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PRELIMINARY GEOLOGY OF THE KERR COPPER-(GOLD) DEPOSIT, NORTHWESTERN BRITISH COLUMBIA (104B/8)

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INTRODUCTION

The Kerr porphyry copper-(gold) deposit, owned by Placer Dome Inc., is in the Sulphurets gold camp 60 kilometres north of Stewart, British Columbia. Reserves calculated in 1989 by the previous owner, Western Canadian Mining Corporation, are 66 million tonnes averaging 0.8 per cent copper and 0.33 gram per tonne gold using a 0.5 per cent copper cut off. Access to the deposit is by helicopter from Tide Lake airstrip 50 kilometres north of Stewart. The deposit was diamond drilled extensively by Western Canadian Mining Corporation from 1987 to 1989 and by Placer Dome Inc. in 1990.

REGIONAL GEOLOGY

The Kerr deposit is hosted by Late Triassic to Early Jurassic island-arc rocks of Stikinia (Alldrick, 1989). The stratigraphic units are characterized by rapid facies changes typical of submarine island arcs. Regional deformation during the Cretaceous (Evenchick, 1991) deformed the volcanic and sedimentary units into westerly dipping thrust slices. These slices are stacked onto each other, exposing the oldest units in thrust wedges and tightly folded anticlines. The lowermost unit exposed in the area is the eastern facies of the Late Triassic Stuhini Group (Anderson and Thorkelson, 1990). The eastern facies consists of hornblende or pyroxene-phyric andesitic and basaltic volcanic conglomerates, and orange and black-weathering laminated siltstone and greywacke. Boulder to cobble conglomerates with shale and siltstone layers form a transitional unit between the underlying Stuhini Group and the overlying Early Jurassic Unuk River Formation (Anderson and Thorkelson, 1990). The Unuk River Formation in the Sulphurets gold camp consists of pyroclastic rocks of andesitic composition, possibly derived from diorite subvolcanic intrusions that are spatially related to porphyry copper deposits (Britton and Alldrick, 1988).

DEPOSIT GEOLOGY

The geology of the Kerr deposit is obscured by intense alteration and deformation. The 'deformed zone' outlined on Figure 6-3-1 is an area of foliated, sericite-altered volcanic and intrusive rock. A band of intense alteration and mineralization outcrops parallel to the edges of the deformed zone. Correlation of rock units between drill holes and on surface is hampered by complex structures in the deformed zone and poor outcrops on the eastern edge of the deposit. Lithologies exposed along the eastern margin of the deposit are regionally upright with local overturning. The absolute ages of the various units are not well constrained, but relative ages have been determined from surface mapping, crosscutting relationships and differences in intensity of deformation and alteration.

SEDIMENTARY AND VOLCANIC UNITS

Bedded ash-tuff forms the lowermost continuous rock unit exposed in the deposit area. It crops out along the eastern edge of the deformed zone and as a small unit below Kerr Peak (Figure 6-3-1). The unit consists of very fine grained siliceous layers interbedded with crossbedded coarser layers.

Volcanic conglomerate with chert clasts conformably overlies the bedded ash-tuff along the eastern edge of the deformed zone (Figure 6-3-2). Heterolithic clasts, up to 7 centimetres in diameter, change in composition from dominantly ash-tuff fragments at the bottom of the unit to porphyritic intermediate volcanic rocks and grey chert pebbles at the top.

Conglomerate and minor sandstone and siltstone overlie the volcanic conglomerate along the eastern margin of the deposit. The conglomerate is distinguished from the volcanic conglomerate by its black calcareous matrix with euhedral to subhedral feldspar crystals and rare cobbles of dull grey, fossiliferous limestone. The relative abundance of feldspar crystals increases up section until the unit appears to be a crystal tuff with a black calcareous matrix. The conglomerate unit fines upward into interbedded grey sandstone and siltstone that is exposed below Kerr Peak and as subcrops 100 metres south of the old camp.

Laminated argillite and rusty weathering siltstone conformably overlie the interbedded grey sandstone. This unit crops out around the old camp and as a sliver of rock below Kerr Peak. Contorted bedding, possibly due to soft-sediment deformation, is characteristic of this unit. Abundant load casts and graded bedding define a steep easterly dip on section 10600N (Figure 6-3-2). Bedding in the sediment is parallel to the bedding in the ash tuff.

