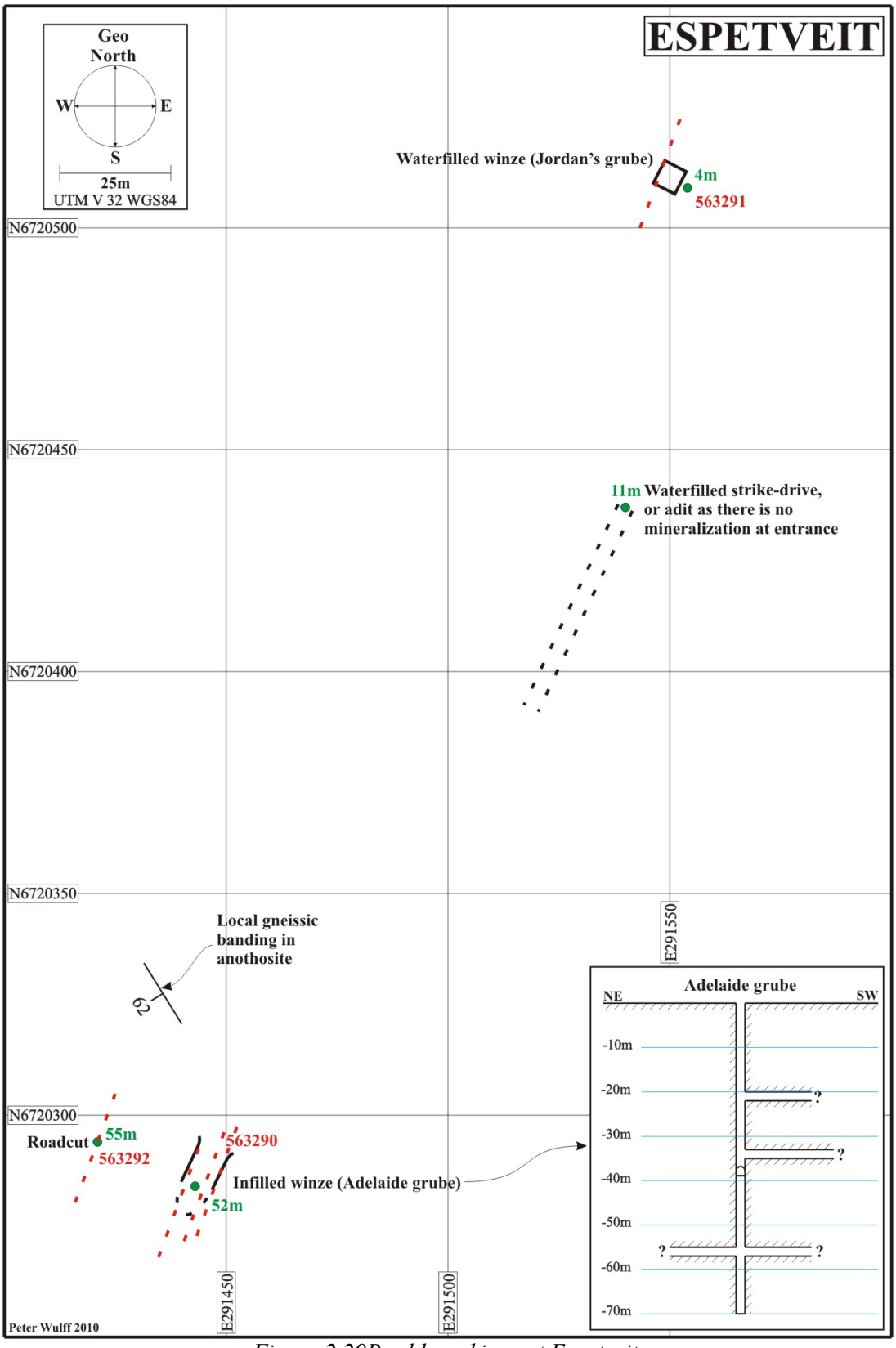

Figure 2.29B: old workings at Espetveit.

2.30 EKNES

According to an old report there should be six test pits at Eknes. I found only the one right at the fiord because the area is now residential with developments still ongoing. The test pit is 3 meter from the fiord and has been infilled and is overgrown so there is little to see except hornblendite with disseminated pyrrhotite and chalcopyrite – very typical of a disseminated magmatic occurrence. An area some fifty meter to the north has a few years ago been leveled with rocks a few of which are massive pyrrhotite with traces

of chalcopyrite. They seem to have been exposed to aerial corrosion for many decades and may come from the old test pits. There are also fresh gabbroic rocks with disseminated pyrrhotite. 150 m northwest of the test pit, and approximately in the local strike-direction, is a fresh road cut with disseminated pyrrhotite>chalcopyrite of the same type as in the test pit. They may be in the same stratigraphic level. The sample of massive pyrrhotite has less copper, nickel and PGMs than the samples with disseminated sulphides.

Figure 2.30A: Eknes, amphibolite with disseminated pyrrhotite, chalcopyrite and pentlandite.

Three samples: 563293-5.

Eknes	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Sb ppm	Fe %	Co%	Ni%	S %	Pt ppm	Pd ppm
563293	0.1	6.9	1.6	0.0	12	16	<5	14	428	8030	8	0.104	0.256
563294	0.1	2.5	0.5	0.0	49	5	<5	10	175	5820	3	0.092	0.140
563295	0.0	1.6	0.2	0.0	7	7	8	47	1820	1545	42	0.007	0.013

