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CMJ feature

Exploration and development

Kerr Addison's Grum deposit: Exploration in the Yukon's Anvil Range

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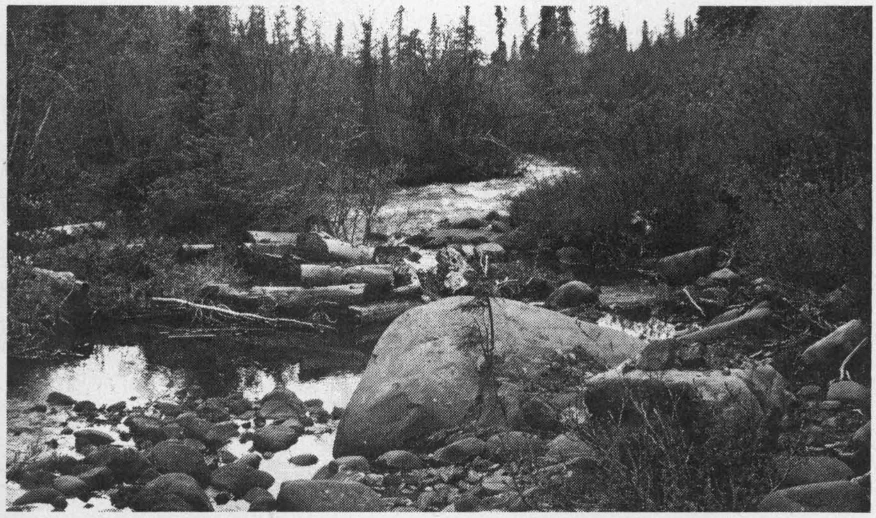
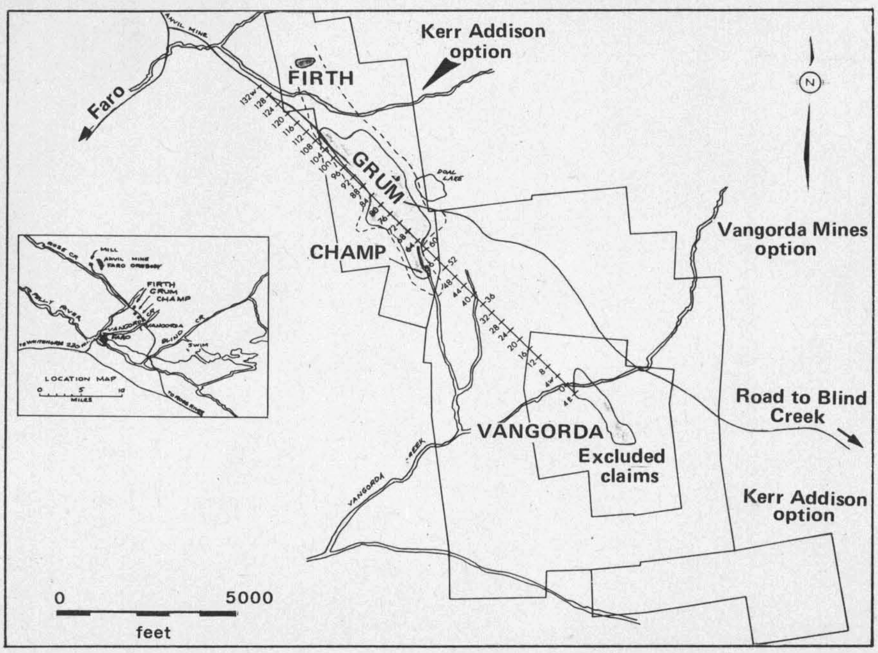
In the twenty year span between 1954 and 1974, four strata-bound stratiform lead-zinc-silver deposits have been found in the Anvil Range District in South Central Yukon Territory. While this is essentially a paper on the history and preliminary geology of the Grum deposit, the history becomes more interesting when it is related to the chronological sequence of events.



Vangorda Creek gossan was first staked by Al Kulan in 1954



Kerr Addison's property map of the Vangorda Creek area

The deposit is located in South Central Yukon Territory, 120 air miles northeast of Whitehorse, 40 miles northwest of Ross River and 10 miles southeast of Cyprus Mines' Faro deposit.

