GLANDORE

Background information:

Mine District: West Cork

Mine Name: Glandore

Alternative Names:
Aghatubrid

Elements of interest:
Mn, Cu

Project Prefix: AGH-

County:	Townland:	Grid Reference:
Cork	Aghatubrid Beg	E122216, N36243

Geology and Mineralization

The Cu-Ba mines of West Cork are hosted by the Old Red Sandstone succession of the Munster Basin. The sediments of the Munster Basin were deposited in a half graben and subsequently uplifted and folded into eastnortheast-trending anticlines that now comprise the rugged peninsulas of the southwest corner of the island. The Glandore mines were known principally as manganese mines, the only significant Mn mines recorded in Ireland (Cole 1922), but copper was also raised. The mineralization is hosted by the Toe Head Formation which is faulted against the Old Head Sandstone Formation and The Castlehaven Formation. Kinahan (1884) describes the ore as angular quartz breccia cemented by hematite (Fe_2O_3) and later manganese (pyrolusite (MnO_2)), possibly a capping to a quartz-barite-chalcopyrite ($CuFeS_2$) lode (Reilly 1986).

Production and Mining History

High concentrations of Cu were known by 1810 to occur in peat in a small bog in the Glandore area (Reilly 1986). The peat was burnt for cupriferous ash between 1812 and 1816, producing 262 tons of 10-15% Cu ash. The Main Lode was discovered in 1840 and opencast mining of Mn began. This lode was approximately 5m wide and 43m long and dipped steeply south. In 1869 a copper lode was discovered below the Mn mineralization but only around 70 tons of Cu ore was sold (Reilly 1986). Further Mn mining took place on a small scale between 1876 and 1882 and again in 1908-1909 (Cole 1922). Altogether, around 18,000 tons of Mn and 1,000 tons of Fe ore were raised during the life of the mine (Reilly 1986).

Site Description and Environmental Setting

The Glandore mine site is located on the side of a small hill between Glandore harbour and the village of Leap, 6 km west of Roscarbery. The surrounding land is used mainly as pasture for cattle and horses. Several new detached houses have been developed in recent years along the small road that runs past the mine site.

The site itself is centred on the shell of the engine house and the large open pit beside and to the south of it. A private house is located immediately to the east of the engine house. The engine house is an impressive structure, with an intact chimney. Its bob wall faces the open pit; a poorly fenced, collapsed shaft close to it is presumably the engine shaft. No trace was found of several other shafts marked on old plans - Reilly (1986) shows the approximate locations of as many as six shafts. The most significant of these was the Copper Shaft, sunk in 1869 after discovery of the copper lode. It was located east of the open pit and intersected the deep adit 36m below the surface (Reilly 1986). Along with the other shafts that lay outside the area of the open it, it has been filled in. The open pit itself is made inaccessible by thick, impenetrable overgrowth.

The mine is drained by the deep adit, which runs along a line from the Copper Shaft to the open pit and thence northwest (Fig. 1). Its mouth is close to the small stream that runs through the floor of the valley at the base of the hill on which the mine site is situated. The adit has now partly collapsed and its mouth is obscured by brambles and vegetation. A small flow of mine water discharges from the adit (photo, left).