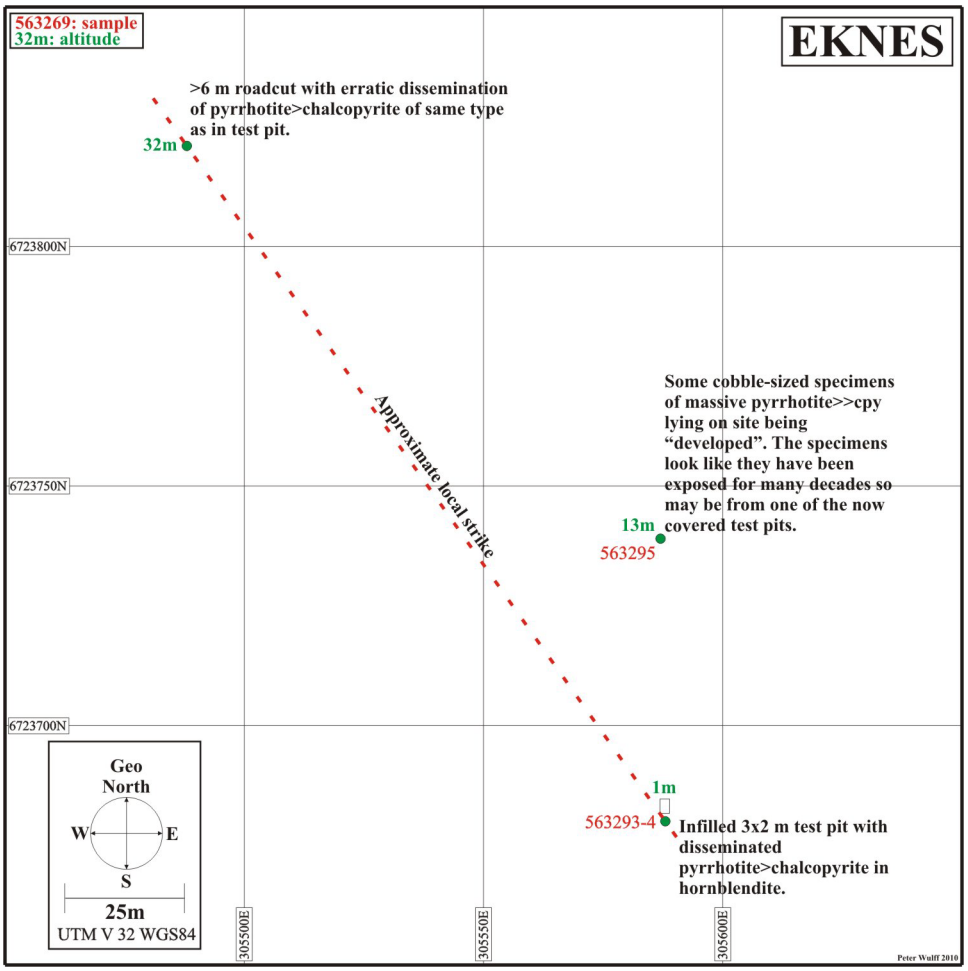

Figure 2.30B: the test pit and mineralized outcrop at Eknes.

2.31 KLEIVELAND

None of the locals knew of old workings at Kleiveland and after one hour of strolling around I gave up finding anything there.

2.32 HERLAND

At NGU's coordinates (UTM E310967, N6721342) is a large, deep hole with streaming water – obviously a part of the old hydro-electric powerplant in the valley below. A little to the southeast (UTM E311013, N6721216) is a 10 m long adit with a concrete-wall in the face – also a part of the hydro-electric powerplant. One wonders if mineralization was found in the tunnels or if some mapping geologist mistook the waste-rock lying beneath the holes as something coming from a mine. I found nothing about any mineralization at Herland in NGU's archives so maybe there is no mineralization at Herland.

2.33 VERNØY

The quartz-vein (c. 135º/50ºSW) is up to four meters thick and can be followed for about 80 m before it goes into the sea both to the NW and the SE. The quartz is locally schist-banded and contains unevenly distributed arsenopyrite (average much less 1%) with gold. The vein is concordant with its host-rock - a mica-schist that at the contact is also mineralized with arsenopyrite. The vein is difficult to access as the hanging wall is over-hanging and unstable so a more thorough investigation of the vein requires a boat and two geologists. In 1994 I took three samples of the quartz with varying content of arsenopyrite (1.7-3.6% arsenic) and averaging 4 g/t gold. Some of the new samples have MUCH more arsenopyrite but on average are not richer in gold. What's worse is that the gold is very erratically distributed. Three of the samples have <10000 ppm As, but judging from the iron-content, their real As-content is at least >25%. Of the 125 samples taken during this project, only the Vernøy samples have notable antimony.

Figure 2.33A: Vernøy, coarse-grained arsenopyrite in quartz.

Seven samples: 563296-302.

Vernøy	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563296	0.0	0.8	0.0	0.0	173	7	<2	<5	23	3
563297	<0.001	<0.5	0.0	0.0	7	6	<2	<5	1	0
563298	<0.001	<0.5	0.0	0.0	9	226	<2	<5	3	1
563299	1.1	<0.5	0.0	0.0	11	>10000	<2	113	28	16
563300	14.7	3.8	0.0	0.0	18	>10000	<2	38	16	9
563301	0.0	<0.5	0.0	0.0	5	1355	<2	<5	4	0
563302	0.6	<0.5	0.0	0.0	8	>10000	<2	49	25	15

Older samples (NGU).

Vernøy	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
HO0007.01	0.6	n.d	0.0	0.0	17	17525	<2	u.d.	2	1
HO0007.02	3.7	0.8	0.0	0.0	6	36186	<2	6	3	2
HO0007.03	6.9	1.6	0.0	0.0	3	21834	<2	4	2	1

