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SAMATOSUM DEPOSIT

DISCOVERY, GEOLOGY AND GENESIS

Presented to the Vancouver Mineral Exploration Group

January 13th, 1988

I.D. Pirie & A.J. Davidson

Slide L MINNOVA Inc

R SAMATOSUM DEPOSIT

The Samatosum deposit (Sam to it's friends) is a precious metal rich volcangenic massive sulphide deposit discovered by Minnova during the summer of 1986. In the next half hour or so, I would like to present to you a brief history of the discovery, a summary of the geology and mineralogy of the deposit and offer some thoughts on it's genesis. I will emphasize at this point that this data is preliminary and that a great deal more work must by done before we fully understand the processes involved if, indeed, we ever do.

Slide L. Location (BC Map)

R. Same

The Samatosum property is located in couth central B.C. some 200km NE of Vancouver, 60km north of Kamloops.

Slide L. Minnova's properties

R. blank

More specifically it is located in the Johnsom lake area some 25km due east of the town of Barriere. Access is by the Squaam Bay road from Barriere and then by one of an extensive network of logging roads or alternatively from the Trans-Canada highway east of Chase. The Samatosum property is shown here in red.

Slide L. Adams Plateau

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It is on what is called the Adams Plateau, a peneplain which sits at around 5000-6000' with valleys dipping down to 1500' as shown here, with Adams Lake in the centre.

Slide L. Topography

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Topography is locally steep, the relief on the cliffs shown here being 3000'.

Slide L. Rolling topography

R. blank

but it is generally just pleasantly rolling, moderately timbered and totally accessible due to the extensive network of logging roads.

Slide L. Alpine topography

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The only true Alpine terrain is confined to isolated granite massifs which may rise to 10,000'.

Slide L. Samatosum property

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The property itself straddles fairly easy terrain between 3000 and 5000 feet on Samatosum Mountain - hence the name. Samatosum is an old Shuswap Indian name meaning "Lookout" - a term we take to refer to the view rather than a warning of impending doom.

Slide L. Rainbow

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Minnova first became interested in the property in October of 1983 while driving through Barriere!

Slide L. Discovery MS

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We were actually conducting reconnaissance in the area. An outcrop of massive sulphides found by a local prospector after the area had been logged, and subsequently optioned by Rea Gold Corporation, assayed 1.32 opt Au, 7.3opt Ag, 2.6% Cu, 3.2% Zn, 7.8% Pb and about 11% As over 10.5 feet. This was to become known as the Discovery Zone.

A deal was struck and two drills moved immediately onto the property. The first seven holes were all drilled to shallow depths beneath and around the Discovery zone. None of them intersected any massive sulphides.

Hole 8 did hit 2.5m of massive barite and half a metre of massive sulphides some 300m up the hill but this proved to be the only significant hit of the first 20 drillholes. However, exploration continued to depth and along strike on the mineralised horizon and by the end of 18 months or so two high grade but small and metallurgically difficult massive sulphide pods, one with associated massive barite, had been outlined.

Slide L. Brokers at Discovery

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No matter how many groups of brokers we took up the hill, we just couldn't seem to make the situation any better --- in fact, we were seriously depleting the reseves with every visit!

At this point a renegotiated deal saw Rea Gold assume control of a small concession immediately surrounding the known mineralization in return for Minnova's increased interest in the rest of the property. Rea continued to explore the Discovery area concession and their latest estimate of the mineralization there is around 250,000 tons of .2opt Au.

After the renegotiated deal, our interest at Minnova turned to other targets on the property.

Slide L. Property geology

R. blank

Hole 35 almost 3000' deep drilled close to the southern boundary of the property to test the Discovery Zone or Rea herizon at depth had intersected stratiform mineralization grading 5% Zn, 1% Pb, .5% Cu, and 30g/t Ag over 15cm high up in the hole where it wasn't expected. The intersection correlated quite well with a Max Min conductor which had been traced well to the NW across Johnson Creek. Along much of its length there were noisey values in Pb, Zn and Ag in the soils (at least until break in slope), this was in contrast to the Au, As anomalies associated with the Rea horizon. We started to test this new horizon and immediately beqan to qet some modest encouragement. Hole 37 intersected 4% Zn and 600q/t Aq over 0.5m, Hole 44 hit 3.5m of massive barite running 164g/t Ag and Hole 55 hit a couple of m of barren but fairly massive pyritic sulphides. By early 1986 we had tested this silver horizon at 100-150m intervals for over 2.6km with the exception of a 400m gap where access was relatively touqh because of steep and rocky terrain. However, in July of '86 we succeeded in diqqinq a pad out of the cliff face for hole RG 64 and it obliged us by intersectinq 1m of 2700g/t Aq [79 opt], 3.8g/t Au, 9.3% Cu, 7.8% Zn and 6.9% Pb. We thouqht we miqht be onto somethinq!

