GEOLOGY AND ALTERATION ZONATION OF THE HANK PROPERTY, NORTHWESTERN BRITISH COLUMBIA (104G/1,2)

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INTRODUCTION

The Hank property is situated in northwestern British Columbia 20 kilometres northwest of Bob Quinn Lake (Figure 1).

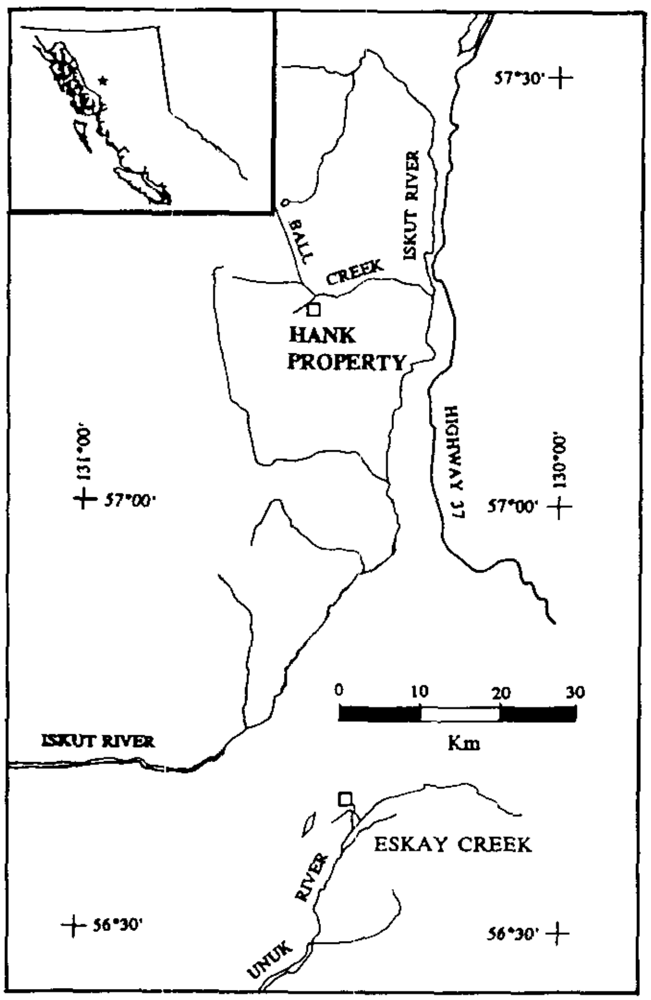


Figure 1. Location of the Hank property adapted form Anderson and Thorkelson (1990).

Access to the property is by helicopter from Bob Quinn Lake; the claims are served by a network of cat trails developed by Lac Minerals Ltd. between 1985 and 1989.

Fieldwork concentrated on relogging of core in the lower and upper alteration zones and logging of core from the Homestake Canada Ltd. 1993 diamond drilling program on Felsite Hill. The emphasis of fieldwork was to document the vertical changes in alteration from the lower alteration zone to Felsite Hill, to identify the lateral extent of the silicified zone beneath Felsite Hill, and to identify those features which characterize hydrothermal alteration on the Hank property as a low-sulphidation epithermal environment. Continued research at the University of British Columbia will comprise part of a M.Sc. thesis supervised by Dr. A.J. Sinclair and Dr. J.F.H. Thompson.

