Kodal Minerals Plc - Grimeli Project

Exploration report- 2016

Introduction

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Introduction

Location

The Grimeli Project is situated in the Sogn og Fjordane region of Norway, 120km North of Bergen, approximately 40km West of the town of Førde. The permits occupy land completely within the Askvoll municipality, figure 1.

Figure 1: Plan detailing the location of the Grimeli Project

Permits

Kodal Minerals ("Kodal or the Company") applied for and were granted three exploration permits at the Grimeli Project in 2014. The three permits cover an area of 30,000,000m², these permits cover the historic mining areas of Grimeli and Vagendal.

Table 1: Details of Exploration Permits held at the Grimeli Project by Kodal Minerals

Type	Name	Number	Point	E	N	Commune	Region	Area		Status	Maintenance due	Expires
Exploration	Grimeli 1	0204-1/2014	A	290500	6819250	Askvoll	Sogn og Fjordane	10000000	m²	Valid	Dec-16	15/07/2021
			B	295500	6819250							
			C	295500	6817250							
			D	290500	6817250							
Exploration	Grimeli 2	0205-1/2014	A	295500	6819250	Askvoll	Sogn og Fjordane	10000000	m²	Valid	Dec-16	15/07/2021
			B	300500	6819250							
			C	300500	6817250							
			D	295500	6817250							
Exploration	Grimeli 3	0206/1/2014	A	290500	6820250	Askvoll	Sogn og Fjordane	10000000	m²	Valid	Dec-16	15/07/2021
			B	300500	6820250							
			C	300500	6819250							
			D	290500	6819250							

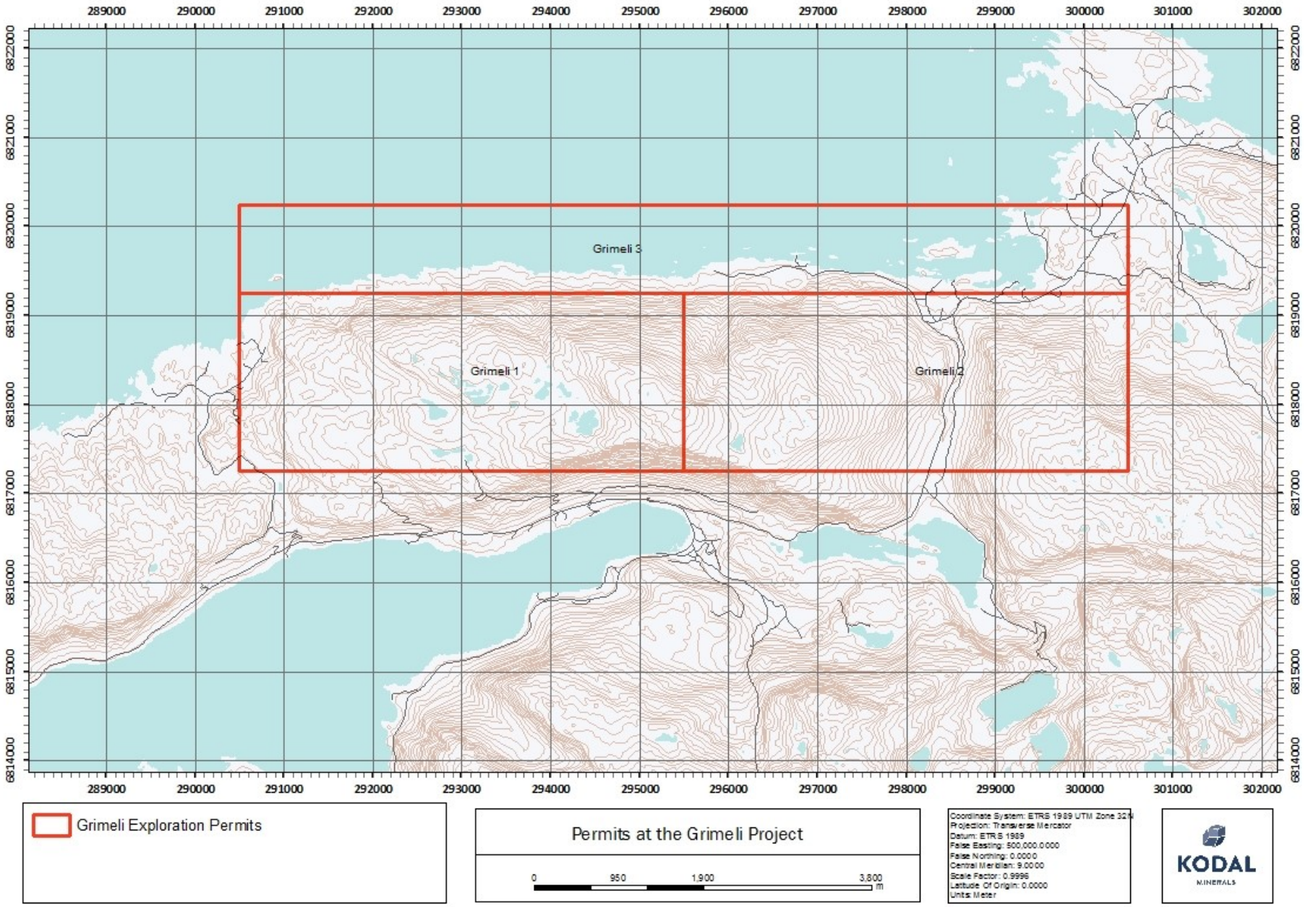


Figure 2: Permits at the Kodal Deposit

Work Conducted

Literature review

Historic information was sourced largely from the library of the NGU along with some reports and maps which the Company were given access to by local residents. The only recent scientific study of the area was completed over several years by the NGU