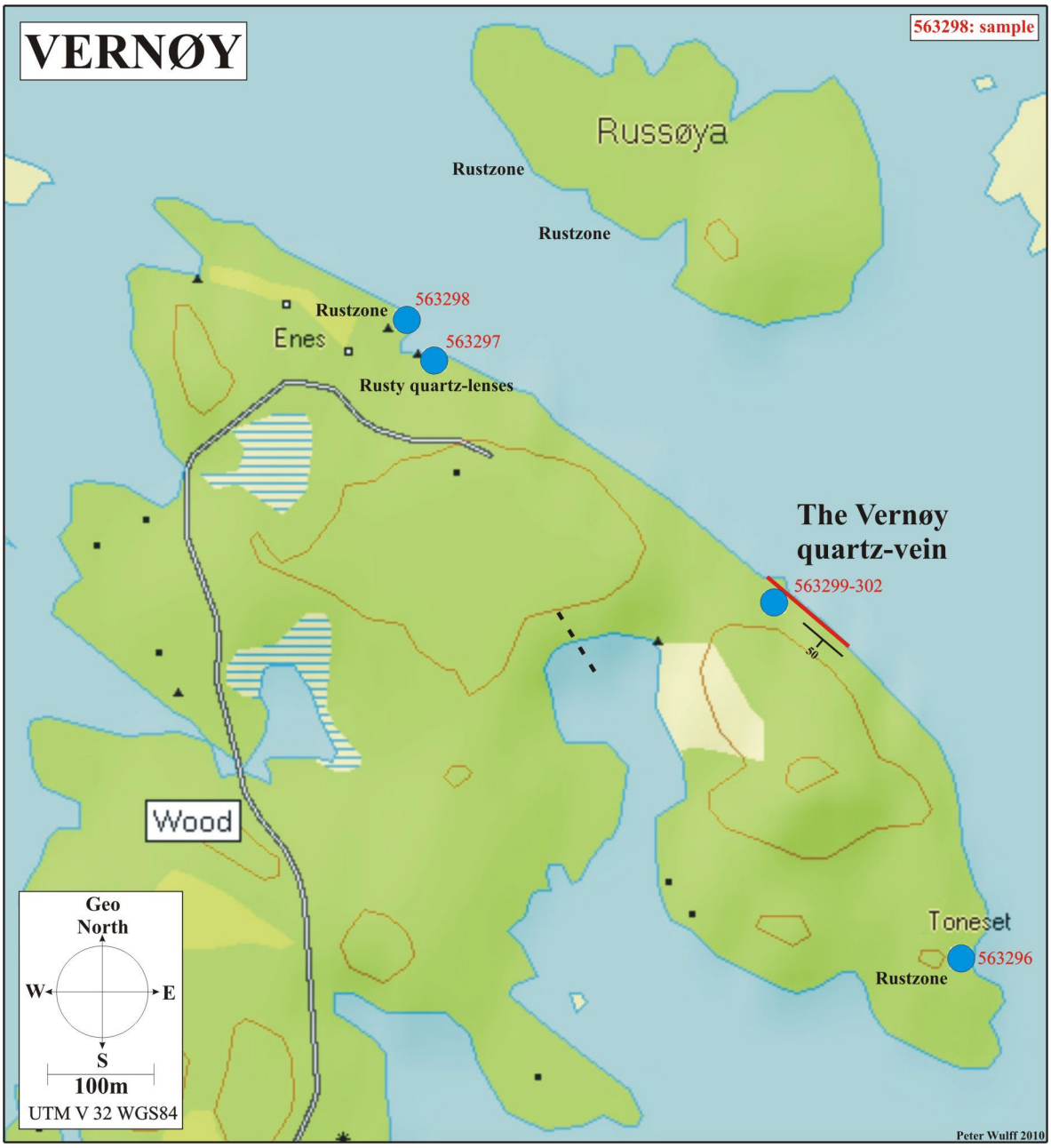

Figure 2.33B: map showing the Vernøy quartz-vein and some sample locations.

2.34 GALTELAND

A local knew one of the three old workings at Galteland but first took me on a boat-ride on the fiord to see a quartz-vein at UTM E307711, N6723551. The 35 cm thick vein has 1-2% pyrite and is concordant with schistosity. One sample: 563307.

There are three old workings at Galteland (the uppermost is at UTM E308193, N6722596, the middle is at UTM E308165, N6722637 and the lowermost is at UTM E308114, N6722713). They all lie within 2-10 meter from a creek and are within 140 m of strike-length but it's safe to say the mineralization is longer than that. Everything is overgrown at the uppermost test pit so I didn't see any outcrop, only some fairly copper-rich specimens of semi-massive pyrrhotite>chalcopyrite lying around the site. The middle test pit has about 4 m of mineralization, perhaps of somewhat lower grade than the test pit higher up. The lowermost is a 2 m long strike-drive in about 3 meter thick mineralization. The sulfides in all the old workings constitute about 20% and sit in a micaceous (chlorite, muscovite and biotite) mafic rock. A sample with 0.12% Ni is mentioned in an old report (Münster, 1908) but as none of our samples has any nickel (or Co, Pt, Pd for that matter), that old sample can hardly come from Galteland. Galteland is a metamorphosed copper-zink occurrence.

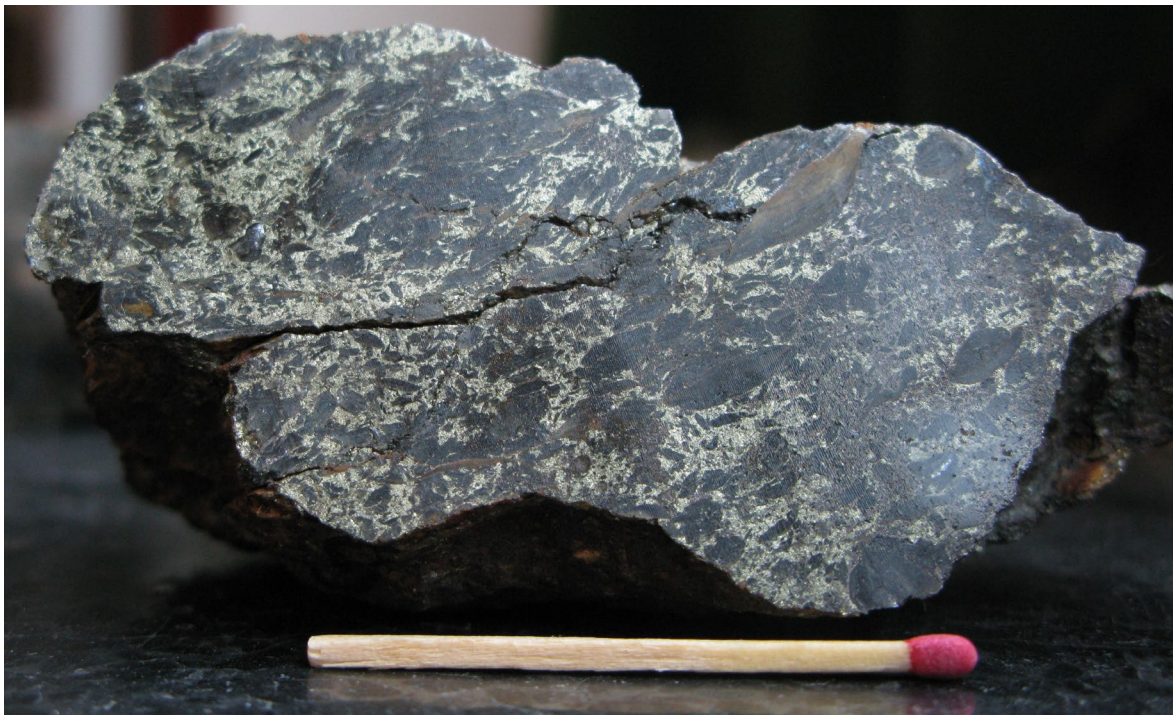

Figure 2.34A: Galteland, sample 563312: durchbewegung-texture, chalcopyrite>pyrrhotite with sheared and rounded fragments of host-rock.

