

Introduction

The Grum deposit is located 11 km southeast of the Faro mine and milling complex. The Grum is the next deposit to the southeast from Faro in a string of five known large stratabound pyritic zinc-lead-silver-(barite) deposits of the Anvil Range, Yukon (Figure 1). Taken together, these deposits contain one of the world's largest reserves of lead, zinc and silver. The Grum orebody will become the third open pit mine in the district and will eventually become the sole source of millfeed to the Faro concentrator once the Faro and Vangorda Pits are exhausted and before the Dy underground mine is developed.

History

The Grum deposit was discovered in 1973 by AEX Minerals in joint venture with Kerr Addison Mines. Discovery resulted from a drill test of a gravity anomaly in an area down fold plunge from the Vangorda deposit and in line with both the Firth showing and the Faro deposit to the northwest.

Surface drilling in 1973 and 1974 indicated a significant deposit. In 1975 and 1976 Kerr Addison Mines carried out an underground drilling and sampling program consisting of fan drilling on 61 metre sections with some intermediate holes drilled to define the high grade core of the deposit. At the same time, further surface drilling was carried out to further define near surface horizons.

Kerr Addison sold the deposit, along with Vangorda and Swim, to Cyprus Anvil Mining Corporation in 1979. From 1980 to 1982 Cyprus Anvil drilled additional holes in and around the deposit and relogged, resampled and reassayed all existing Kerr Addison drillholes.

Curragh Resources Inc. acquired the assets of Cyprus Anvil Mining Corporation in late 1985 and reopened the Faro mine and milling complex in early 1986. Additional surface diamond drilling programs were carried out in 1987, 1988, 1989 and 1991 to further delineate reserves in the early phases of Grum development and to provide sample for metallurgical testing. Several drillholes in the 1989 program were targeted to test the lower grade "Champ" horizon in the southwest portion of the deposit. The Champ Zone is not included within the current ultimate pit design.

Since the deposit's discovery in 1973, a total of 333 surface diamond drillholes and 218 underground diamond drillholes totalling 86,313 metres of drillcore have now been drilled in the vicinity of the Grum deposit. These projects have yielded 12,099 samples all assayed for lead, zinc and silver. Many of the samples were also assayed for gold, total and soluble iron, copper, barite and pulp S.G. Prestripping of the deposit has been sporadically carried out beginning in 1988. To date, a total of 7.5 million tonnes of glacial till and waste rock has been removed.

General Geology

Stratigraphy and Lithology

The Grum deposit is a stratiform, sediment hosted, sulphide deposit consisting of five or more distinct, highly contorted horizons of massive and disseminated pyritic sulphides. The sulphide horizons are hosted by phyllites within a 150m thick stratigraphic interval at the transitional contact of the Vangorda and Mt. Mye formations (Figures 2, 3 and 4).

At Grum, the Vangorda formation consists of soft, highly fissile, calcareous phyllite (unit 40) interlayered with metabasite (unit 44), noncalcareous phyllite and carbonaceous phyllite (unit 30). Metabasites in the Grum area are minor and tend to be highly foliated chlorite phyllite rather than blocky, massive greenstones that typify the Vangorda formation elsewhere. The basal carbonaceous member of the formation is well developed at Grum. It thickens across the deposit from about 10m in the northeast to as much as 80 or 100m southwest of the deposit. On a regional scale the sulphide horizons appear to be spatially associated with the northeast pinchout of this unit. Immediately above the main ore horizons the carbonaceous rocks are soft, highly sheared and gouged but elsewhere they are moderately hard, highly fractured, black siliceous phyllites.

The underlying Mount Mye formation also consists of soft phyllites (unit 20) which are distinguished from those of Vangorda formation by being noncalcareous and less distinctly banded.