Summary from Literature

In the mid 1700's 8-10 copper mines already existed in the county, with the first starting at around 1500. In 1761, paid for by the king, Otto Leffert surveyed the site with a number of colleagues, though initially the site was deemed not favourable for extraction. However, a trial extraction and smelting produced high quality copper. As such a smelting facility was constructed in 1760 despite the inhospitable coastal conditions, partially paid for by the royal purse in return for a stake in the project. The smelting facility and the mine itself provided jobs for approximately 60 local.

The historic operations on the site were split between three zones of production; the West, Lower, and Upper Mine. The West Mine was extracted using a surface mine. Underground mining methods were used in the Upper and Lower Mines. Recent studies suggest the thickness of solid ore varied from 1-3m.

It appears that the plan for the operation was to work beneath the West Mine, working in from the Lower Mine once it had reached an appropriate depth. However, the lode in the Lower Mine was lost, and as such this planned extension was never completed.

The few hundred thousand tonnes of ore that are estimated to have been extracted were passed to an on-site smelting facility made of stone. The ruins of this were apparently still visible in the late 1920's, though today there is little evidence of it.

During production in the 1800s there was no harbour on the site due to the often violent seas, and even a jetty was deemed almost impossible. As such, the material from the smelter was transported by barge 11km to Forkenes in the east where it could then be loaded onto transportation ships for distribution.

The late 1920's saw the construction of a road linking the north and south sides of the peninsula, though the connecting roads to Stongfjorden and beyond are more recent, having been laid around 1940. This road was not built in order to create better access to the mine however, as production ceased in 1917.

Several studies have attempted to assess the tonnage of ore still left at the site, and these estimates range from approximately 3Mt at 5% Cu from a study in 1929, to 900,000t and 750,000t for the Lower / West and Upper Mine respectively based on VLF and CP surveys conducted by the NGU. The NGU detail a number of geophysical signatures which appear concordant with mined mineralisation at Grimeli, these are detailed in Figure 3.

Geophysics

In order to verify the work of the NGU the Company conducted a ground based combined magnetic and delta magnetic survey over the project area. A total of 40 lines were walked across the

area, split up into two orientations. The first and largest area covered the Grimeli Lower and Upper mine areas and continues a significant distance to the West of the mining area where anomalies have been shown by work conducted by the NGU to continue and outcrop of mineralisation can be found. As the ground rises to the west the outcrops become less frequent and more difficult to locate, it is not proven whether this degradation in mineralising conditions is due to lateral or vertical displacement from the centre of mineralisation around the mining area. The second area is the foreshore area where historic infrastructure and housing was built, now largely covered by farm and forest land, outcrop is intermittent. Here a change in orientation of lines was introduced In order to match changing mineralised orientation.

Both areas encountered positive geophysical anomalies that strongly correlated with those identified by the NGU and expanded these target to the East and west. Of the two methods the rate of change in magnetic signature, calculated using the variance between the two magnetic signal recorders at differing heights gives a clearer post processed image of the geophysical anomalies.

Drilling of these targets showed that while ground based methods have identified mineralisation, the majority of these have proven to be disseminated horizons devoid of copper and zinc bearing minerals and future work will have to carefully consider what geophysical methods can be employed to identify the economically interesting horizons.

