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THE SAATTOPORA GOLD ORE AND THE PAHTAVUOMA Cu-Zn-U OCCURRENCES IN THE KITTILÄ REGION, NORTHERN FINLAND

by
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INTRODUCTION

The Saattopora gold deposit and the Pahtavuoma Cu-Zn-U occurrences are situated within the rural municipality of Kittilä, some 200 km north of Rovaniemi. Geologically the area belongs to the Kittilä greenstone belt (Lehtonen et al. submitted). Exploration in the area commenced in the 1960's, resulting in the discovery of the Pahtavuoma occurrences in 1970 and the low-grade Saattopora copper occurrence (7.4 Mt at 0.69% Cu) two years later. Numerous drill holes had actually penetrated the Saattopora gold deposit during this exploration phase, but since gold was not routinely analyzed at the time, the presence of the ore remained undetected for more than a decade. On the basis of numerous similarities with the Bidjovagge Cu-Au ore in Arctic Norwey, the earlier drill cores were reanalyzed for gold 13 years later, resulting in the discovery of the Saattopora gold ore.

GEOLOGY

The predominant rocks in the Saattopora-Pahtavuoma area are metavolcanics and sedimentogenic schists of the Kittilä Group of the Kittilä greenstone belt and the younger, synorogenic coarse clastic sedimentary rocks of the Kumpu Group. The present mineral assemblages in the greenstones are dominated by amphibole-albite rocks with albite, hornblende and biotite as major minerals. The lower part of the Kittilä Group volcanic succession consists of Fe-tholeiites which are separated from the stratigraphically overlying Mg-tholeiites by the Porkonen banded iron formations (Lehtonen et al., submitted). Greenstones are also associated

with hypabyssal amphibole-albite diabase intrusions.

The metasedimentary lithologies within the Kittilä greenstone belt form a very heterogeneous unit composed of chloritic and micaceous schists, phyllites, graphitic phyllites, cherts and greywackes. Primary sedimentary structures, such as bedding, graded bedding and laminar structures are locally well preserved. In some places scapolitization and skarn breccias are extensively developed. The youngest plutonic rocks in the area include the Kallo quartz monzodiorite intrusion (1883 Ma) and the 1800 Ma Kittilä granite.

THE SAATTOPORA GOLD ORE

The Saattopora gold deposit is hosted by albitites that occur as two separate, but equally mineralized E-W trending, N-dipping zones (Gold ore A and gold ore B; Fig. 6). The hanging wall to the A-ore body comprises intermediate volcaniclastic lihtologies that commonly contain narrow and discontinuous intercalations of phyllite and graphitic phyllite. The volcaniclastic lithologies become progressively more mafic towards the north, locally displaying evidence for a magmatic origin.

The footwall to the A-ore body, between the A- and B-ore bodies, consists of an ultramafic talc-chlorite schist or talc-chlorite-carbonate schist whose chemical characterisitics are consistent with a komatiitic protolith. These pass southwards into albitized metasediments, including intercalations of phyllite, graphitic phyllite, intermediate volcaniclastics and dolomite, in the immediate hanging wall of the B-ore body. In addition, an intraformational breccia is present, containing fragments of albitic schist and a variety of other sediment types. The footwall of the B-ore body terminates against an extensive area of phyllites, graphitic phyllites and intermediate volcaniclastic deposits, intruded sporadically by diabase sills

The protolith to the albitite host-rock to the A-ore body, prior to structurally controlled Na-metasomatism, is believed to have been an intermediate volcaniclastic deposit, whereas the B-ore body protolith is more likely to have been a felsic sediment. Albitization is most intense in the immediate vicinity of the gold ores, diminishing both eastwards, towards the Saattopora Cu occurrence, as well as westwards, in the direction of Pahtavuoma, where albitization is only present as discontinuous narrow zones.

The highest gold grades within the two ore bodies at Saattopora are found in vertical, predominantly N-S trending quartz carbonate veins, almost orthogonal to the main trend of the albitite. The veins are sharply bounded, brittle structures that vary in thickness from several millimeters up to several metres. The principal sulfide minerals are pyrrhotite and pyrite, with gold tending to occur as discrete grains, mostly in close association with quartz, pyrrhotite, gersdorffite and various U-Th-oxides. The mean grain size of gold is 200–250 μm, while finer-grained gold (< 20 μm occurs as grain boundary films associated with carbonate minerals and in fractures. The fineness of the gold is very high, with Ag contents remaining below 1%.