The first important lead-zinc discovery in the area was staked by prospector Al Kulan on behalf of himself and his associates in 1954. This was on Vangorda Creek, 1½ miles southeast of the Grum deposit. The Vangorda property was optioned to Prospectors Airways who, under the direction of Ted Chisholm, carried out extensive geophysical and geochemical surveys, followed by a large scale drilling program. The deposit is estimated to contain 9.4 million tons of 8.16 per cent combined Pb-Zn and 1.76 oz of Ag.

Following the Vangorda discovery, Kerr Addison staked a group of claims on the northwest side of the Vangorda property and exploration of these claims resulted in the discovery of two small mineralized zones which were called the Champ and Firth deposits. These were considered too small to be important at that time.

In 1963, Kerr Addison discovered the Swim Lakes deposit 10 miles southeast of the Vangorda property. The Swim Lakes discovery was made by a combination of airborne magnetics and gravity surveys. Estimated tonnage is 5 million tons of 9.5 per cent combined Pb-Zn and 1.5 oz of Ag.

In 1965, the Dynasty Syndicate and Cyprus Mines discovered the Faro deposit, estimated at 63 million tons of 9.5 per cent combined Pb-Zn and 1.5 oz Ag, by doing follow-up geochemistry and geophysics on a claim block previously held by Prospectors Airways in 1954. This was originally known as the Gal group. The Gal group has been staked on the basis of a piece of mineralized float and a transported gossan.

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In 1973, the Grum deposit was discovered by the AEX syndicate by drilling the area between the Champ and the Firth zones on the Kerr Addison claims north west of Vangorda.

The Grum deposit occurs on the west flank of the Anvil batholith in a regionally metamorphosed sequence of cambrian sediments and volcanics. Apart from doming the intruded rocks, the batholith does not appear to have played any significant role in the development of the four known lead-zinc deposits in the area. Regional metamorphism and plastic deformation in pre-Devonian time converted the former sediments into folded phyllites ranging in metamorphic rank from green schist to amphibolite facies.

Later deformation in the area is dominated by the Tintina Trench, which is a northwesterly trending trans-current wrench fault with a right lateral displacement of 250 miles. The earliest movement is now believed to be late Triassic and the latest post-Cretaceous.

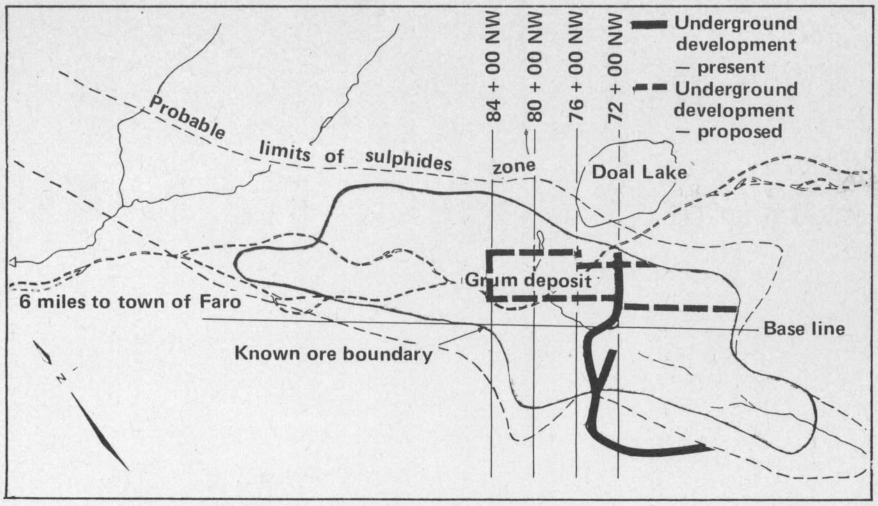
Featureless map

The original ground magnetic map of the Grum deposit area was somewhat featureless except in locations such as at the Champ and Firth zones where there were fairly distinct anomalies caused in part by magnetite in massive sulphides. An untested circular feature occurs on L72 west at 400 south and another in the area east of Doal Lake where calc — silicate rocks or skarns are the probable cause of the anomaly.