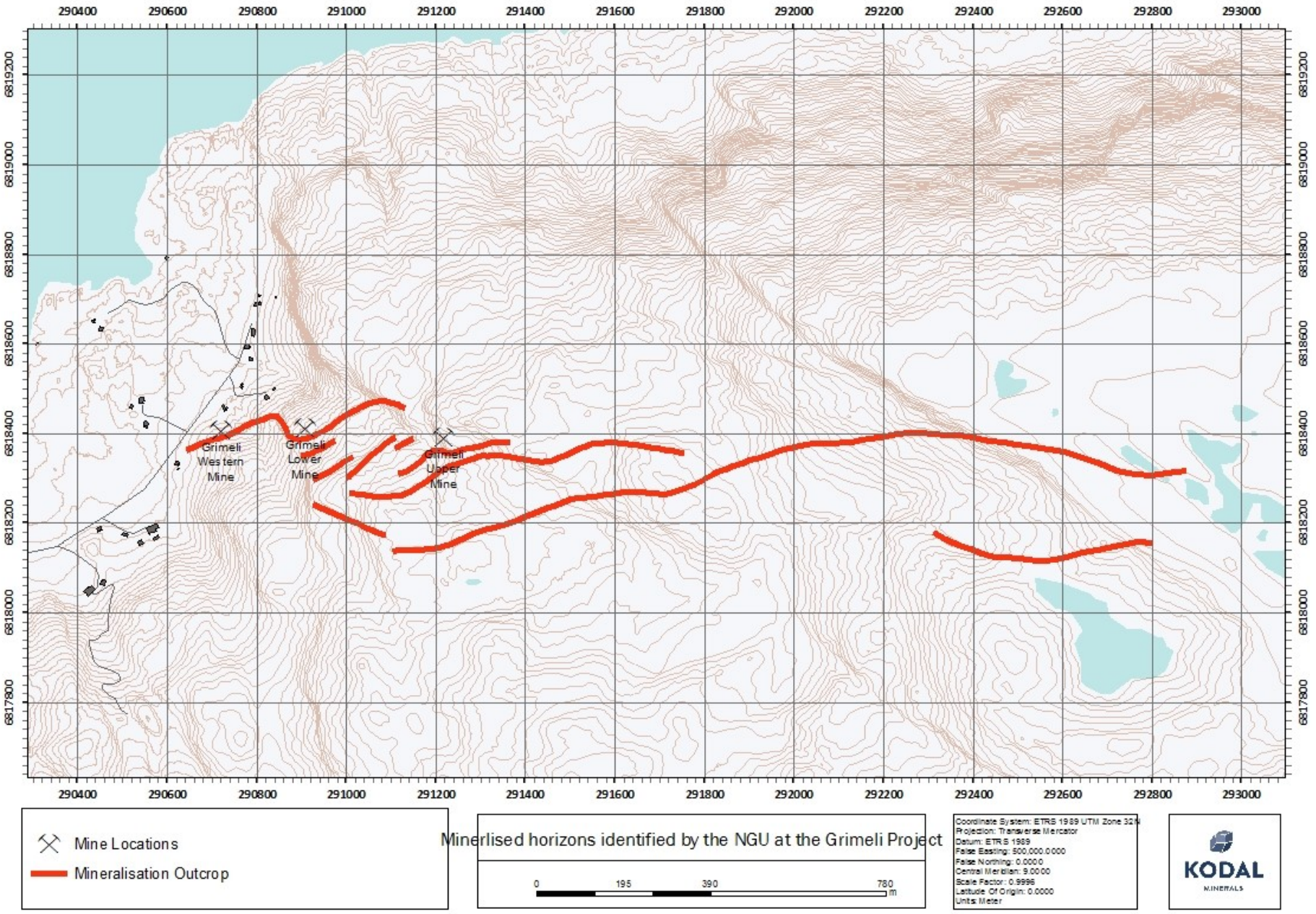


Figure 3: geophysical anomalies identified by NGU at Grimeli Project in the vicinity of Grimeli.