Slide L. G+T

R. blank

73 holes later we had established a mineral inventory of 600,000 metric tonnes grading 1100g/T Aq [32 opt], 1.8g/T Au [0.05], 1.2% Cu, 3.5% Zn and 1.7% Pb. This is undiluted and uses a 250g/T [7oz] cut off. A recently completed drill program included another 20 or so holes in and around the deposit and has confirmed these reserves.

GEOLOGY

Slide L. EBF Geoloqy

R. blank

The Samatosum Deposit is hosted by rocks of the Paleozloc Eagle Bay Formation. This slide shows the Eagle Bay geology in very general terms.

It is bounded to the east by metasediments of Proterozloc age and to the west by Permian age Fennell basalts. The slide shows only a part of the formation. It continues to the north beyond the Cretaceous granodiorite known as the Baldy batholith and to the south-east on the other side of Adams Lake.

The age of the Eagle Bay is not well defined with a possible spread from Cambrian through to Mississippian.

The four principal rock groups are labelled A to D with A being oldest, D youngest. A is made up predominantly of mafic volcanics - mainly pryoclastics with minor flows and intrusions. Near the base, these volcanics are interbedded with limestones and are themselves vary limey. Higher in the stratigraphy cherts, argillites, various types of wacke and fine conglomerates are more common.

B is also composed of interbedded volcanics and sediments, but in this case the volcanics are mainly intermediate to felsic flows and pyroclastics, the sediments mainly mudstones and siltstones.

C consists almost entirely of sediments, many of them coarse clastics up to quartz pebble conglomerates, with only minor high TiO_2 basalts.

Finally, D, the youngest group, is mainly argillite.

With a little armwaving it is not too hard to picture an original mafic volcanic pile being uplifted rapidly, felsic volcanism associated with the uplift, rapid deposition of coarse clastic sediment and then relative quiescence as the basin redevelops.

The Samatosum deposit sits at a mafic-sediment contact on the transition from mafic to felsic volcanism. That is - at the onset of rapid uplift and rifting.

Slide L. Geology Plan - Property Scale

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Examining the geology of the property in more detail we see a NW-SE striking NE dipping volcano-sedimentary sequence progressing from the Tshinikan limestone in the east, through mafic volcanics, sediments and chert, then more mafics and sediments eventually to felsic volcanics in the west. All evidence suggests that units in this area are overturned, thus the limestone is the oldest unit on the property, the felsic volcanics youngest with a major synclinal axis to the south. Metamorphic grade is sub-greenschist.

What this simplified geology fails to show is the intense folding present especially in the sediments. Being less competent, they have folded isoclinally while the basalts have deformed brittly. Axial planar shearing along the very tight isoclinal folds has resulted in numerous essentially bedding parallel faults developing.

Slide L. Geology Plan - Sam

R. Legend

Zooming in to the Sam/Discovery area we can see that it is quite complex in detail. The Samatosum deposit is shown here, projected to surface. The Discovery, 98 and 97 lenses here, here and here. What we believe we are seeing is the same mafic-sediment transition repeated by a combination of faulting and folding. Although in differing proportions, the principal rock types - mafic pyroclastics, cherts, muddy tuff and sediments - are identical in character in the two packages. The only real difference is the occurrence of a thin andesite unit at the Discovery zone.

The next slide is a cross section in which we are looking to the northwest which is to the left along section A-A.

Slide L. Section

R. Legend

What we have, as I previously mentioned, is an entirely overturned sequence, therefore the stratigraphically oldest rocks - the footwall mafics - are on top. All units dip at 20 to 45 degrees to the NE. The sequence goes from mafic pyroclastics through sericitic tuffs and chert into a unit we call Muddy Tuff which is interlayered with sediments, and is host to the sulphides. The entire package is in fault contact with what is probably an older chert.