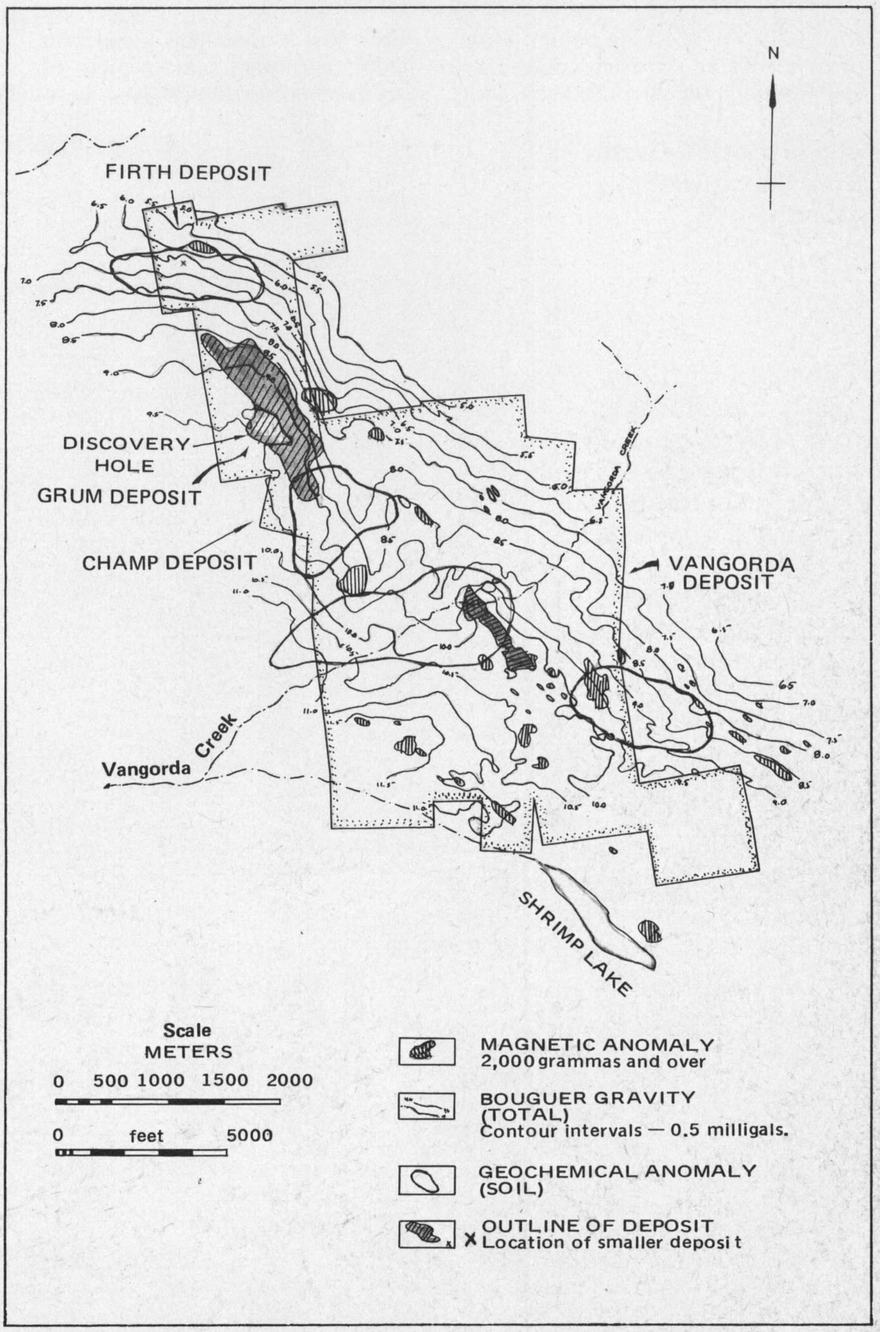
The anomalies over the Champ and Firth zones, if left to sink or swim on their own merits, would, because of their limited size, scarcely cause much of a ripple in the overall evaluation of the magnetic map, except that in the case of the Firth zone, which is on the granite-phyllite contact, some skarn might reasonably have been suspected in ignorance if nothing else.