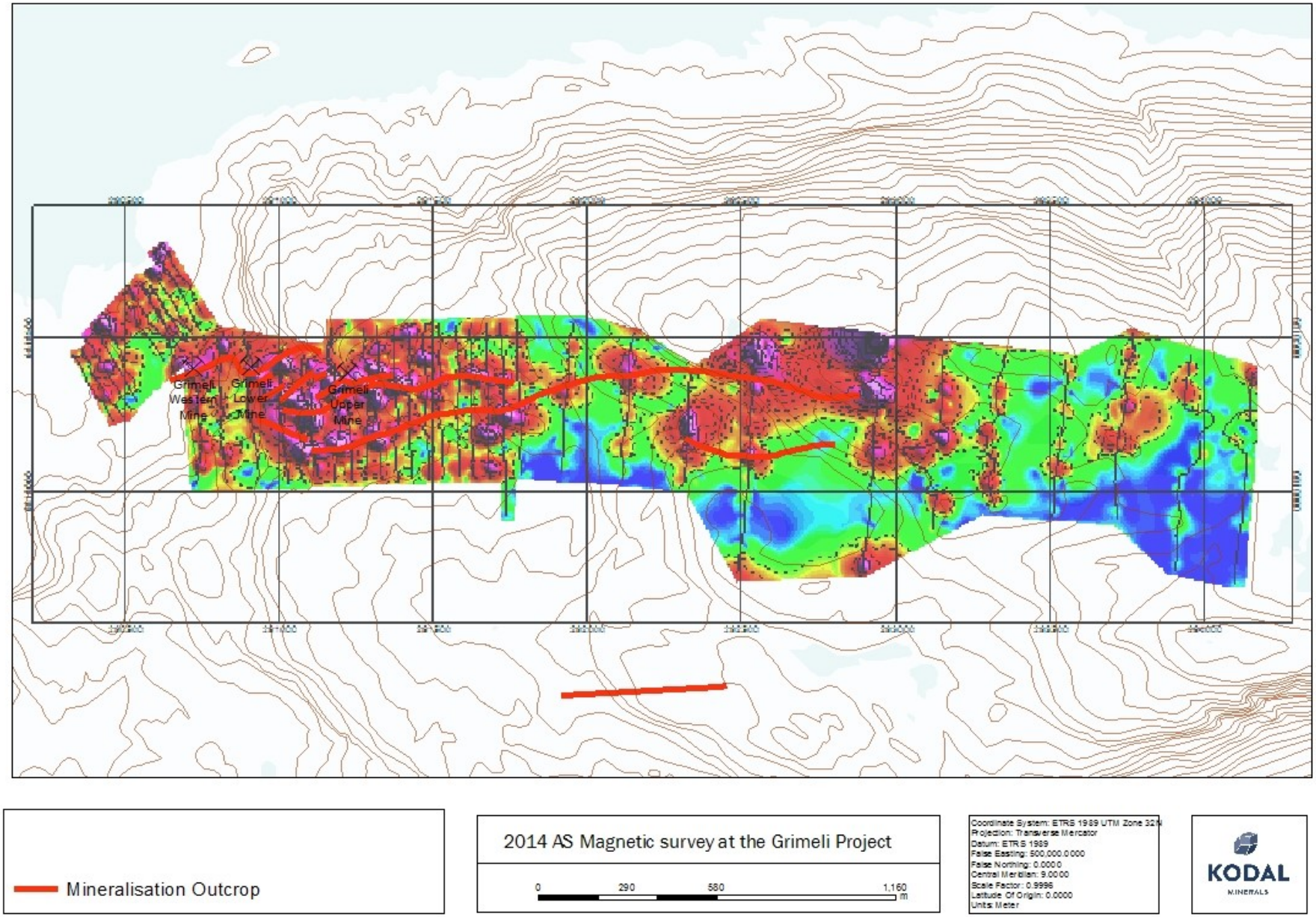


Figure 4: delta magnetic signature at the Grimeli Project

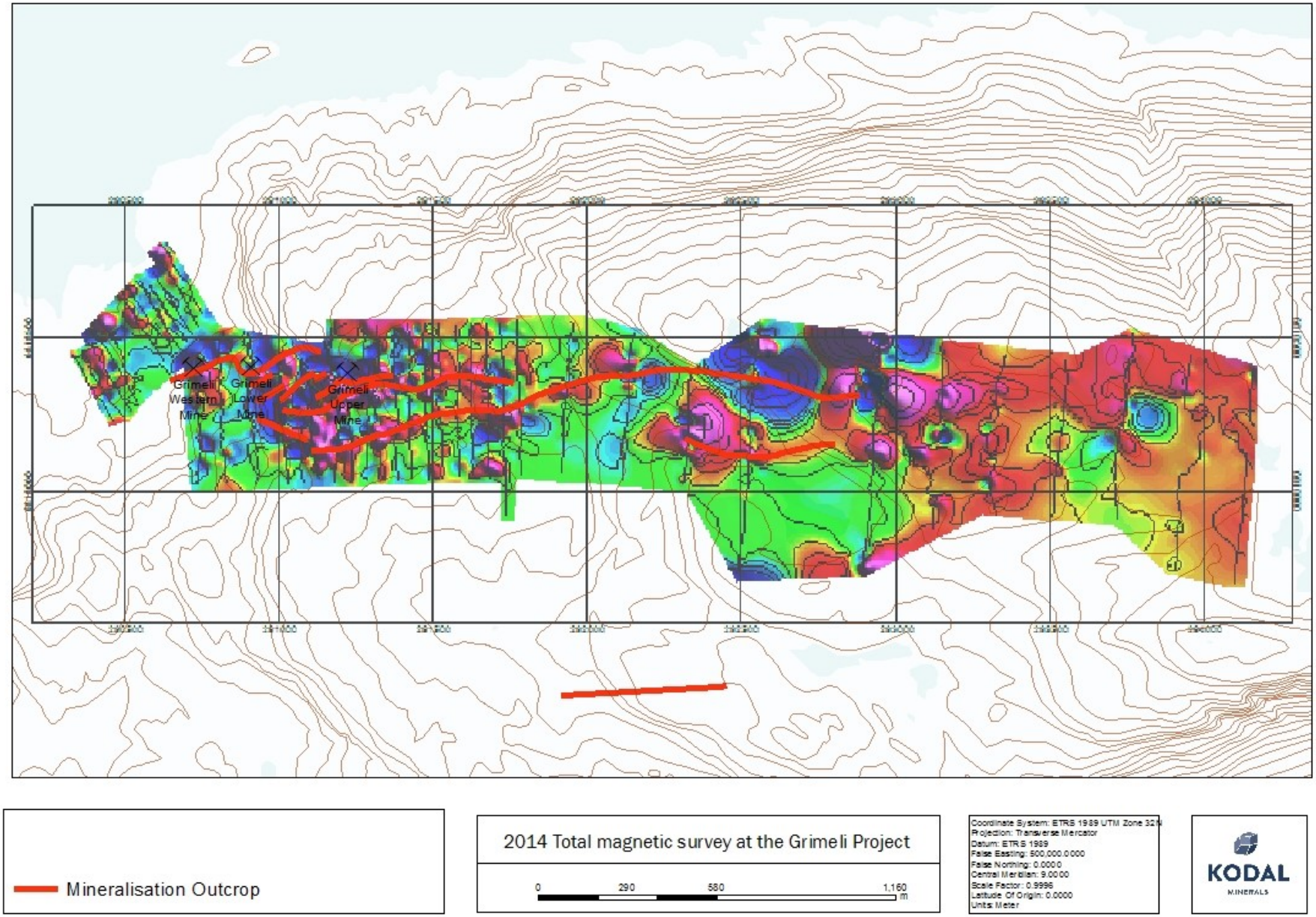


Figure 5: total magnetic signature at the Grimeli project

Surveying

The company surveyed the site, including the underground workings using 3D laser scanning techniques. The 3D scans completed are attached with the submission of this report as a DXF file. Work was conducted using a series of base points set up around site, these were surveyed using a DGPS, a scanning total station was used to traverse into accessible parts of the workings to scan wherever possible.

From this work Kodal minerals was able to ascertain the dip and approximate extent of previous workings in order to direct drilling to ensure that drill holes were designed to intercept mineralisation outside of these areas.

Sampling Underground