Slide L. Section

R. Mafic Pyros (1)

The footwall mafics are mainly pyroclastics, here seen with small block sized fragments of basalt in a matrix of darker colour but identical composition.

Slide L. Section

R. Mafic Pyros (2)

The frags are locally quite stretched. Mafic flows and pillowed flows have been found but are rare.

Slide L. Section

R. Mafic Pyros (3)

In this slide the piece of drill core at the top is of unaltered mafic lapilli tuff. A and B show progressive alteration through sericite-carbonate and minor chlorite to essentially a sericite-quartz schist in which the lapilli can still be made out.

Slide L. Section

R. Altered Mafics

This sericitic alteration is typical and generally occurs as a stratiform band at the stratigraphic top of - and up to 30 metres into - the mafics. To date no clearly cross cutting pipe-like alteration feature has been noted.

Slide L. Section

R. Chert

Here we see chert remote from mineralization. It is a well layered silica gel with tuffaceous and argillitic laminae. Locally it shows both primary and tectonic brecciation.

Slide L. Section

R. Chert/Sericitic Tuff

Elsewhere, and especially near mineralization, the sericitic tuff component of the chert increases markedly. It has been suqqested that these tuffaceous bands represent a felsic volcanic component. This may be true, but the bands are always too narrow to provide a discrete lithogeochemical sample with which to test this theory. Our experience has been that similar, thicker sericite-quartz schists on the property which appear quite felsic have, in fact, a distinctly mafic lithochemical siqnature. We suspect that detailed petrographic work will confirm a mafic origin to these too.

One other thinq I should point out in this slide is the stronq deformation which in not uncommon.

Slide L. section

R. Seds

Sediments vary from argillite to very coarse wacke, either interlaminated, as here, or in thicker beds. It is a graphitic argillite that provides the marker HEM conductor.

Slide L. Section

R. Muddy Tuff

The muddy tuff unit is somewhat difficult to define or typify. It is basically a garbage term to describe a mixture of tuffs and sediments including sedimentary debris flows, cherts, wackes and argillites which have been homogenized by sea floor hydrothermal activity soon after deposition to form a fairly uniform, muddy grey rock. It is only in local areas where hydrothermal activity has been less intense that the primary features show through the strong sericite alteration. It is also strongly mineralized.

Slide L. Section

R. Pyritic sulphides

Much of the mineralization takes the form of syngenetic to diagenetic pyrite. Here we see pyrite rosettes after marcasite. In the background you see homogeneous grey muddy tuff.

Slide L. Section

R. Massive Sulphides

Pyritic sections can be quite thick. This one was about 11m but ran only 3% Zn and 1-2 oz silver. You can see fragments and vague bedding.

Slide R. Bedded sulphides.

Locally bedded sulphides can be more exciting; this section shows tet-sp-cpy-gn and py and probably runs in the neighbourhood of 3000 g/T Ag

Slide R. Silica Flooding (1)

Here we see grey pyritic muddy tuff flooded by silica, light coloured sphalerite and dark tetrahedrite which doesn't show.

Slide R. Silica flooding (2)

Here again you can see the light sp and tet.

Slide R. Vuggy qtz

And again - this time cut by very late vuggy quartz which clearly is much younger and has nothing to do with mineralization. This type of material generally runs in the range 250-1000 g/T Ag and makes up the majority of the tonnage.

Slide R. QV ore

Deformation, probably in the Triassic or Jurassic, has remobilized some sulphides into quartz veins. Here massive tet with galena.

Slide R. QV ore

And here again massive galena, tet and sphalerite with quartz. These sections have returned values of up to 3.5% silver (35,000 g/T Ag or 1000 opt) and an ounce or so of gold. This quartz veining is distinctly different from the silica flooding shown in the previous slides. It is dominantly white bull quartz. By good fortune it also makes up most of the near surface portion of the orebody.

Slide R. Trench

Slide R. Trench

The deposit did not outcrop but has been exposed by trenching. On surface only remobilized material is present and, apart from some nice malachite and other secondary minerals, it's not too impressive -

Slide R. Broken ore

until you start to break some pieces open. Then the galena, tetrahedrite etc is quite apparent.

Slide L. Polished section

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Polished section work has shown that most of the ore is quite coarse grained - here sp-tet-gn - and should be easy to mill.