Six samples: 563307-12.

Galteland	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563307	<0.001	<0.5	0.0	0.0	<2	24	<2	<5	5	4
563308	0.0	3.6	1.5	0.3	190	59	<2	<5	16	10
563309	0.1	6.0	2.6	0.2	67	63	<2	<5	20	12
563310	0.1	5.0	1.7	0.3	184	78	<2	<5	17	11
563311	0.0	2.8	0.6	1.5	637	11	5	<5	27	19
563312	0.1	22.7	7.6	1.2	1070	94	<2	<5	19	17

Figure 2.34A: map showing the old workings and a quartz-vein at Galteland.

2.35 ØVREDAL

The test pit is at UTM E309946, N6688915. It's about 5 x 2 m large and most of the outcrop is rusty. There is more or less mineralization in the whole test pit so the mineralization is at least 5 m thick. There is plenty of semi-massive mineralization (pyrrhotite>chalcopyrite) in the waste dump below the test pit. Matrix is fine-grained serpentinite (I take Korneliussen's word for it) while the country rock is medium-, almost coarse-grained gabbro, which is more basic than mafic. The samples have the expected copper and nickel, but also some palladium.

Figure 2.35A: Øvredal, semi-massive pyrrhotite>chalcopyrite in serpentinite.

Four samples: 563303-6.

Øvredal	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Sb ppm	Fe %	Co%	Ni%	S %	Pt ppm	Pd ppm
563303	0.0	0.8	0.2	0.0	2	888	<5	23	535	7210	14	0.024	0.479
563304	0.4	7.4	2.1	0.0	3	101	<5	24	456	5620	14	0.022	0.185
563305	0.1	6.8	2.2	0.0	<2	54	<5	16	110	1575	4	0.016	0.145
563306	0.0	2.5	0.9	0.0	6	110	<5	28	592	7900	16	0.131	0.441

2.36 EITRHEIM

The occurrence is at UTM E362600, N6664900 and 10 meter west of road 550. It's in a residential area. There is a garbage-filled adit, a strike-drive which is almost concealed by soil and decaying organic matter, two small test pits and above them all a winze which is hidden somewhere under a play-ground that seems to rest on rusty rock from the winze. A woman passing by said that many years ago her brother had entered the strike-drive and emerged at the adit – so they are interconnected. Host-rock is mafic, probably a gabbro. There is only little mineralized rock lying around at the site and massive sulfide is almost absent. In the outcrops I only noticed disseminated pyrrhotite>chalcopyrite. The samples have copper and nickel but no PGMs.

Two samples: 563313-4.

Eitrheim	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Sb ppm	Fe %	Co%	Ni%	S %	Pt ppm	Pd ppm
563313	0.0	20.1	5.0	0.1	10	24	5	23	379	2210	14	0.005	0.019
563314	0.0	1.1	0.4	0.0	10	31	<5	26	658	4190	16	<0.005	0.021

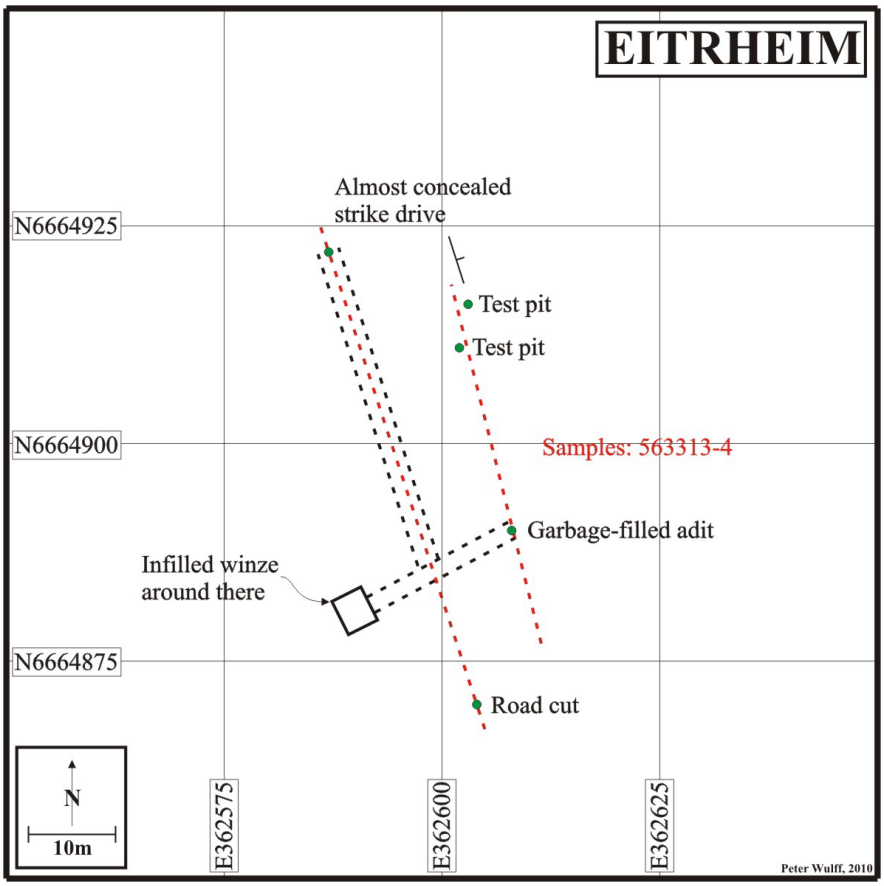

Figure 2.36A: sketch of the old workings at Eitrheim.

2.37 LINDVIK

There are two occurrences at Lindvik, Lindvik 1 & 2. They are VHMS occurrences, and according to the geological map hosted in the 1540 million years old Ullensvang supracrustals.