Initial work was to test the accuracy of historic mining reports of grades and widths achieved during operations. In order to do this, the company sampled a number of pillars remaining in the mine. Once access was gained, channel samples were cut systematically where possible or in remaining pillars where not. Samples were 50mm wide, 30mm deep and full width of the existing excavation. The length of the channel along with the bearing and orientation were also recorded. Assaying was completed by SGS laboratories using a combination of ICP methods.

Table 2 shows the abridged results from the underground sampling. The most significant results being found at the Grimeli Upper Miner (GU) with 1.75m @ 7.24 % Cu, 1.02 m @ 4.89% Cu and 0.5m @ 4.19% Cu. The results from Vagendal also yielded moderate copper grades along with previously unreported amounts of Zinc.

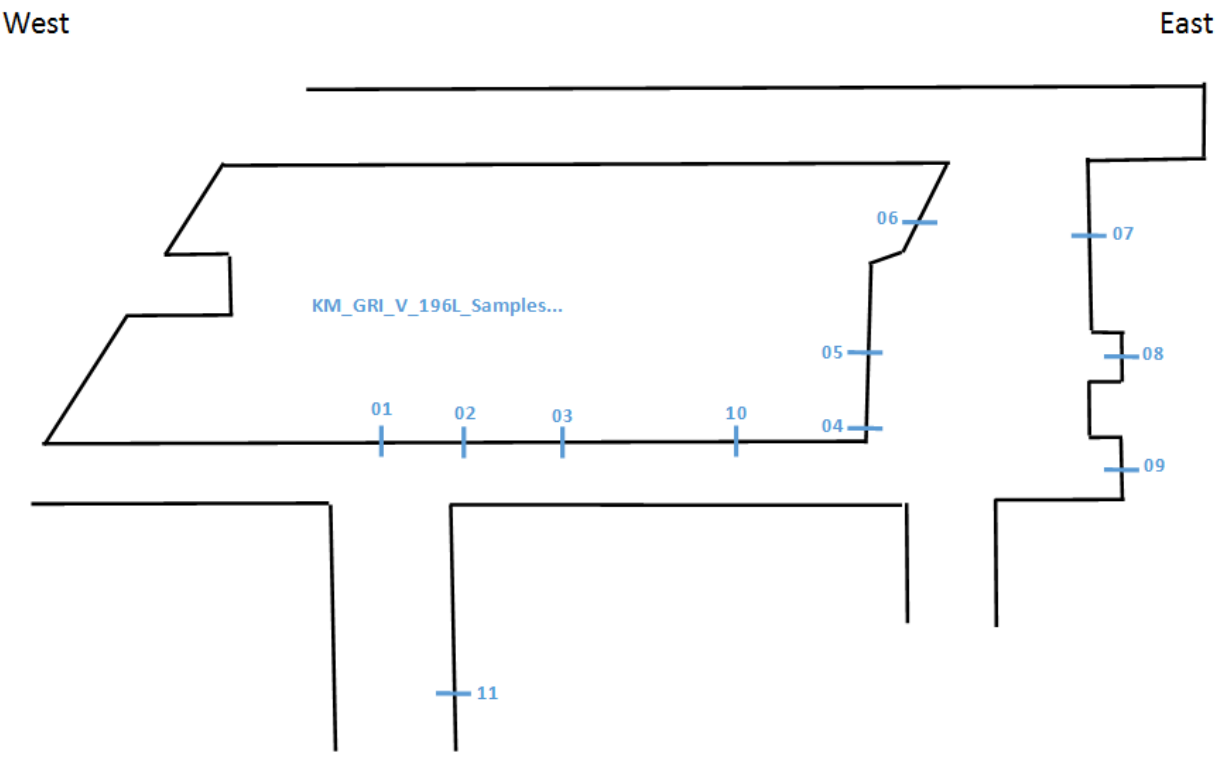


Figure 6: diagram detailing location of Vagendal samples on mine long section

Figure 7: Photograph from Grimeli Upper Mine with typical Channel sample. 170 RL sample KM_GRI_GU_170_19