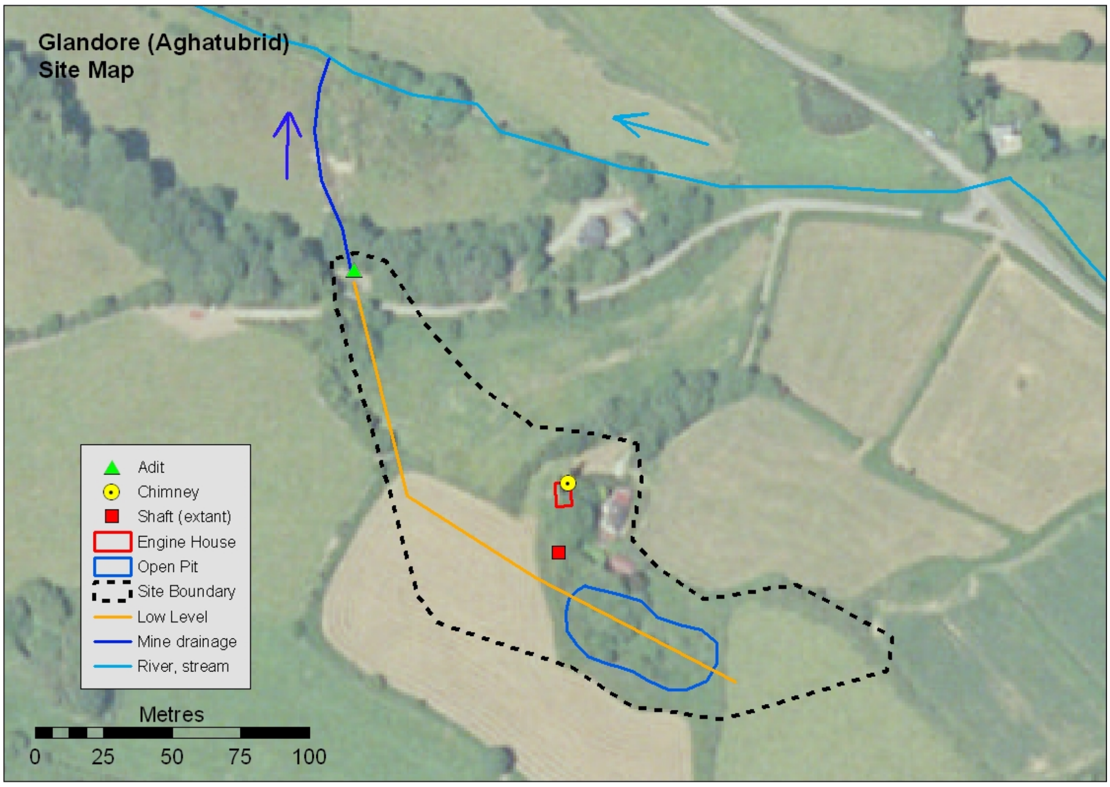

Fig. 1 Glandore: mine features

Geochemical assessment

1. Surface water

Three surface water samples were taken at the Glandore site. The adit discharge was sampled in summer 2007; upstream and downstream samples were taken from the stream in the valley floor in summer 2008. Only dissolved metals were analysed in the 2008 samples. The adit discharge had elevated concentrations of total metals including Cu (215 µg/l), Ni (20 µg/l), Al (551 µg/l) and Fe (589 µg/l). Dissolved metal concentrations were generally much lower except for Cu (210 µg/l). The limited data for the stream water upstream and downstream of the adit discharge suggest some impact from the mine water on the downstream sample (Table 1), particularly in the case of Cu, for which the measured concentration of 47 µg/l in the downstream sample exceeds the Draft EC (Surface Water) limits. The high Mn concentration in the downstream sample might be considered consistent with contamination from the adit discharge given that Glandore was primarily a manganese mine. However, the Mn concentration of the adit discharge was low when sampled in summer 2007. It is possible that the different sampling periods may explain discrepancies. Equally, the high Mn concentration of the downstream sample may reflect influences other than the adit discharge.

Table 1 Water analyses, Glandore (dissolved metal)

ug/l	Cu (diss)	Mn (diss)	Ni (diss)	Pb (diss)	Zn (diss)
Adit	210	13	4	<1	<1
u/s	1	<1	<1	2	3
d/s	47	395	3	4	6