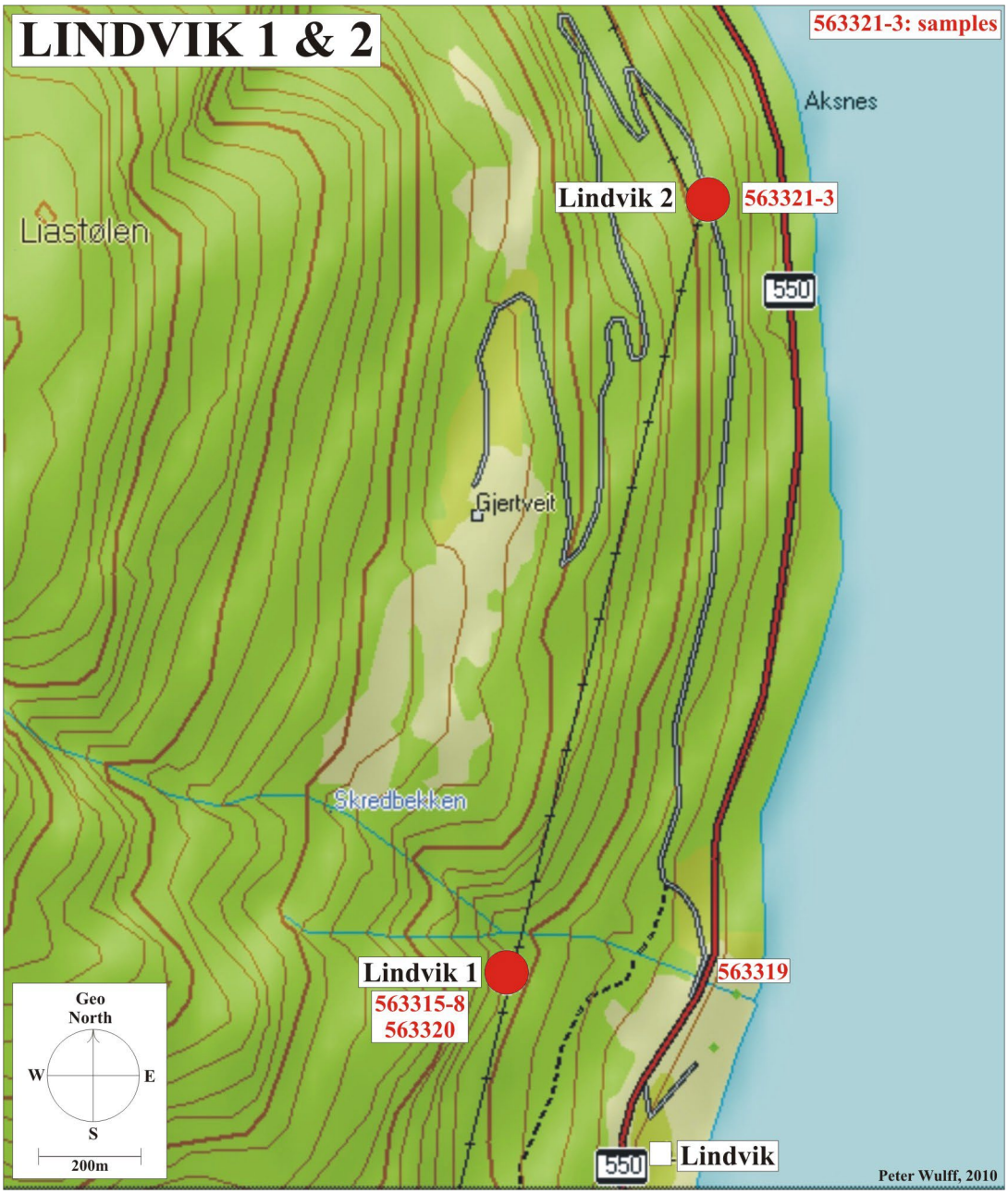

Figure 2.37A: the two occurrences at Lindvik.

Lindvik1

Albeit small, Lindvik 1 is a regular mine with adits, stopes, pillars, levels etc. The mine is dry, at least as far as I could see down-dip inside. The ore is banded pyrite in a matrix of quartz which doesn't rust much but turns to sand when weathering – quite similar to the pyrite from e.g. Hisdalen on Varaldsøy. Macroscopically one only sees pyrite but with a hand-lens also a few specks of chalcopyrite were seen. Host-rocks are both rhyolite/dacite and basalt. There are two pyrite layers; the lower is up to 70 cm thick and is the one that was mined while the upper is 20 cm thick and has been tested in a 5 m long strike-drive. They are identical with regard to ore type. One of the samples has 0.18% copper, but else the samples are barren.

Figure 2.37B: Massive pyrite. Matrix is quartz but the dark layer may be chlorite.

Six samples: 563315-20.

Lindvik 1	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563315	0.0	<0.5	0.0	0.0	9	163	<2	<5	35	41
563316	0.0	1.3	0.2	0.0	15	48	<2	<5	33	26
563317	0.0	0.5	0.0	0.0	8	190	<2	<5	37	38
563318	0.0	<0.5	0.0	0.0	23	52	<2	<5	18	15
563319	0.0	<0.5	0.0	0.0	12	91	<2	<5	7	6
563320	0.0	<0.5	0.0	0.0	10	81	<2	<5	22	21