Table 2: abridged assay results from channel sampling at the Grimeli Project, Location Codes, VA = Vagendal, GL = Grimeli Lower, GU = Grimeli Upper

					Measured			Cu	Zn	S
								AAS42S	AAS42S	CSA06V
								0.001	0.001	0.005
								%	%	%
Location	Level	Number	Lateral	Vertical	Length	Bearing	Dip			
VA	196	1	15.3	2.3	1.43	170	60	1.39	2.52	16.5
VA	196	2	21.7	2.5	1.18	190	53	1.51	1.69	10.9
VA	196	3	26.9	2.5	1.25	192	80	N.A.	N.A.	6.84
VA	196	4	32.3	2.2	1.05	190	80	2.39	1.75	15.4
VA	196	5	33.7	6.9	1.55	190	80	1.15	2.7	22.8
VA	196	6	36.2	10.3	1.4	190	66	1.4	4.21	19.4
VA	196	7	41.7	9.7	1.46	190	48	1.49	2.57	21.1
VA	196	8	45	6.3	0.86	190	50	1.05	2.4	14.1
VA	196	9	42.65	3.1	1.03	190	75	2.07	2.85	19.3
VA	196	10	29.7	2.5	1.5	190	80	2.92	2.12	14.5
VA	196	11	16.5	-2.6	1.25	190	58	N.A.	1.57	10.7
GL	57	12	13E	0	0.96	325	25	4.93	N.A.	NVL
GL	57	13	2W	0	0.86	325	35	4.7	N.A.	>40
GL	40	14	41E	2.6	0.95	325	25	N.A.	N.A.	NVL
GU	150	1	80	1.8	0.35	170	80	N.A.	N.A.	14.8
GU	150	2	84.5	1.59	0.34	162	80	N.A.	N.A.	6.15
GU	150	3	91.4	1.8	0.74	170	58	N.A.	N.A.	9.3
GU	150	4	95	1.8	0.87	185	52	N.A.	N.A.	5.09
GU	150	5	100.3	1.75	0.81	150	55	N.A.	N.A.	6.41
GU	150	6	110	1.5	0.95	150	80	N.A.	N.A.	5.28
GU	150	7	115	1.5	0.93	145	60	N.A.	N.A.	N.A.
GU	150	8	157	1.6	0.3	155	50	N.A.	N.A.	N.A.
GU	150	9	170	1.17	0.66	180	85	N.A.	N.A.	N.A.
GU	150	10	172	2.3	1.19	115	35	1.43	N.A.	10.2
GU	150	11	172	2.7	1.02	115	46	4.89	N.A.	34.2
GU	150	12	172	7.1	0.935	115	53	3.73	N.A.	16.6
GU	150	13	172	9.5	1.4	115	48	1.83	N.A.	9.41
GU	150	14	172	13	1.75	115	47	7.24	N.A.	26
GU	150	15	166	10.5	0.7	115	46	2.45	N.A.	22.1
GU	170	16	48	2.4	0.44	180	60	N.A.	N.A.	N.A.
GU	170	17	55	1.38	0.74	145	74	1.07	N.A.	6.9
GU	170	18	94	-3.3	0.5	110	60	4.19	N.A.	28.5
GU	170	19	98	3.55	0.86	110	37	N.A.	N.A.	14.5
GU	170	20	110	4.4	0.88	165	65	1.65	N.A.	9.24
GU	170	21	110	7	0.87	165	65	N.A.	N.A.	7.24