The Saattopora gold deposit shows a distinct structural control, being associated with an almost E-W trending brittle-ductile shear zone that can be traced in the regional aeromagnetic data as a zone up to 250 m wide and 20 km in length. The gold-bearing quartz-carbonate veins have preferentially developed in rock types predisposed to brittle failure, principally albitites. In addition to the dominant N-S strike and vertical orientation of the lode veins, some E-W trending veins containing gold have been found in the hanging wall to the A-ore body and within a localized shear zone in the central part of the B-ore body.

THE PAHTAVUOMA Cu-Zn-U OCCURRENCES

Exploration in the Pahtavuoma area delineated four separate low-grade stratabound ore bodies (Western orebody, Central orebody, A-orebody and Ulla orebody; Fig 7), six zinc mineralizations and three uranium occurrences. The total in situ copper reserves have been estimated to be 4.4 Mt at 1.04% Cu and 23 g/t Ag. Global developments in the price of copper during 1976 meant however, that the Pahtavuoma deposits were not considered to be economi-

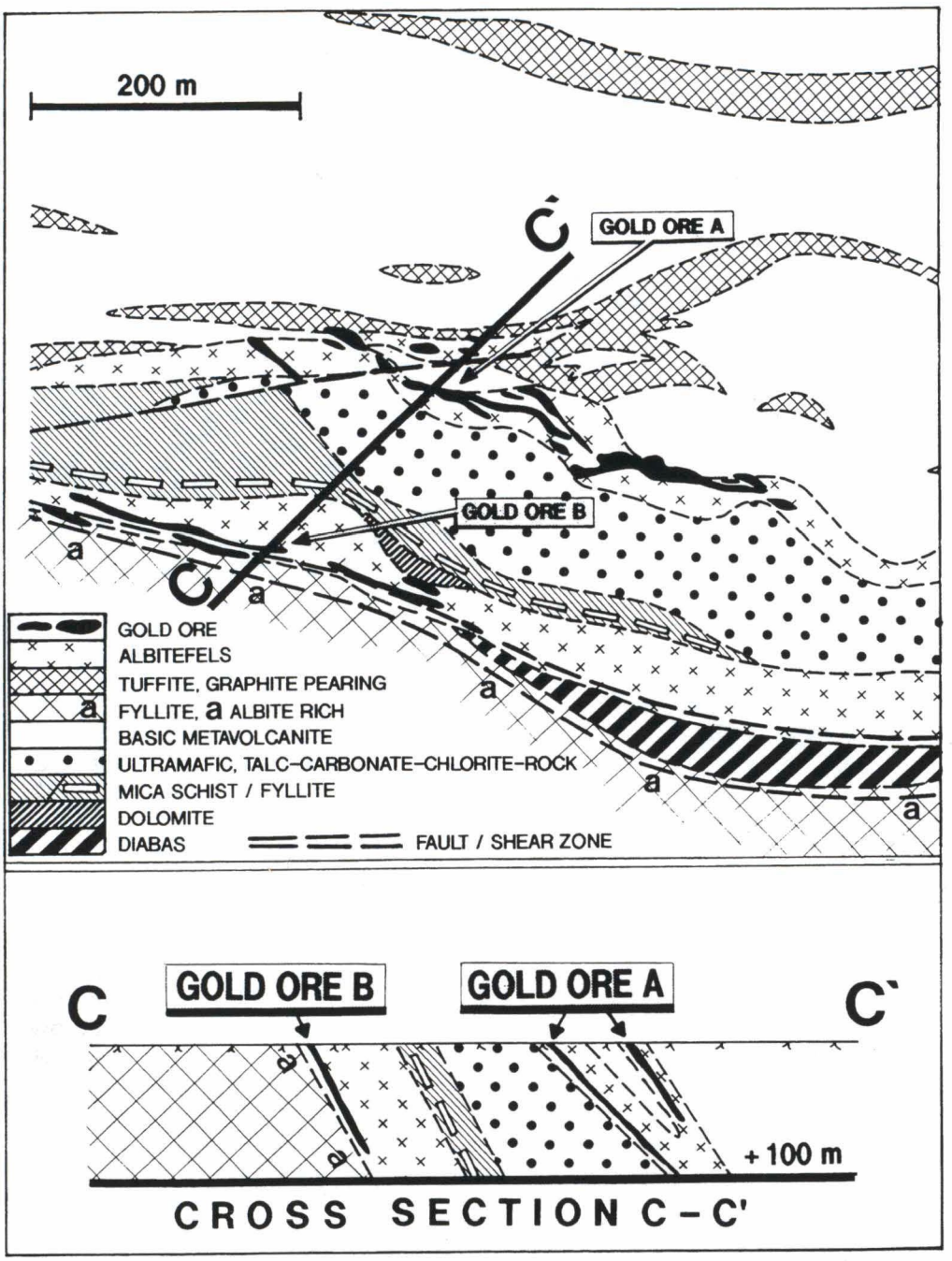

Fig. 6. Geological map of the Saattopora area.

cally viable at the time and investigations in the area ceased. Similarly, the zinc and uranium reserves (4.1 Mt at 1.51% Zn and 0.14 Mt at 0.39% U in situ) were not considered economically recoverable. However, the opening of the nearby Saattopora mine led to renewed interest in the Pahtavuoma deposits, with the A-ore body and Ulla ore body being mined in conjunction with the Saattopora operations.

Copper, zinc and uranium at Pahtavuoma occur in the metasedimentary schists. The ore showings are roughly concordant with the strike and dip of the schistosity; the plunge also parellels the regional lineation. The copper showings occur at the southern edge of the schist zone in contact with greenstone; the predominant host rock is a graphite-bearing phyllite or micaceous schist, although in some cases mineralization is also present in intercalations of schistose metagreywacke, albite schist, or garnetiferous skarn (Inkinen 1979.).

The orebodies dip towards the north at 60–80°. Footwall contacts are sharp, particularly contacts with greenstones, whereas hangingwall contacts are more gradual. The predominant mineral association is chalcopyrite-pyrrhotite,