The first gravity survey in the Anvil Range was done by Duncan Crone in 1954. This outlined the Vangorda deposit very well indeed. Only a few small kinks occurred over the Champ and Firth zones but these, in addition to magnetics, may have aided in Prospectors Airways' decision to drill those areas.

In the re-evaluation of Kerr Addison claim holdings in the Anvil Range in 1965, a residual gravity map of the general Doal Lake area was constructed and outlined a low amplitude (0.4 milligals maximum) anomaly extending 1100 metres northwestward from the Champ zone which outlined the Grum deposit with reasonable accuracy, but no follow-up drilling was done at that time. The residual anomaly does not show the north edge



Plan of the mineralized zone and underground workings of the Grum deposit



Surface map showing geophysical and geochemical anomalies

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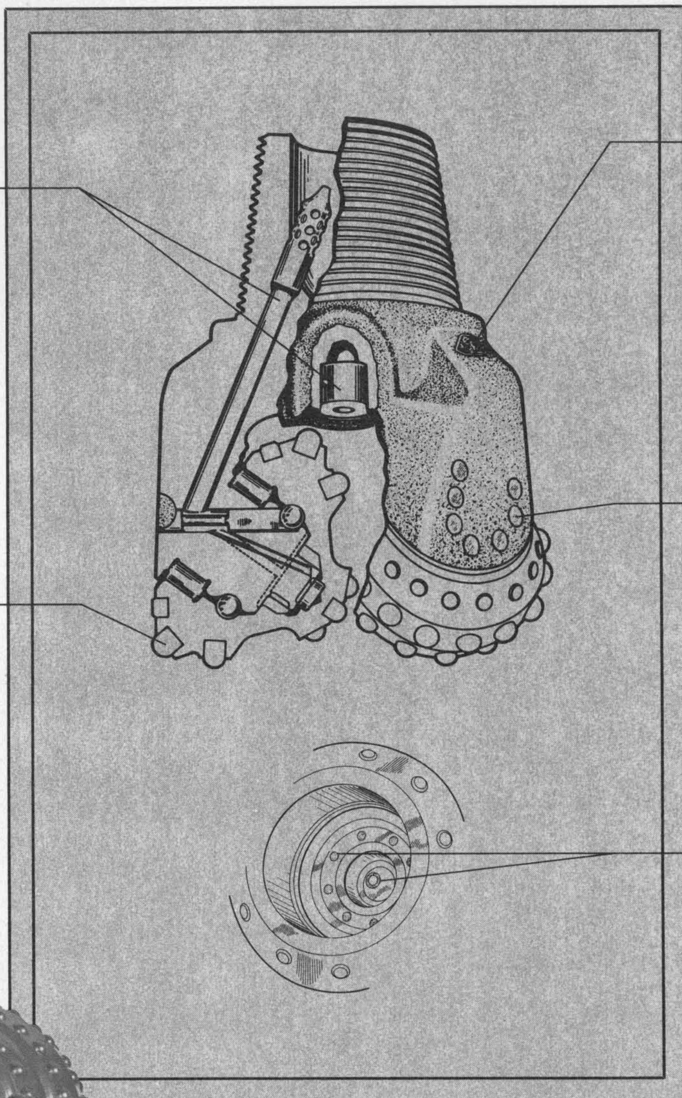