Drilling

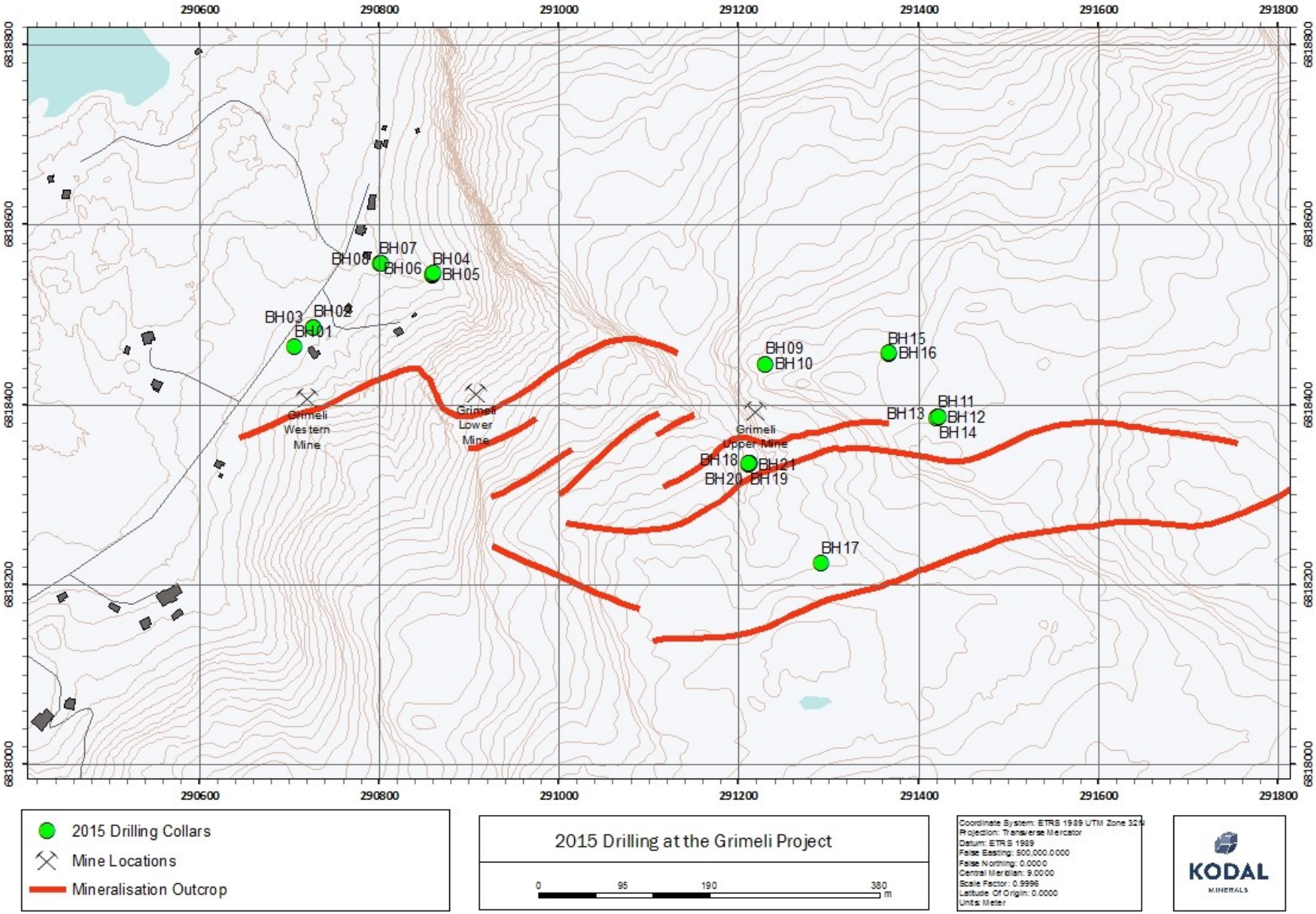
Following positive results from the underground sampling, the company began planning a drilling program to further explore the site. The aims of which were as follows;

- Test the down dip extension of the known mineralisation at the Lower, Main and Western mines at Grimeli. Second to this test lateral extent of mineralised horizons.
- Test the additional geophysical targets identified by the NGU's 1980's geophysical campaign.

Drilling began in February 2015, a total of 2000m of diamond core drilling was budgeted with the campaign to be flexible in terms of drilling targets as more information was gathered from initial drilling information. Access and a limited number of topographically suitable drilling platforms largely dictated where drilling was collared.

Table 3: Summary of drillholes completed at Grimeli Project 2015

BHID	Collar Coordinates			Azimuth	Dip	Hole Depth	Intercept depth
	Y	X	Z	Degrees	degrees	meters	meters
BH01	6818464.28	290706.81	37.5	140.415	-55.5	63	40
BH02	6818486.028	290727.856	36.538	155.43	-54.58	65	45.34
BH03	6818486.028	290727.856	36.538	155.43	-79.82	67.9	44.25
BH04	6818544.4	290859.75	44.27	189.83	-53.91	151.81	68.28
BH05	6818544.7	290859.35	44.38	224.6	-77.75	82.7	70.89
BH06	6818546.7	290861.86	44.53	89.47	-69.98	92.47	71.53
BH07	6818557.169	290801.406	34.3	214.32	-76	128.59	-
BH08	6818557.27	290802.901	34.351	149.76	-52.81	80.1	73.55
BH09	6818445.08	291230.549	229.1	183.16	-63	116.1	-
BH10	6818445.337	291230.805	229.024	179.2	-83.19	113.2	-
BH11	6818385.54	291421.923	244.012	149.64	-54.75	91.6	-
BH12	6818386.04	291421.662	243.929	149.74	-85.17	44.4	-
BH13	6818385.65	291420.73	242.97	188.43	-56.26	58.82	-
BH14	6818386.69	291423.16	243.99	128.96	-56.24	52.79	-
BH15	6818456.829	291367.162	239.202	165.61	-55.99	109.91	-
BH16	6818457.318	291368.37	239.196	136.96	-56.14	106.89	-
BH17	6818223.66	291292.36	208.81	154.03	-55.18	103.78	-
BH18	6818334.501	291212.627	192.401	146.32	-55.18	128.5	-
BH19	6818335.172	291213.576	192.379	123.62	-55.55	109.3	-
BH20	6818334.185	291211.912	192.593	179.62	-55.41	110.6	-
BH21	6818334.524	291212.238	192.606	147.16	-75.98	126.5	-