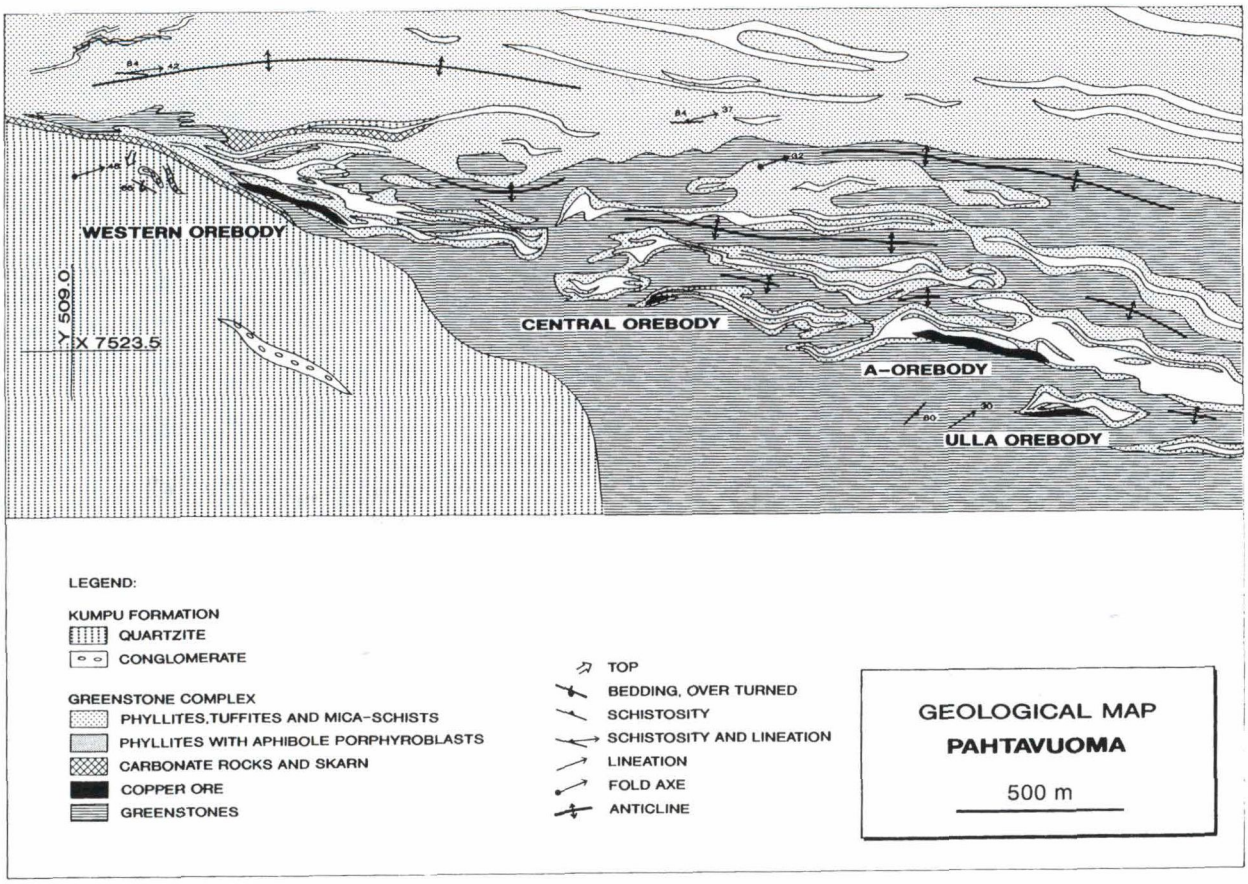

Fig. 7. Cu-Zn-U occurrences, showing the separate ore bodies.

with additional common ore minerals being arsenopyrite, sphalerite and ilmenite.

The zinc showings occur within the same schist sequence, at the margins of the copper mineralizations, as well as further north in distinctly separate schist zones. The zinc showings occur predominantly in phyllites and to a lesser extent in other rock types. Unlike the copper orebodies, however, they are not restricted to the immediate vicinity of the contacts with the greenstone. Where a close association exists between the zinc and copper mineralization, the zinc showings tend to be found in low-grade chalcopyrite-pyrite disseminations in the hanging wall of the copper orebodies proper or laterally along strike. The ore mineral paragenesis in the zinc showings is more simpler than in the copper showings, consisting primarily of pyrrhotite, sphalerite and ilmenite, together with carbonate and quartz as fracture fillings in breccias.

The uranium showings also occur in close proximity to the copper showings and are mainly hosted by mica schists and phyllites that contain abundant carbonate veins and skarn breccias. Together with carbonate, the ore minerals fill the youngest fractures truncating the primary structure of the rock. The major ore minerals are pyrrhotite and uraninite (Inkinen op. cit.).

MINING