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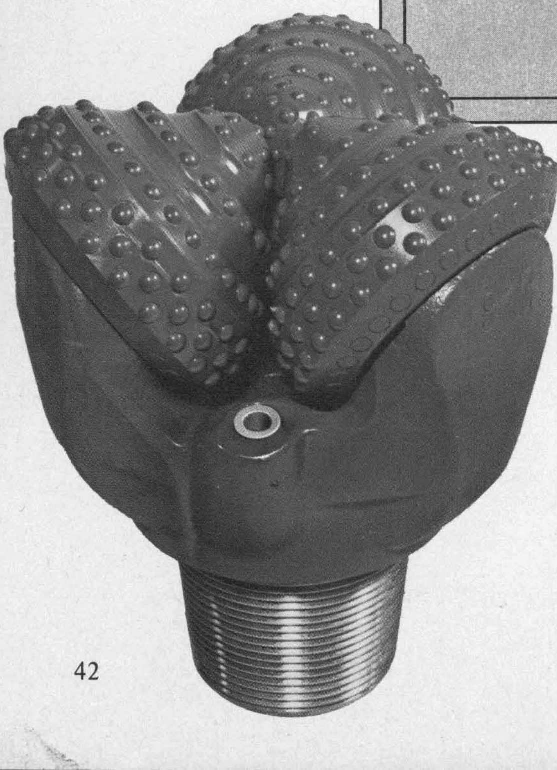

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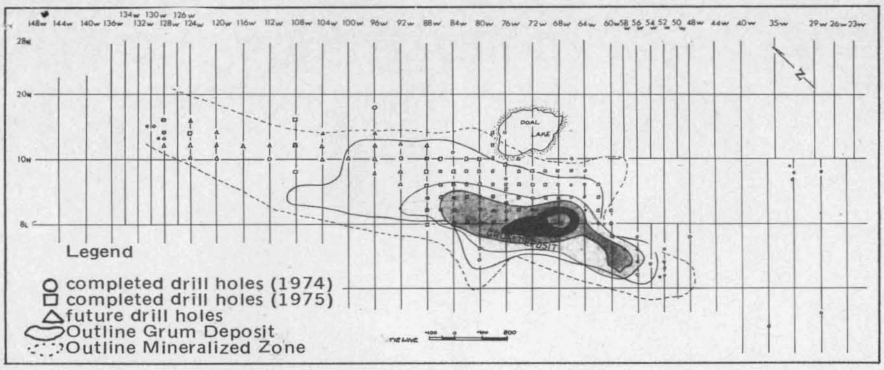


Residual gravity map that outlined a low amplitude anomaly extending 1100 metres northwest from the Champ zone. When first drawn in 1965 it outlined the Grum deposit with reasonable accuracy

of the deposit because that flank is not composed of massive sulphides. Similarly, the residual map does not show the total extent of the deposit northwestward because of the 10° plunge in that direction.

In the early 1950's, Bloom's cold citrate procedure for heavy metals was very much in vogue and Prospectors Airways used this technique over the Grum deposit area. While we do not have the details of this work, at least two distinct anomalous zones were found: one covering the Champ zone and dispersing downhill, and another extending eastward from the Firth zone.

Agreement concluded

There is a long broad geochemical fan extending southwestward from the northwest end of the Vangorda deposit and still another geochemically anomalous zone at the southeast end.

Some of this work was post Vangorda discovery so it is not known if any of it was used as an exploration guide, but the geochemical results could certainly be considered positive criteria.

In July 1973, an agreement was concluded between the AEX syndicate (now Canadian Natural Resources) and Kerr Addison Mines for additional exploration work by the syndicate in and around the Champ and Firth deposits. In August 1973, a Turam survey covered the area of interest and delineated the position of some of the graphitic phyllites.

Diamond drilling commenced in September under the supervision of Dr. Aaro Aho and diamond drill hole No. 4 encountered 5.79 metres of 17.5 per cent Pb-Zn and 3.85 oz Ag. Since then, more than 30 000 metres of surface diamond drilling and 18 000 metres of underground drilling have been completed.

Early in 1975 a program of underground work was contracted to Canadian Mine Services of Vancouver. This consisted of a 16 per cent decline, 4.3 metres in cross section, 805 metres long, designed to reach a point 200 metres below the surface. From the end of the decline, 2 ramps, 120 metres apart and 600 metres long were driven down the plunge of the mineralized structure. From these ramps, 4 cross cuts on 60 metre centres connected the 2 ramps and provided a cross sectional view of the mineralized structure. This work was completed in the fall of 1976.

The underground program provided a base from which detailed drilling was conducted on 60 metre centres along the ramps. In addition, the underground work made it possible to examine ground support problems and to determine continuity of the mineralized structure.