Epiclastic conglomerate underlies Kerr Peak southwest of the deposit. This unit is in fault contact with underlying black argillite. Clasts in this conglomerate are 1 to 30 centimetres in diameter, and are elongate parallel to an east-striking, steep westerly dipping penetrative fabric. The clasts are matrix supported and comprise: plagioclase por-

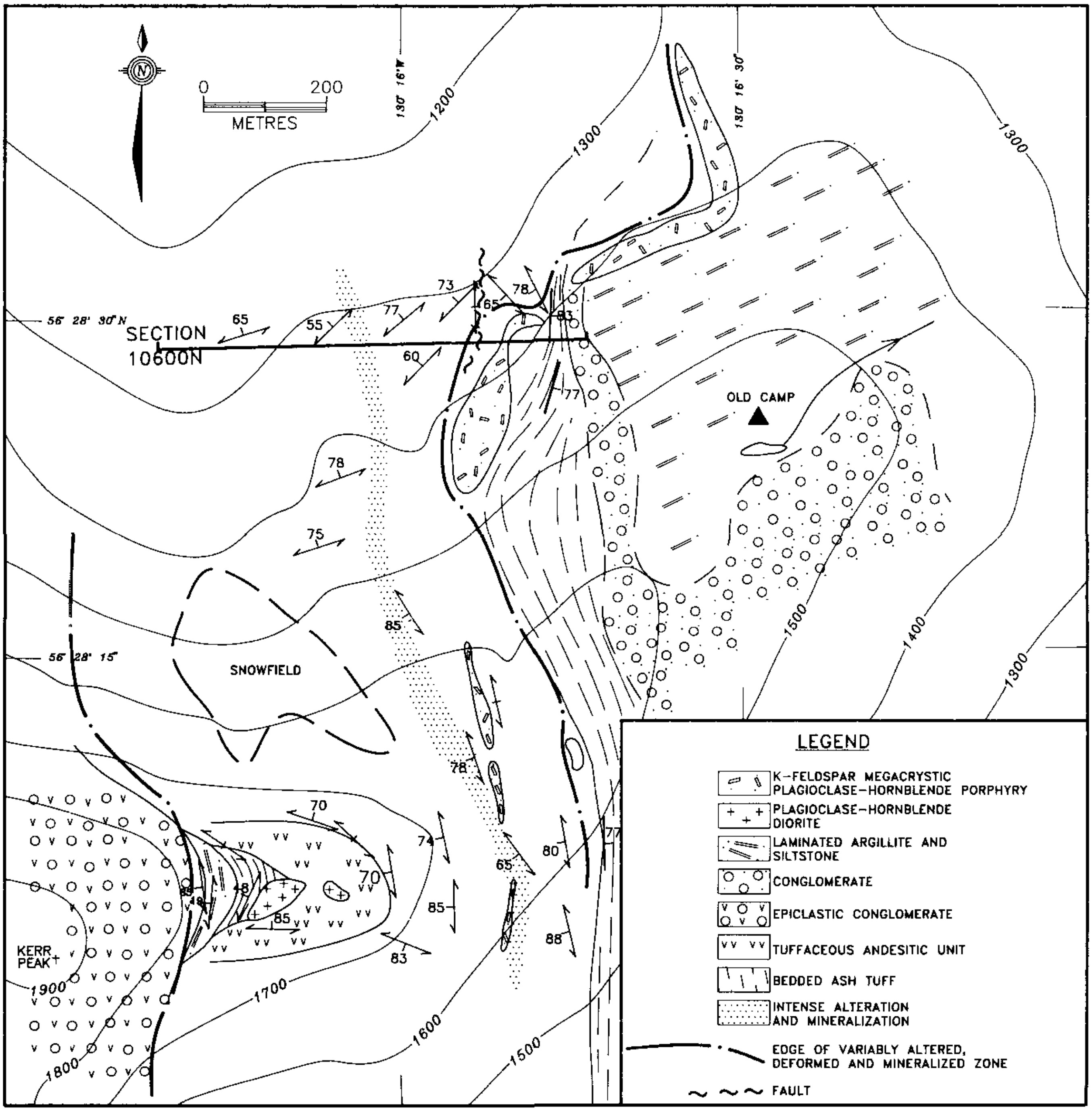

Figure 6-3-1. Simplified surface geology from this study of the Kerr deposit. Small dikes have been omitted for clarity. Rock units (volcanic rocks, pre and syn-mineral dikes) in the variably altered, deformed and mineralized zone have been omitted in places because of intense deformation, alteration and weathering that has obscured the relationships between individual units.