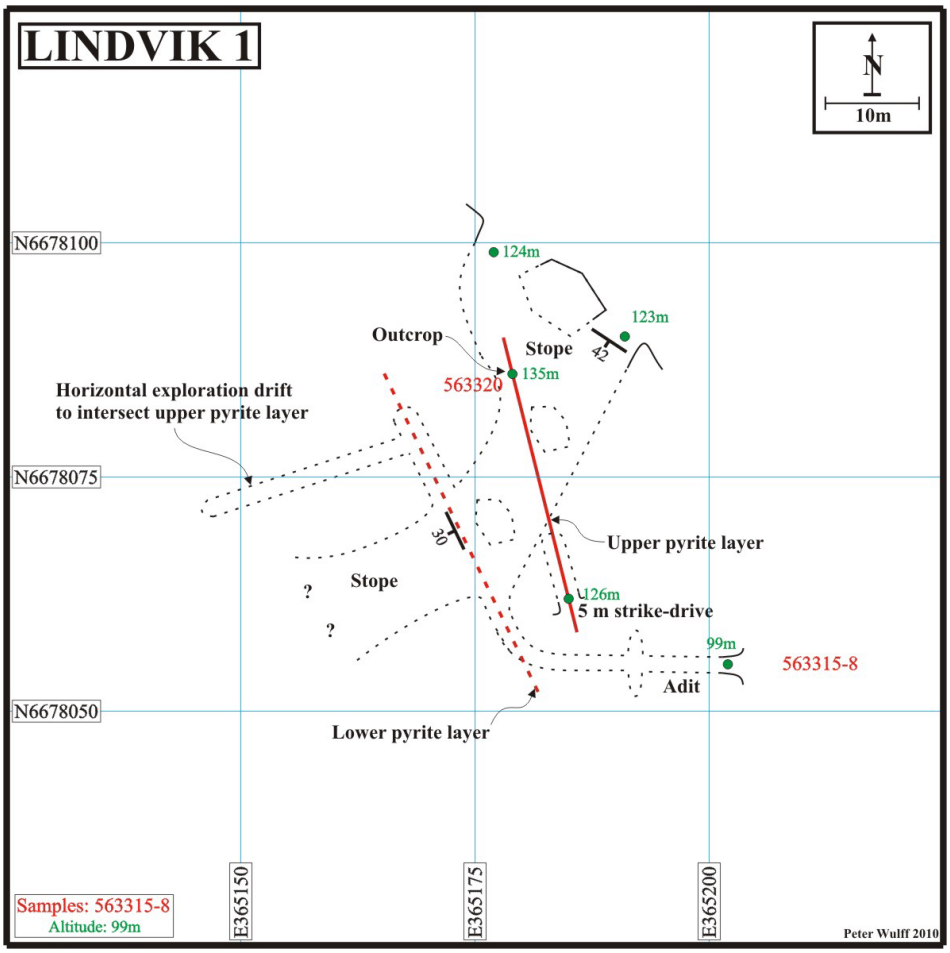

Figure 2.37C: sketch of the Lindvik 1 mine.

Lindvik 2

Lindvik 2 is at UTM E365390, N6678839 and on the western side of the tractor road. This is also a small mine – a c. 40 m wide stope with one small pillar supporting the hanging-wall rhyolite. There is both basalt and rhyolite in the footwall. The stope is waterfilled and has been filled with rocks and garbage. The ore (172º/30º) is 60-70 cm thick in the pillar and is identical to the ore from Lindvik 1. I didn't see the upper margin of the hanging wall rhyolite which can be followed along the tractor road almost all the way to Lindvik 1. The samples are as barren as those from Lindvik 1.

Three samples: 563321-3.

Lindvik 2	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563321	0.0	1.6	0.0	0.0	10	80	<2	<5	33	38
563322	0.0	1.7	0.0	0.0	5	82	<2	<5	27	31
563323	0.0	2.3	0.0	0.0	6	97	<2	<5	35	42

2.38 SKÅNEVIK

I found nothing at the coordinates and none of the interrogated locals had any knowledge of old workings there.

2.39 FLESJO

The garbage- and rock-filled test pit is at UTM E349218, N6608741, five m from the fiord and one m above it. There is nothing to see in the test pit but nearby are a few rust-zones which are of no interest.

2.40 FUGLAVATNET

The occurrence is already described in great detail by NGU-geologists who had six samples analysed. Their highest gold content is 4.5 ppm, which is associated with >1% arsenopyrite. The test pit is at UTM E300322, N6590963. The 2 x 2 m test pit is waterfilled as it is level with the bog surrounding the outcrop. On the outcrop lies about ½ m^3 waste-rock of which 50% has more or less arsenopyrite. Traces of chalcopyrite were also noticed. The rock is a quartz-veined and possibly silicified, banded biotite-amphibole gneiss. My sample has more gold than NGU's samples – something that required some work with the hammer.

I later learnt that there are two more old workings (fig. 2.40A) but that there is less mineralization in them.

Figure 2.40A: Fuglavatnet, amphibolite with disseminated arsenopyrite.

One sample: 563324.

Fuglavatnet	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563324	6.1	1.8	0.1	0.7	8	>10000	25	<5	10	4

Older samples (NGU)

Fuglavatnet	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
RO0137.01	4.4	1.8	0.2	0.0	10	>10000	9	<3	12	4
RO0137.02	2.2	0.9	0.1	0.2	11	76734	5	<3	9	3
RO0137.03	1.8	0.6	0.1	0.0	7	31351	4	<3	7	2
RO0137.04	1.5	0.6	0.1	0.0	15	93220	4	<3	10	2
RO0137.05	1.8	n.d.	0.1	0.0	10	97758	<3	<3	9	2
RO0137.06	0.3	n.d.	0.0	0.0	8	9894	3	<3	4	0