Rocks over-lying the Grum massive sulphide deposit are calcite — chlorite — sericite phyllites, underlain by sericite and sericite chlorite phyllites which in turn are underlain by graphitic phyllites which sometimes, to the chagrin of the mining engineer, form the hangingwall of the deposit.

In the footwall are the chlorite sericite biotite phyllites which are locally in fault contact with underlying biotite garnet staurolite rocks. In other words, the hangingwall rocks are dominated by calcareous chloritic, sericitic and graphitic units and the footwall by biotite phyllites and higher ranking garnet staurolite rocks. A white bleached phyllite occurs as a partial halo around the sulphides but this we consider to be an alteration phenomenon rather than a separate rock unit.

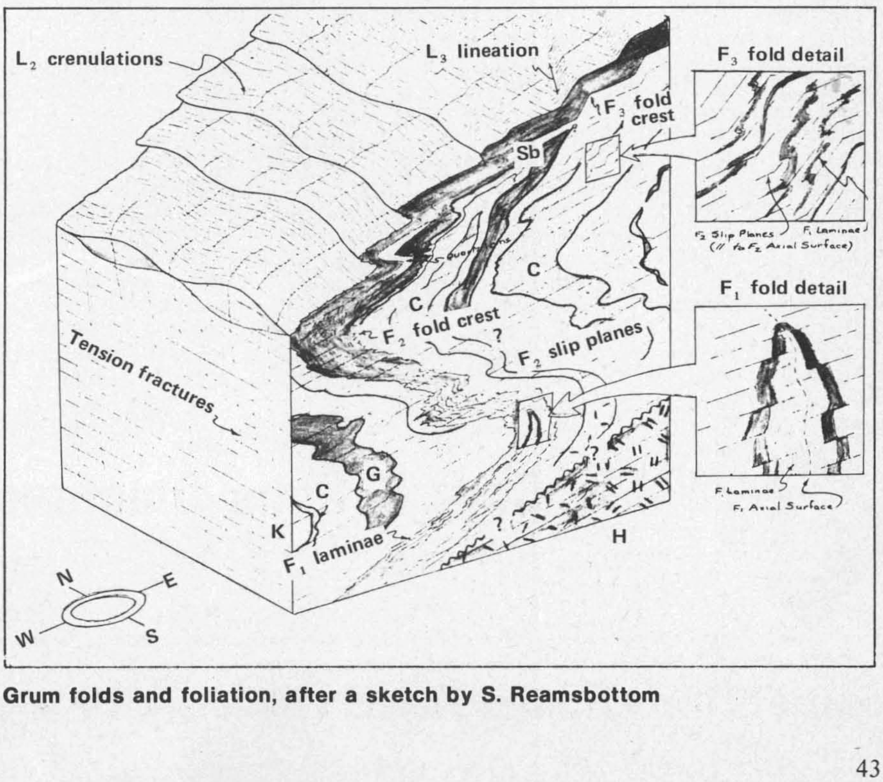
Description of deposit

The deposit consists of at least two and possibly three bands of massive sulphides and quartz sulphides which have been folded into a northwesterly plunging structure, more or less sigmoidal in cross section and having a down-plunge length of at least 1 200 metres, a width of 300 metres and a vertical amplitude of approximately 300 metres. Each sulphide band has a massive hangingwall underlain by a thicker mass of quartz sulphides.

The sulphide bands are dominantly pyritic and envelop lead-zinc mineralization varying from a metre to more than 30 metres in thickness. The average might be 10 metres.

In plan, the structure trends perhaps 10° west of north but plunges N40°W at −10°.