phyry (30% of the unit), hornblende porphyry (10%), aphanitic felsic volcanic rock (10%), and epidotite (5%). The matrix (45%) consists of plagioclase fragments (20%) and altered ash. The rock is weakly propylitized, possibly as a result of lower greenschist metamorphism (Britton and Alldrick, 1988). Age and stratigraphic position relative to units described above is uncertain. Anderson and Thorkelson (1990) mapped this unit as part of the Late Triassic Stuhini Group.

A pale brown weathering tuffaceous andesitic unit, is exposed surrounding the bedded tuff below Kerr Peak. It consists of bedded feldspar-phyric crystal tuff and a monolithic fragmental rock consisting of clasts of aphanitic tuff in a fine-grained feldspar-rich matrix.

Intrusive Units

Several distinctive pre to post-mineral dikes and stocks comprise 70 per cent by volume of rock in the deposit (Figure 6-3-2). Their relative age was determined from crosscutting relationships, distribution of sulphides and veins, and extent of deformation and alteration.

PRE-MINERAL DIKE?

A fine-grained plagioclase and hornblende-phyric unit is shown only on Figure 6-3-2. It hosts most of the copper mineralization in the Kerr deposit. Extensive alteration and deformation have obscured its original identity. One by two millimetre euhedral laths of plagioclase, hornblende and minor pyroxene comprise 30 to 70 per cent of the rock. The unit may be a premineral intrusive rock.

SYN-MINERAL DIKES

Plagioclase hornblende diorite occurs as a dike that is up to 100 metres wide (Figure 6-3-2). It strikes north and dips west, parallel to the trend of the copper mineralization. This unit consists of 2 by 4 millimetre phenocrysts of plagioclase (30%) and hornblende (10%) in a fine-grained matrix. The plagioclase hornblende diorite is interpreted to be a syn-mineral dike because it cuts and hosts pyrite and minor chalcopyrite-bearing banded quartz veins. Unmineralized magmatic breccias locally form margins to this intrusion. Small dikes of plagioclase hornblende diorite cut silicified unmineralized heterolithic hydrothermal breccia near the surface at the western corner of section 10600N (Figure 6-3-2).

Feldspar-megacrystic plagioclase hornblende porphyry forms a westerly trending dike 1 to 5 metres thick, but is not visible at map scale. It cuts bedded tuff below Kerr Peak and is in chill contact with plagioclase hornblende diorite. The unit is interpreted to be a late syn-mineral dike because it hosts polymetallic quartz veins and postdates the plagioclase hornblende diorite.

POST-MINERAL DIKES

Augite-hornblende-plagioclase porphyry crops out 500 metres east of Kerr Peak as a 10 by 50 metre lozenge in strongly altered and deformed tuffaceous rocks. It is too small to show on the figures. Alteration consists of epidote replacement of fine plagioclase laths and epidote veins.