Slide L. Cp disease

Only minor zones may pose problems as with this chalcopyrite disease in sphalerite.

Slide L. Au in tet

Almost all the silver is in tetrahedrite and much of the Au a couple of grains of which are seen here. Other minor minerals identified include bournonite, chalcocite, arsenopyrite and an as yet unidentified sulfosalt.

Slide L. Thickness

R. Aq x thickness

In long section, shown here in the plane of the mineralization, the deposit appears to have a flat plunge. On the left are thickness contours RED > 9m, ORANGE >5m, YELLOW > 3m. The surface is to the upper left. Aq grade x thickness on the right shows the same. It is currently estimated that everthing to line 98 (point) will be open pittable. Unfortunately slope works against us precluding pitting the entire beast. Preliminary estimates suqgest that about 5m tonnes of waste will need to be recovered to mine 350,00 tonnes of ore, a stripping ratio of almost 15:1.

SLide L. 9850 Section

R. Legend

As for metallogenesis there are several clues in the sections. Going back to the section I showed you previously, we can see quite clearly that the chert thickens rapidly down dip.

Slide L. 9725 Sect.

R. Leqend

Moving 125m SE the same is true. This slide shows the considerable dip extent of pyritic semi-massive to massive sulphides but only the hatched area is ore.

Slide L. 9975 Sect.

R. Leqend

Moving 125m the other way - NW - the thickening of the chert is not so apparent but the seds have thickened substantially. As this happens the sulphides tend to become more disseminated with fewer concentrations to make ore grade.

Slide L. Model

R. Legend

If we reconstruct the geology and turn things back upright the model you can draw is of a topo high dropping off into a chert and muddy tuff filled graben in one direction, into a more sediment dominated basin in the other. Mineralizing solutions welled up along the graben boundary fault. Early mineralization was pyritic, forming both on the topo high and laterally out into the basin. Continuous sediment and tuff deposition didn't really give truly massive sulphides much chance to form but did allow preservation of what was being deposited. With time the chemistry of the mineralizing fluids changed most likely due to an increase in their temperature. They now carried base and precious metals in significant quantities. Instead of exhaling onto the sea floor they deposited their load into the still unconsolidated muddy tuff and sediments. Where silica had previously been carried to the surface and dumped as chert, it now precipitated out subsurface and produces silica flooding.

Pb isotope data indicate that all the mineralization came in at the same time, in the Devonian and thus concomitant with the host rocks. Deformation in the Triassic and later which overturned the sequence certainly remobilized some of the sulphides into quartz veins but no addition of Pb occurred.

The most likely tectonic setting for this style of mineralization and geologic model I have described is in a volcanic island arc. However, lithochemical studies conducted by Tryg Hoy of the B.C. Geological Survey suggest that the host rocks are alkali basalts. As such they may be associated with a volcanic island or a seamount or with rifting in a mature island arc. The latter setting seems to best fit the geology of the area.

Slide L. Minnova
R. Sam Deposit

In summary then, the Samatosum Deposit is a precious metal rich volcanogenic sulphide deposit formed at a mafic - sediment contact during a transition period between mafic and felsic volcanism. Although felsic volcanics are believed to be present at the mineralised horizon elsewhere in the area, they are not a factor at the deposit itself. Footwall rocks are mafic pyroclastics while the host rocks are ocean floor muds made up of sediments, tuffs and chert. Principal ore minerals are silver-bearing tetrahedrite, sphalerite, galena and chalcopyrite which occur as massive pods and disseminated veinlets in pyritic and silica flooded zones.

Deformation has caused the remobilization of some of the sulphides into quartz veins but has not affected the overall bulk composition of the ore body.

Although the known lens is pretty well closed off now, exploration will continue down dip, along strike and elsewhere on the property. In the meantime a Prospectus has been filed with the B.C. Mines Steering Committee and a feasibility study and Stage I development proposal is slated for this spring.

The Adams Barriere area has a long history of exploration, but has developed a reputation for being a bit of a teaser with numerous near misses. Perhaps this discovery will pave the way for others and lead to the development of a new mining camp in an area that could certainly use the jobs. We believe we are slowly getting a handle on the complex geology of the belt -----SLIDE ----- despite the efforts of certain individuals to complicate matters further. We are confident of additional discoveries.

SLIDE

After all, how can we fail when the Black Smokers are still active in the area!