For mineral inventory purposes, we have divided the sulphides into two categories, massive sulphides, and quartz sulphides. The massive sulphides have a total sulphide content of 50 - 75 per cent, and may be divided into compositionally banded, porous, pyrite rich and brecciated varieties. These massive sulphides usually carry the highest lead-zinc values (say 10 - 30 per cent combined lead-zinc) in the



Grum folds and foliation, after a sketch by S. Reamsbottom

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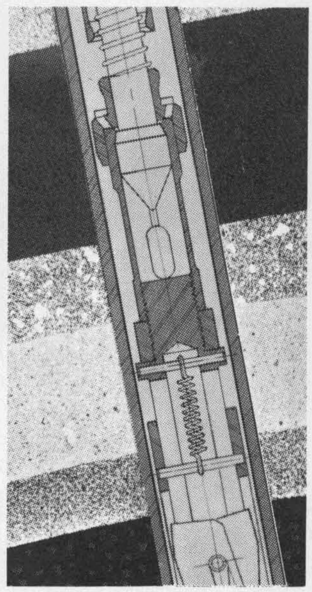

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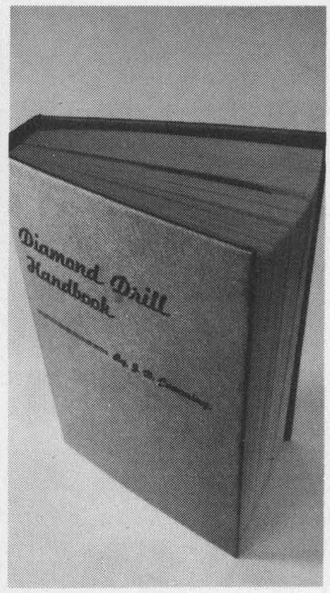

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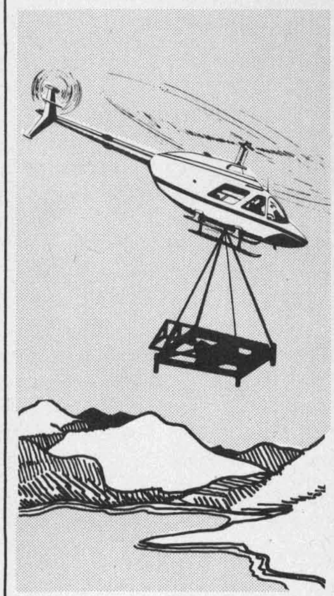

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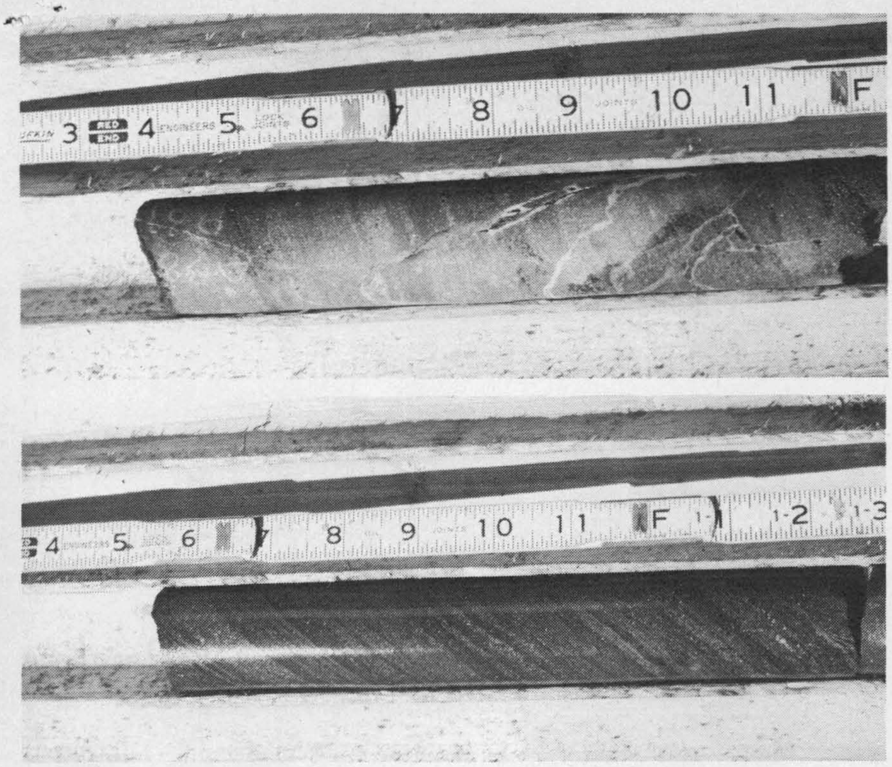

Drill core showing compositionally banded sulphides, top, and pyrite rich sulphides

form of bands, stringers and disseminations or some combination of all three. Quartz sulphide varieties are banded, granulose and foliated in which the lead-zinc values are generally lower than in the massive sulphides.