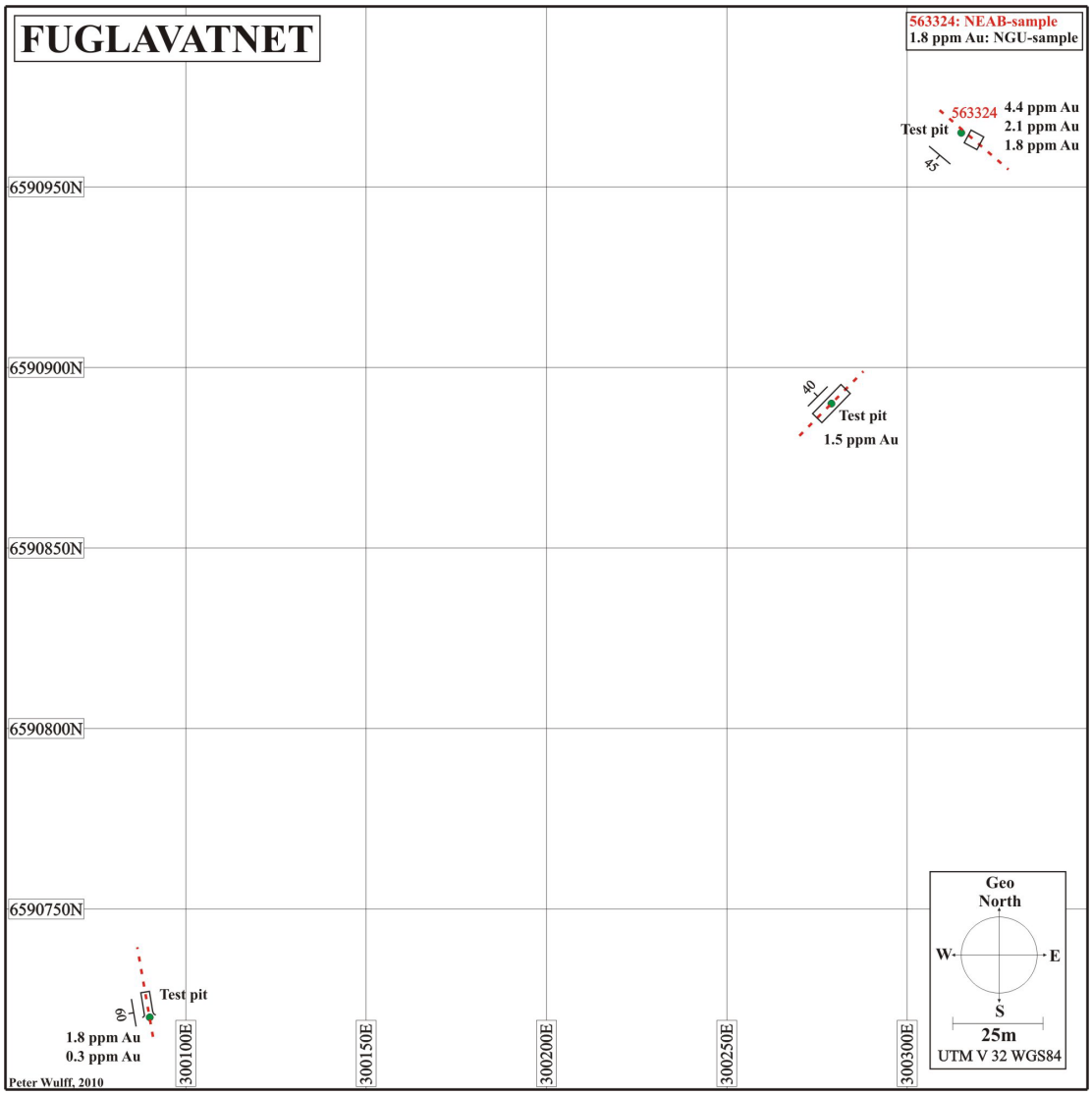

Figure 2.40B: map of the old workings at Fuglavatnet, most data are from NGU.

2.41 DRITLAND

At NGU's coordinates I found nothing but granite.

2.42 NØTELAND

There is very little outcrop at the site due to alluvial deposits and vegetation. The little there is, is a rather felsic and quartz-veined gneiss. I quickly gave up finding old workings there.

2.43 NÆRBØ

The local 67 year old farmer had lived his whole life about 200 m from NGU's coordinates but had never heard about or seen old workings at the site. This doesn't necessarily mean that there is no mineralization. The area is farmland and old workings would be in the way so may have been filled in.

2.44 GARBORG

At UTM E308791, N6510095 is a waterfilled adit which "goes down" according to the property owner, a farmer. The farmer said that some bat-interested people had once sailed into the adit in an inflateable boat but there were no bats inside. He also said that German students each year came and mapped a larger

outcrop some hundred meters to the north, but that no geologist had ever visited the occurrence. The area is farmland and very unlike the other places I visited - not a place where one commonly finds old workings.

The adit is at least 10 m long and strikes 144º SW. The dump has since long been removed and now lies here and there in the area. Most of it is overgrown and mixed with soil but it was still possible to find some rusty samples with plenty of pyrite, chalcopyrite and pyrrhotite. Host rock seems to be mainly fine- to medium-grained biotite-gneiss which sometimes is silicified. There may also be basalt. Quartz also occurs but it has no sulfides. The orientation of the gneiss's banding/schistosity is at the entrance 54º/50ºN and the mineralization most likely has the same orientation. There is nothing but copper and zink in the samples, and as there is massive pyrite, Garborg is most likely a VHMS.

Figure 2.44A: Garborg, pyrrhotite+chalcopyrite in quartz matrix (there are far more sulfide-rich specimens but they are very weathered).

Five samples: 563325-29.

Garborg	Au ppm	Ag ppm	Cu %	Zn %	Pb ppm	As ppm	Bi ppm	Sb ppm	Fe %	S %
563325	0.0	<0.5	0.0	0.0	6	39	2	<5	1	0
563326	0.0	2.3	0.0	0.5	8	84	<2	<5	18	15
563327	0.0	5.0	1.6	0.4	6	13	<2	<5	12	10
563328	0.0	7.4	2.4	0.1	10	19	<2	<5	12	7
563329	0.0	12.0	3.9	0.2	8	15	<2	<5	19	15

3.1 RESULTS, FURTHER WORK AND CONCLUSION

The main objective of the sampling program was to identify sulphide occurrences enriched in gold or platinum group elements.

A new gold occurrence was located at Løkedal. The gold is associated with high contents of copper and silver originated from quartz-feldspatic mobilisation. However, overall dimensions are small and no further work is recommended.

Known gold occurrences at Flatskarvåsen, Vernøy and Fuglavatnet were also sampled, and their (low) gold contents were confirmed. Their tonnage potential is unknown but probably small, so no further work is recommended.

Platinum Group Metals are associated with two nickel occurrences, but always in amounts less than 1 ppm. The best nickel occurrence is Øvredal but the showing has limited size potential, and nickel in the sulphide facies is only 1 to 2 % - a type not worth pursuing.

The very large rustzone at Sandfjellet has some chromium and nickel but they are most likely locked up in silicates.

The three Cyprus-type copper-zink±cobalt occurrences on Svanøy and those at Vågene, Grimeli and Gjerdvika (fig. 3.1) have average grades for their class of VHMS. The size potential would be maximum two million tons and even at today's high copper price such deposits would need an equivalent of 3 to 5 % copper. Average for selected samples from the six Cyprus-type occurrences (and Søyset and some of the Averøy-occurrences) fullfil this requirement, but historical data on production, combined with occurrence type and their mostly small dimensions make it rather unlikely that targets worth further investigations would be identified. No further work is recommended.