The most important ore horizon occurs immediately beneath the basal carbonaceous member of the Vangorda formation and has been named "main horizon". The main horizon consists of both an upper upright and lower overturned limb of a large scale phase one northeast verging anticline. There is another, less important, low grade horizon named "Champ Zone" of dominantly disseminated sulphide lithofacies. This horizon occurs above the main horizon and is generally thin except where it thickens dramatically in highly attenuated phase two fold hinge zones. A third important horizon, particularly in the lower phases of the Grum pit, is the "upright panel horizon" so named because it is stratigraphically and structurally upright. The upright panel occurs entirely within upper Mount Mye formation. This horizon shares many similar characteristics of the main zone of the Vangorda deposit. Its similarities include the presence of a well developed essentially barren semi-massive sulphide base grading abruptly up into high grade massive pyritic/baritic sulphides at the top of the horizon. The upright panel is distinctly different from the other sulphide horizons of Grum in that it has a thick, well developed alteration or "bleached" phyllite and sulphide stringer zone below the semi-massive base. The intensity of alteration is similar to the alteration developed beneath the main zone at Vangorda.

There are several other less important, thin, intermediate horizons within the

Mount Mye formation which generally quickly pinch out and are not continuous over significant strike intervals.

There are no significant post metamorphic dykes at Grum. The Anvil Batholith outcrops 1.5 km northeast of the deposit but is separated from it by major faults. The batholith is unrelated to the deposit and does not appear to have significantly affected it.

Structure

The ore layers at Grum are contorted into a complex, shallowly northwest plunging, polyphase fold structure. The prominent 'S' shaped folds are second phase structures. They are superimposed on a larger 'Z' shaped first phase anticline-syncline pair. The dominant plane of fissility (S_2) in the phyllites at Grum is axial planar to the second phase folds and dips shallowly (10° to 30°) generally to the west or southwest. This fissility is a major factor in assessing slope stability for a Grum pit. The overall deposit elongation parallels the axial direction of the second phase folds (315° trend/ 11° plunge).

There are several important faults at Grum. The largest displacements occur on moderately (35° - 45°) dipping structures that truncate the deposit at both its northwest and southeast ends. Neither of these structures would be exposed in an open pit but smaller related, subparallel faults will likely occur within the pit. A series of subparallel 060° to 080° trending faults dipping steeply to the northwest have resulted in apparent dip slip displacements ranging from 5 to 30 metres. Movement along these faults appears to have been oblique slip with a significant horizontal component of displacement. Underground mapping has located a myriad of smaller faults and joint systems of similar orientation. Diamond drilling by itself cannot resolve displacements on these smaller fault systems and will not be suitable for predicting short term ore release. Diligent ongoing pit mapping will be required to "fine tune" the geological interpretation to minimize surprises in short term ore production.

Predating the 060° trending faults is a steeply southwest dipping fault which cuts the high grade massive sulphide at the top of the main horizon and downdrops it to the southwest. This fault is important because it has resulted in unusual microtextures in sulphides due to high strain along the fault zone. A bulk sample collected underground by Kerr Addison Mines within this fault zone contained unusually abundant middling textures and proved to be metallurgically difficult. Oxidation has penetrated more deeply along this fault and effected the adjacent sulphides.

A poorly understood major shallow southwest dipping fault is interpreted above the upright panel oriented near parallel to S_2 . There is no physical evidence of the fault in drillcore and is interpreted based on structural and lithological inconsistencies across it.

Surficial Geology

The subcrop of the ore deposit is covered by up to 100m of morainal material (tills) and better sorted glaciofluvial silts, sands and gravels. These unconsolidated sediments are water saturated and may contain pockets of permafrost. The northeast wall of any pit designs at Grum must contend with thick sections of these sediments. Dewatering in advance of stripping may help increase stability substantially as well as simplify operations in the pit.

Deposit Geology and Sulphide Lithofacies

As with other deposits in the Anvil Range a given ore horizon at Grum tends to have a massive sulphide upper and central portion and a quartzose, disseminated sulphide lower and peripheral portion. The horizons can be up to 30m thick but are mostly 15m or less thick. Grade is strongly partitioned into massive, particularly baritic, sulphides. The tops of the horizons tend to be high grade and the bottoms lower grade (except of course where the horizons are overturned). The sulphide horizons are separated by significant thicknesses of barren phyllite. Interfaces between ore and waste tend to be sharp at the stratigraphic hanging wall contact against barren phyllite and gradational both at the footwall and laterally against sulphide waste.