In addition to pyrite, sphalerite and galena, pyrrhotite, chalcopyrite magnetite and barite occur sporadically throughout the deposit with barite accompanying some of the higher grade mineralization.

Three stages recognized

We recognize the following three stages of deformation which took place during regional metamorphism in pre-Devonian time:-

(1) Isoclinal folding (F1) of what may be original sedimentary compositional banding (So).

(2) Re-folding of the F1 isoclines into large recumbent and similar folds and the development of secondary foliation (F2). The compositionally banded rock layers are transposed along the F2 foliation planes in the manner of minute thrusts. To some extent this is also true of sulphide layers but, being more massive and competent, the sulphide layers exhibit flow lines or shattering or both. It has been suggested that whether a massive sulphide layer shatters or flows would be in part a function of the base metal sulphide content of that layer, but we are not really able to corroborate that suggestion at this time. Perhaps it is simply a function of confining pressures. We do know that in the folding process, sulphides are squeezed in some instances into tension fractures, almost normal to the sulphide layer, and there has been some tendency to remobilization of base metal sulphides into fractures in massive pyrite. We have evidence too that some of the sulphide mineralization has been transposed into the secondary foliation layers (F2). In fact, some thick massive sulphide bands are parallel to F2, but this is a function of the sigmoidal or S-shape of some of the folds wherein the top and bottom of the fold will parallel the foliation and the remainder will be cross cutting.

(3) The third event was the development of small kink folds on the F2 foliation surfaces and the warping of these surfaces into broad gentle antiforms and synforms.

Fault patterns

The wrinkle lineation (L2) produced by the intercept of F1 and F2 is parallel to the major fold axes and plunges gently northwest. The coarse wrinkle lineation (L3) which accompanies kink folding is transverse to major fold axes.

The most striking fault phenomenon is the thrust at the bottom of the mineralized zone which separates the normal green schist facies from the higher ranking biotite-garnet-staurolite rocks. On the southeast end of the deposit, at the Champ zone, this thrust is indicated by mylonite in at least three drill holes. Mapping U/G indicates max. shear at N 40°W parallel to the Tintina Trench and N 30° - 40° E, more or less parallel to Vangorda Creek. This would indicate maximum stress from the north.

The most prominent and significant alteration on the property is a white bleached phyllite forming a partial halo around the mineralization. This appears to form at the contact between the mineralization and the enclosing rocks except where those rocks are graphitic phyllites. It is very hard to do anything with graphite. We have not done any thin section work on the bleached phyllites, but under the hand lens they seem to be composed mostly of quartz and muscovite and possibly some Kaolin.

We think the deposit falls into the category of a distal volcanic exhalative deposit formed during quiet sedimentation in a basin wherein the conditions varied from aerobic and anaerobic. In consequence, there were black muds interspersed with clay members and sulphide deposition appears to have taken place (at least in the case of the Grum) at the facies change between normal clays and black organic members. Each mineralization pulse appears to have been preceded by the deposition of tuffaceous (?) material which is now metamorphosed to a chlorite-phyllite.

Suffice is to say that the content of volcanic debris seen in most of the Anvil Range deposits and the tendency of these deposits to have limited extent, is highly suggestive of some form of volcanic origin.

Of the four known deposits in the area, only Vangorda was exposed at the surface. The other three were discovered by some combination of geophysics, geochemistry and diamond drilling. Of the various methods used, gravity proved to be the most positive method having outlined all four deposits pre- or post-discovery.

What lies ahead? The use of essentially the same tactics plus a much better understanding of geology and structure which, in our case, has been greatly aided and abetted by underground work on the Grum deposit. Given a reasonable amount of exposure, we can now place ourselves a little closer to the proverbial "needle in the haystack". **CMJ**

This paper was originally presented to the 45th annual meeting of the Prospectors and Developers Association.