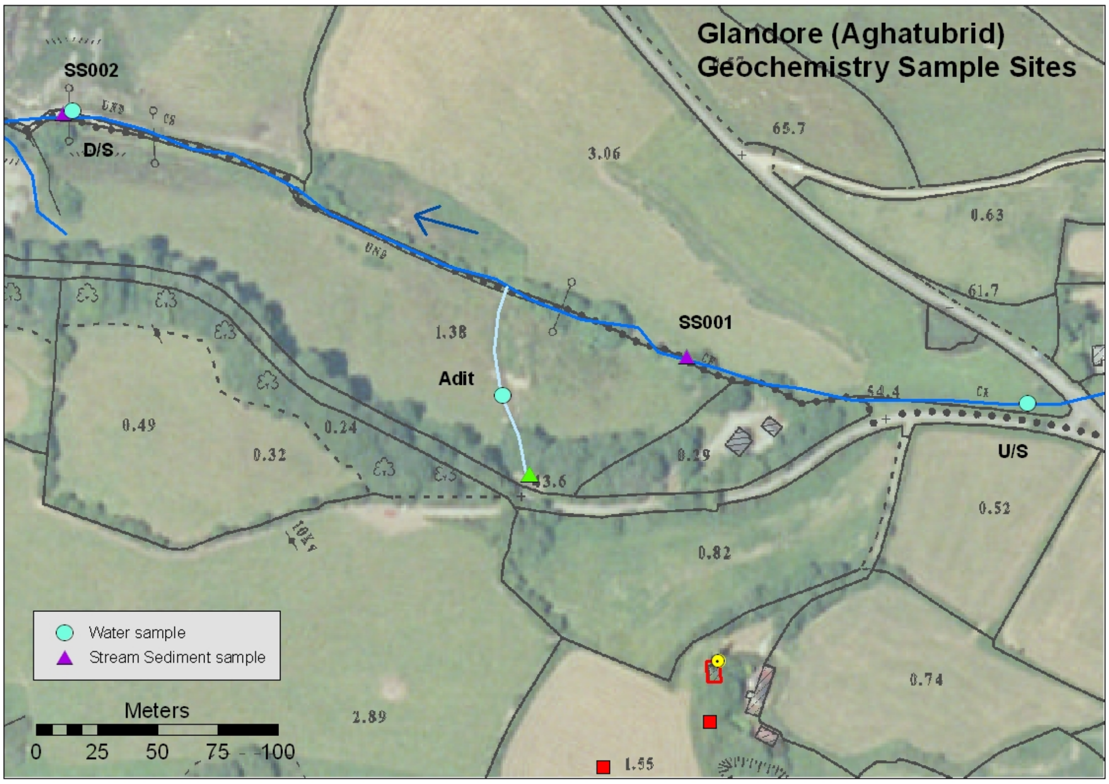

Fig. 2 Glandore Geochemistry sample sites

2. Groundwater

No groundwater samples were taken at Glandore. Leachate testing was not carried out at Glandore as no solid waste was found on the site.

3. Stream sediments

Two stream sediment samples were taken at Glandore, one upstream and one downstream of the adit discharge. Elevated concentrations of Cu, Mn, Pb, As and Ni were measured in the fine (<150 µm) fraction of the sediment (Table 2) in both samples. Moreover, the upstream sample had higher measured concentrations of some elements than the downstream sample, notably Mn, Pb, As and Ni. This suggests that the upstream sample is probably contaminated by mine waste, although the possible source of this is unknown as no evidence was apparent in the field for any mine waste in the vicinity of the upstream sample site. The site was chosen because the stream is very small upstream of the adit discharge and there was a difficulty in finding a site with sufficient sediment. The stream channel in the vicinity of the downstream sample site has been reworked in recent years (photo, above right), as part of drainage works, and some bank material has been deposited in the stream bed. This could have altered the composition of the stream sediment, by diluting any possible mine waste influence.

Table 2 Steam sediment chemistry, Glandore

mg/kg	Cu	Mn	Pb	Zn	As	Ni
u/s	2109	70066	329	91	149	313
d/s	2253	15264	109	40	70	90

Regardless of the relative compositions of the upstream and downstream samples, it is clear that there is significant contamination of stream sediments at Glandore by both Cu and Mn, the main metals mined on the site. The measured concentrations of both are well in excess of guideline limits for protection of livestock (100 mg/kg for Cu and 5,000 mg/kg for Mn).

4. Solid waste

No solid waste was found in at Glandore.

5. HMS-IRC Site Score

The total HMS-IRC Site Score for Glandore is 6. Both surface water and stream sediments show significant contamination downstream of the mine, particularly by Cu. However, the lack of any significant concentrations of high-relative toxicity elements in the sediments or water as well as the absence of significant concentrations of solid waste limits the site score. The stream sediments make the largest single contribution to the score, hence the dominance of the Direct Contact (livestock) pathway (55%).

Table 3 HMS-IRC Site Score, Glandore

Waste	Adit Discharge	Stream Sediments	Total
1. Hazard Score	9	8	17
2. Pathway Score			
Groundwater	1.12		1.12
Surface Water	1.60		1.60
Air			
Direct Contact			
Direct Contact (Livestock)		3.29	3.29
3. Site Score	**3**	**3**	**6**

6. Geochemical overview and conclusions

Glandore was a significant producer of Mn in the 19th century and also produced a very limited amount of Cu. The workings were mainly carried on by opencast but exploratory underground workings were undertaken and the mine is now drained by a deep level. The opencast is densely overgrown and no solid waste was identified on the site. The adit discharges around 1 l/s of mine water with elevated Cu concentration (215 µg/l). Stream sediments in the adjacent river have high concentrations of both Mn and Cu, in excess of guideline limits for the protection of livestock, that are most likely a consequence of mining.

References

Cole, G.A.J. (1922) Memoir and Map Localities of Minerals of Economic Importance and Metalliferous Mines in Ireland. *Memoirs of the Geological Survey of Ireland*.

Kinahan, G.H. (1884) Notes on some Irish crystalline iron ores. Sci. Proc. Roy.Dub.Soc., 4, 306-317.

Reilly, T.A. (1986) A review of vein mineralization in SW County Cork, Ireland. In Andrew, C.J, Crowe, R.W.A., Finlay, S., Pennell, W.M. and Pyne, J.P. *Geology and genesis of mineral deposits in Ireland*, Irish Association for Economic Geology (Dublin), 475-480.