Grum, like Vangorda and Dy, has several characteristics that distinguish it from Faro. In large part this is due to the lower metamorphic grade the deposit has reached. The most outstanding difference between Grum, along with all other Vangorda Plateau deposits, and Faro is the form of the deposit. The Vangorda Plateau deposits consist of several distinct, highly contorted horizons separated by barren phyllite waste. Faro on the other hand is essentially one thick horizon in overall outline with lesser internal phyllitic waste but substantial barren sulphide internal waste banding. This implies that dilution by phyllite will be higher at Grum than at Faro. Faro however contained considerable internal sulphide waste thus its dilution is higher than might appear at first glance. It is none the less inescapable that Grum has more potential dilution and will have more complex mining problems than Faro. On the positive side, the dilutant at Grum will be more commonly easily identifiable phyllite rather than lower grade sulphides as at Faro. Experience at Faro shows that phyllite dilution is much easier to control than low grade sulphides.

The next most obvious difference is that the massive sulphides have a finer grain size and more complex mineral intergrowth, necessitating finer grinding than Faro ores. Also, a feature unique to Grum among the Vangorda Plateau deposits, is the relative abundance of quartzose ore types, particularly carbonaceous pyritic quartzites which comprise about 50% of total projected millfeed. This ore type is harder than massive sulphide and will undoubtedly place greater demands on the grinding circuit to achieve liberation of sphalerite and galena grains. The carbon content of this ore type is

significant. Extensive bench scale test work however, has not indicated that the carbon poses a metallurgical difficulty.

Ore Types

Disseminated carbonaceous (Unit 2)

Unit 2 is dark grey to black, moderately hard to very hard, well banded, sulphide bearing, carbonaceous locally micaceous quartzite. Compositional bands usually range from 1mm to 2cm thick. They are dark grey to black, fine grained locally micaceous quartzite interbanded with light grey to locally red-brown quartz-sulphide bands. Pyrite is usually the dominant sulphide species with lesser sphalerite and galena. Locally, base metal sulphide, particularly light reddish-brown sphalerite are dominant. Locally, pyrrhotite replaces pyrite but is only a minor constituent overall. Carbon content is normally within the ¼ to ½ % range and generally occurs in thin coatings concentrated on thin cleavage surfaces (S1 and S2 surfaces). Chalcopyrite occurs locally in traces as small blebs within sulphide bands and fractures.

Total sulphide content is variable from 15% to 30% and may locally range up to 60%.

Unit 2 rock types are more abundant than any other ore facies at Grum and constitute 53% of the millfeed in the I.V. stage 1 pit and 40% of the I.V. ultimate pit millfeed.

Disseminated noncarbonaceous (Unit 3 & 4)

Unit 3 is light to medium grey, moderately hard to locally very hard, usually well banded generally well foliated, micaceous, pyritic quartzite. The unit is texturally and mineralogically similar to Unit 2 except that carbon is less abundant. Banding is commonly less well developed and sulphide bands in the high grade ore are characteristically redder in colour and contain less pyrite than Unit 2. Unit 3 feed grade is slightly higher grade and gold content is slightly elevated over Unit 2. At Grum, contacts with Unit 2 are commonly gradational over a few feet making a "clean" separation of these ore types at a mining scale difficult.

Unit 3 rock represents 14% of the millfeed from both the I.V. stage 1 and the I.V. ultimate pit.

Unit 4 is a low grade variant of Unit 3 with contained lead + zinc less than 4%.

Massive Sulphide (Unit 5 and 7)

Dominant rock type of this composite is massive pyritic sulphide (Unit 5) which may locally contain up to 10-30% barite (Unit 7). Massive sulphides consist of banded to homogeneous, usually weakly foliated fine grained massive pyrite +/- barite with lesser sphalerite and galena. Total sulphide +/- sulphate content is at least 60%, generally greater than 80% and commonly near 100%. Gangue consists of quartz, muscovite, chlorite, +/- carbonates (calcite, dolomite, ankerite, siderite). Accessory minerals include pyrrhotite, magnetite, chalcopyrite, arsenopyrite and marcasite.

Massive sulphide ore types are the highest grade at Grum and represent 33% of the millfeed from the I.V. Stage 1 pit and 37% of the millfeed from the I.V. Stage 3 pit.