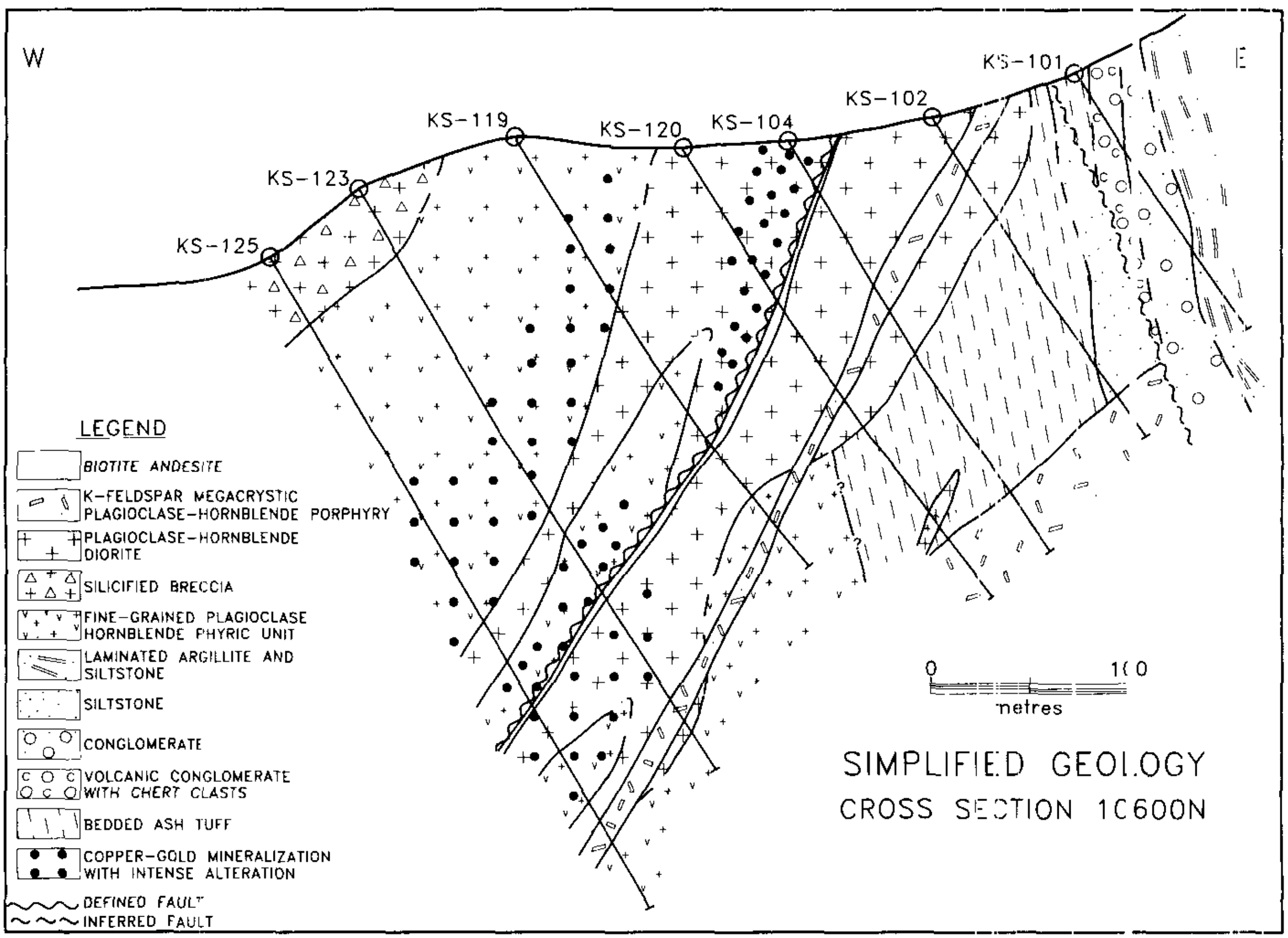

Figure 6-3-2. Simplified cross-section from this study showing distribution of altered lithologies and areas of intense mineralization.

Potassium feldspar megacrystic plagioclase hornblende porphyry strikes north and dips to the west (Figures 6-3-1 and 2). The potash feldspar megacrysts are euhedral, up to 20 millimetres in length in a matrix of plagioclase laths and minor hornblende. The dike is boudinaged and surrounded by strongly altered tuffaceous and intrusive rocks.

Green, aphanitic andesite dikes strike east and dip steeply south but they are volumetrically insignificant. These dikes are concentrated in the deformed zone where they are intensely folded with their fold axes parallel to the north-trending fabric.

Biotite andesite dikes are up to 2 metres wide and follow major late faults which parallel the trend of the mineralization and earlier intrusions (Figure 6-3-2). This unit is characterized by minor biotite books in a magnetic, dark reddish brown aphanitic matrix. Quartz and pink potassium feldspar crystals with corroded edges are concentrated in the centre of these dikes.