The Saattopora gold deposit was mined by the then Outokumpu Finnmines Oy (currently Outokumpu Mining Ltd.) between 1988-95. The decision to commence mining was made in August 1988 and was based on an original reserve estimate of 680 000 t of ore amenable to open-cut mining,with a mean grade of 3.6 g/t Au and 0.28% Cu. Quarrying operations began later the same year and the anticipated lifetime of the mine was about two and a half years. An important factor influencing the exploitation of the deposit was that it was found to be feasible to transport the ore

some 54 km to the existing concentration plant at Rautuvaara, in the neighbouring municipality of Kolari, rather than invest in new facilities at Saattopora itself. Further reserves were found during the course of mining, with the result that production shifted from open-pit to underground mining between February 1992 and the closing of operations, due to exhaustion of known reserves, on May 1st, 1995.

A total of 2.1 Mt of ore was mined, requiring the additional quarrying of 3.7 Mt of wall rock. The open pit yielded 1.24 Mt of ore, with the remainder being mined underground. The thickness of the ore body varied between 1–25 metres. The bulk grade of the ore prior to concentration was 3.29 g/t Au and 0.28% Cu, yielding a total of 6278 kg Au and 5177 t Cu. Over the period 1972–1995 inclusive, a total of 58.7 km of diamond drilling, 27.2 km of percussion drilling and 0.7 km of reverse circulation drilling was carried out in the Pahtavuoma area.

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