290600
290800
291000
291200
291400
291600
291800
6818800
6818600
6818400
6818200
6818000
BH01
BH02
BH03
BH04
BH05
BH06
BH07
BH08
BH09
BH10
BH11
BH12
BH13
BH14
BH15
BH16
BH17
BH18
BH19
BH20
BH21
Grimeli Western Mine
Grimeli Lower Mine
Grimeli Upper Mine
2015 Drilling Collars
Mine Locations
Mineralisation Outcrop
2015 Drilling at the Grimeli Project
0
95
190
380
m
Coordinate System: ETRS 1989 UTM Zone 32N
Projection: Transverse Mercator
Datum: ETRS 1989
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 9.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
KODAL
MINERALS

Sampling and Procedure

Sampling of drill core was conducted anytime sulphide mineralisation exceeded 2% and was extended at least 2 metres beyond any mineralised intercept. Samples were crushed on site and reduced using a fiffle splitter before being dispatched to SGS laboratories. Analysis was by ICP-OES and Atomic Absorption after acid digest where higher grades were required. Duplicates of all samples were produced and are stored on site. A suitable quantity and variety of QAQC samples were also submitted as part of the sampling procedure.

Full details of the procedures adhered to are contained within the appendix in the Standard Operating Procedures (SOP's) numbered 1-12. A JORC Table 1& 2 is also appended.

Results

From the 2000m of drilling two style of mineralised intercepts were identified, firstly massive sulphide intercepts in the rage of 60 – 100% sulphides, these were typically 0.5-1m thick and were the focus of the historic mining activities in the area. Second to this were disseminated horizons found within the ophiolite stack. These were often found to extend over 20m+ with 0.5 – 5% sulphide minerals. The sulphides were typically pyrrhotite and pyrite and were found to contain no significant economic importance however they are potentially the lateral extent of massive sulphide horizons outside of the heavily mineralised zone and may be used in the future to target horizons in future work.

Borehole 1-6 and 8 all intercepted mineralisation concordant with massive sulphide mineralisation while the remaining holes hit disseminated mineralisation or no mineralisation. It was generally found that the massive sulphide horizons have a lateral and vertical extent less than 200m and likely for the majority of horizons less than 100m but that these are stacked and offset so that many horizons may be present.

The most promising results have come from BH04 and BH05 which follow mineralisation below sea level in the vicinity of the river below the waterfall. Further drilling should continue exploring the extent of this horizon and other horizons along the foreshore area.

Kodal Minerals interpret these massive sulphide horizons as being formed in situ on spreading sea floor, the deposit and mineralisation are similar to the Lokken the deposit in age and genus. To date the size of the massive sulphide lenses discovered have not reached the same size as Lokken, further structural interpretation and geophysics will help better understand the deposit and aid the conclusion whether this site presents the opportunity to host a deposit of this scale.

Table 4: Details of significant intercepts from the 2015 Grimeli drilling program

BHID	Collar Coordinates			Azimuth	Dip	Hole Depth	Intercept From	Intercept To	Intercept Length	Cu	Zn
	Y	X	Z	Degrees	degrees	meters	meters	meters	meters	%	%
BH01	6818464	290706.8	37.5	140.415	-55.5	63	40	41	1	0.26	2.44
BH02	6818486	290727.9	36.538	155.43	-54.58	65	45.34	46	0.66	0.17	0.61
BH03	6818486	290727.9	36.538	155.43	-79.82	67.9	44.25	44.75	0.5	4.29	6.98
BH04	6818544	290859.8	44.27	189.83	-53.91	151.81	67.31	68.28	0.97	6.39	0.82
BH05	6818545	290859.4	44.38	224.6	-77.75	82.7	70.38	70.89	0.51	4.92	0.82
BH06	6818547	290861.9	44.53	89.47	-69.98	92.47	70.45	71.53	1.08	0.21	0.15
BH08	6818557	290802.9	34.351	149.76	-52.81	80.1	73.55	74.03	0.48	2.77	1.1

Conclusion

Kodal minerals have proven that the mineralisation mined at Grimeli was of a grade to be economically interesting at current prices and that a massive volcanoclastic sulphide style mineralisation is present within the ophiolite of the Grimeli peninsula. Both copper and zinc are present in sufficient concentrations to warrant the investigation.

Drilling has proven that additional mineralised horizons are present within the vicinity of the historic mining that were never discovered during the time of operation and that ground based geophysics can partly help to identify the location of these mineralised horizons.

The drawback of magnetic survey information is that near surface features have been identified preferentially over massive sulphide and that it does no differentiate between massive sulphide horizons and the disseminated horizons.

Further Work

Further work should look closely at the properties of the different styles of mineralisation and consider how the massive sulphide horizons can be successfully identified, this is likely to use airborne methods such as VTEM or SKYTEM.

While there is evidence for disseminated mineralisation over a strike length in excess of 8km massive sulphide horizons are focussed in the area of the historic Grimeli workings and further massive sulphide horizons have been identified here. Additional un explored magnetic signatures have been identified in the foreshore area and early drilling should look to explore these to help better understand the controls on massive sulphide mineralisation to be applied to the whole project area.