Mineralization and Alteration

Copper and gold mineralization on cross-section 10600N is concentrated above the fault hosting the biotite andesite dike (Figure 6-3-2). Minor mineralization is present below the fault.

Five distinct vein types have been identified, from oldest to youngest:

- banded, grey to milky white quartz veins with minor pyrite and chalcopyrite,
- magnetite and specular hematite with minor disseminated chalcopyrite and pyrite,
- pyrite and minor chalcopyrite with minor quartz gangue,
- anhydrite, quartz and calcite with pyrite, chalcopyrite and tetrahedrite, and
- pink gypsum veinlets with selvages of chalcopyrite and minor molybdenite.

These veins form stockworks in the plagioclase and hornblende-phyric unit above the plagioclase hornblende diorite dike. Alteration of the host unit varies repeatedly over 10 metre intervals. Each alteration interval has a texturally destructive chlorite and magnetite or pyrite 'core' assemblage, flanked successively by green sericite and pyrite, and white and yellow sericite with quartz and pyrite. This small-scale zonation reflects the overall alteration pattern across the deformed zone. The stippled region marked on Figure 6-3-1 represents an area of chlorite and green sericite alteration. It is crosscut by white gypsum veinlets. These may have formed during deformation, by remoblization from earlier anhydrite and pink gypsum veins. Mineralization intersected by drill hole KS-120 below KS-104 (Figure 6-3-2) in the plagioclase hornblende diorite dike consists of banded quartz veins cut by pyrite and chalcopyrite veinlets.

Minor polymetallic veins occur around the periphery of the plagioclase hornblende diorite locally cutting feldspar-megacrystic plagioclase hornblende porphyry. They consist of milky white quartz and carbonate with pyrite, chalcopyrite, tetrahedrite, sphalerite and galena.

Deformation

A strong northerly trending foliation follows the trace of the area of intense alteration and mineralization (Figure 6-3-1). It dips to the west, parallel to the dip of the plagioclase hornblende diorite dike and megacrystic plagioclase hornblende porphyry dike. All post-mineral dikes are strongly deformed except for the biotite andesite dikes. They intruded along relatively late major faults that were subsequently reactivated.

DISCUSSION AND CONCLUSIONS

The Kerr deposit is interpreted to be an Early Jurassic copper-(gold) porphyry system that was deformed during the Cretaceous (Evenchick, 1991). This interpretation is supported by the observation that post-mineral dikes are extensively folded and boudinaged parallel to a strong northerly trending foliation. Regional mapping by Britton and Alldrick (1988), Alldrick (1989) and Anderson and Thorkelson (1990) suggests that the deposit is hosted by the Late Triassic Stuhini Group. However, the footwall cannot be directly correlated with published stratigraphy of the Stuhini Group or of the Early Jurassic Unuk River Formation. Further geological mapping in the vicinity of the Kerr deposit is required.

Intense copper mineralization on cross-section 10600N occurs as quartz, magnetite and sulphide stockworks in lenses within the plagioclase hornblende diorite dike and in its hangingwall. Anhydrite and gypsum veins are concentrated in the strongly altered plagioclase and hornblende-phyric unit. The relationship between these stockworks and the syn-mineral plagioclase hornblende diorite dike will be investigated by a detailed petrographic study.

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REFERENCES

Alldrick, D.J. (1989): Volcanic Centres in the Stewart Complex (103P and 104A, B); *in* Geological Fieldwork 1988, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1989-1, pages 233-240.

Anderson, R.G. and Thorkelson, D.J. (1990): Mesozoic Stratigraphy and Setting for Some Mineral Deposits in Iskut River Map Area, Northwestern British Columbia; *in* Current Research, Part E, *Geological Survey of Canada*, Paper 90-1F, pages 131-139.

Britton, J.M. and Alldrick, D.J. (1988): Sulphurets Map Area (104A/5W, 12W; 104B/8E, 9/E); *in* Geological Fieldwork 1987, *B.C. Ministry of Energy, Mines and Petroleum Resources*, Paper 1988-1, pages 199-209.

Evenchick, C.A. (1991): Structural Relationships of the Skeena Fold Belt West of the Bowser Basin, Northwest British Columbia; *Canadian Journal of Earth Sciences*, Volume 28, pages 973-983.