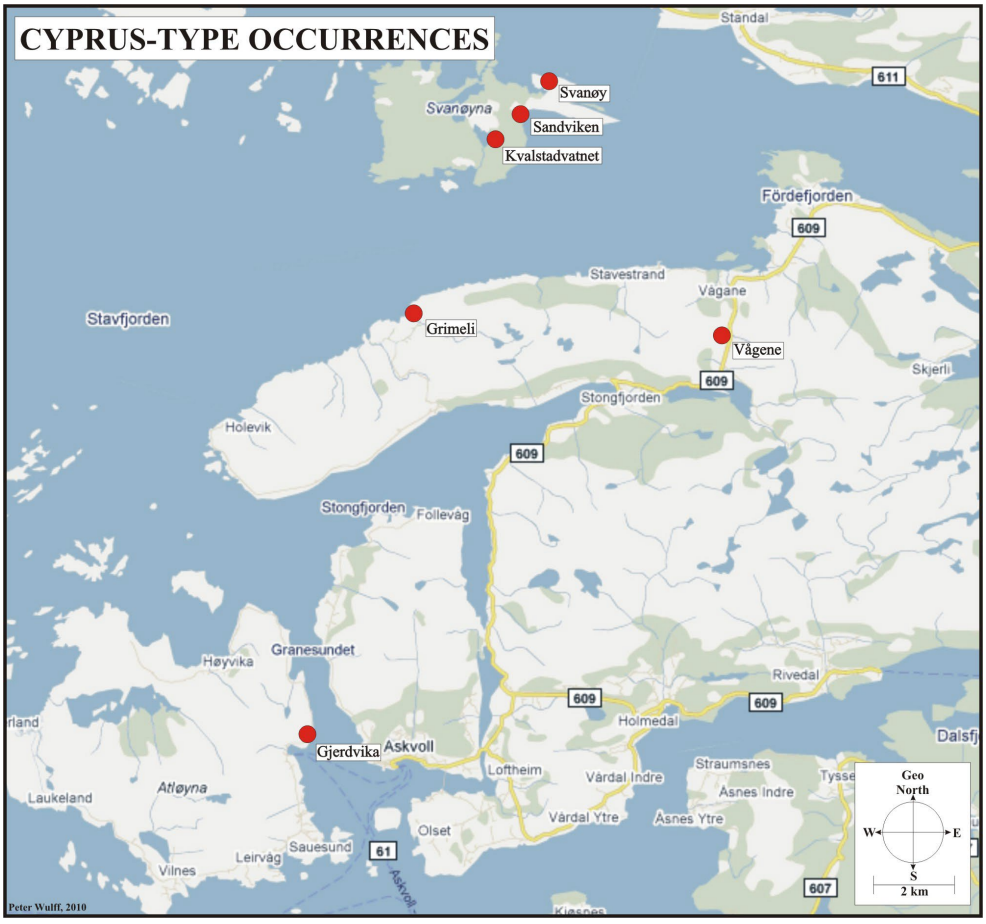

Figure 3.1: The six visited Cyprus-type copper-zink occurrences.

The reconnaissance programme was executed during a short period for a modest expense. Especially in southern Norway there remain a large number of sulphide occurrences where knowledge about the content of precious metals is lacking. It is recommended to do a similar type of program for selected targets within geological settings which has a potential for enrichment in precious metals.

APPENDIX 1: Alschemex's analytical procedures

The 125 samples have been analyzed by Als Laboratory Group (Alschemex) as shown below.

ME-ICP61: Elements by HF-HNO3-HClO4 Acid Digestion, HCl Leach and ICP-AES.
This package utilises a near total digestion so that data reported for nearly all elements is considered quantitative. It is considered most appropriate for rock characterization as it includes data for all major and minor elements except silicon.

Notes: Digestion For this digestion, the acid mixture must be taken to incipient dryness. This process ensures the best possible dissolution, but also results in the loss of volatile mercury. In addition, this particular acid mixture results in the loss of silicon, an element not normally considered to be volatile.

To assist in the final dissolution of the sample residue, hydrochloric acid is added and then sample analysis is carried out in a dilute hydrochloric acid matrix.

This digestion will be "total" for most rock samples. Certain types of highly resistant minerals, for example zircons, may not be totally attacked. In these limited cases, we recommend that the Whole Rock fusion technique be used.

Ag, Al, As, Ba,Be, Bi Ca, Cd, Co, Cr, Cu (<10000 ppm), Fe, Ga, K, La, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Sc, Sr, Th, Ti, Tl, U, V, W and Zn (<10000 ppm).

Fire Assay-Atomic Absorption procedures for Exploration and Low to Medium Grade Ore Samples
Exploration samples (particularly soils) may require a better detection limit than that offered by the above procedures. Method codes Au-AA21 and Au-AA22, which include a fire assay collection followed by cupellation, dissolution of the precious metal prill and a pre-concentration solvent extraction step. The final determination is by flame AAS, providing a detection limit of 1 ppb. It is a more expensive technique than the conventional fire assay /AAS procedure, but for explorers looking for the best resolution of low level gold anomalies, this procedure is excellent.

In recent times, we have turned to ICPMS technology to offer trace level gold. See method codes **Au-ICP21** and Au-ICP22. In addition to a detection limit of 1ppb, the advantage offered by this technique is the ability to determine platinum and palladium together with gold.

Many samples arriving at our laboratories have "intermediate" levels of gold; that is in the range of 3-10 g/t (0.1-0.3 oz/ton). These samples are best analyzed using FA-AAS procedures Au-AA23, Au-AA24. If samples contain higher concentrations of gold, procedures **Au-AA25** or Au-AA26 would be a more appropriate technique.

Au-ICP21: Au (<10 ppm)
Au-AA25: Au (>10 ppm)

Ore Grade Analysis

For simple characterisation of ores, recommended procedures include; the aqua regia digestion (OG26) primarily for lead/silver/zinc rich ores and; four acid digestion method **(OG62)** for copper and zinc ores with low lead, and silver and nickel laterite ores. Samples expected to contain significant amounts of sulphides of copper; nickel and/or cobalt are fused with sodium peroxide and then leached with dilute hydrochloric acid using procedure ICP-81.

Cu (>10000 ppm) and Zn (>10000 ppm).

I found nothing specific about **S-IR08** (S) or **PGM-ICP23** (Au, Pt, Pd) but trust the results are completely ok as the analytical packages are specifically designed for the mentioned elements.