EXPLORATION HISTORY

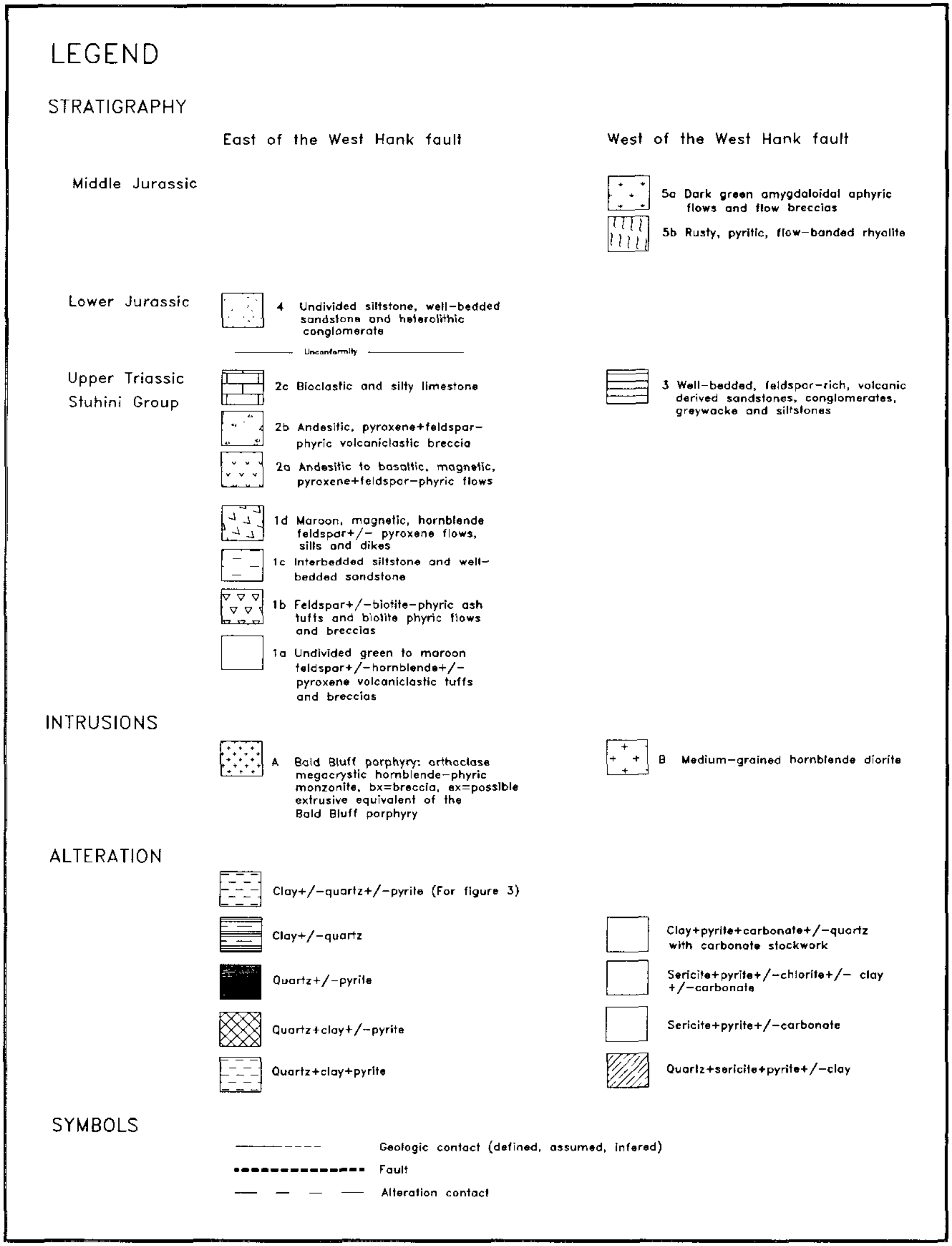
The Hank property comprises two groups of claims, the Hank claims, owned by Lac Minerals Ltd., which cover the majority of the hydrothermal alteration zones on the property, and the Panky claims, owned by Cominco Ltd., which lie to the east and south.

The Hank property was initially staked by Lac Minerals Ltd. in 1983. During 1984 to 1985 and 1987 to 1989 Lac Minerals Ltd. completed geological mapping, geochemical surveys, trenching, geophysical surveys, and diamond drilling totaling 11 604 metres in 88 holes in the upper, lower and flats alteration zones. Drilling outlined geological reserves of 245 000 tonnes with an average grade of 4.0 grams per tonne gold and 218 000 tonnes with an average grade of 2.0 grams per tonne in the 200 and 440 pit areas of the upper alteration zone, respectively (Figure 2).

Carmac Resources Ltd. (now Camncr Resources Ltd.) optioned the Hank claims in 1990 and drilled five holes totalling 1 090 metres in the Upper and Lower zones, then terminated the option.

Homestake Canada Ltd. optioned the Hank and Panky claims in 1992 and completed a program of soil and rock sampling, an induced polarization survey and detailed geological mapping, concentrating on the Felsite Hill and Rojo Grande alteration zones (Figure 2, Kaip

Legend for Figures 2 to 5.



and Macpherson, 1993). In 1993 Homestake Ltd. drilled five diamond-drill holes for a total of 657 metres targeting geochemical, and geophysical anomalies in the flats and Felsite Hill alteration zones.

REGIONAL GEOLOGY

The Hank property lies within the Stikine Terrane along the western margin of the Intermontane Belt and the eastern margin of the Skeena fold belt. Regional mapping in the area (Logan *et al.*, 1992; Evenchick, 1991; Anderson and Thorkelson, 1990; Souther, 1972) has defined the following major units: Paleozoic volcanic and sedimentary rocks of the Stikine assemblage; Mesozoic volcanic-plutonic arc assemblages, represented by Triassic Stuhini Group, and Jurassic Hazelton Group; a Middle and Upper Jurassic overlap assemblage, the Bowser Lake Group; and the Mesozoic to Cenozoic Coast Plutonic Suite.

The oldest rocks in the region are complexely folded schists and gneisses of middle Paleozoic age, which form the basement to the area and are exposed in Moore Creek south of the Hank property. Closer to the property, regional mapping has defined the stratigraphy surrounding the property as Upper Triassic augite andesite flows, pyroclastic rocks and volcanic-derived sediments overlain by Lower Jurassic grits, conglomerates and greywackes (Souther, 1972).

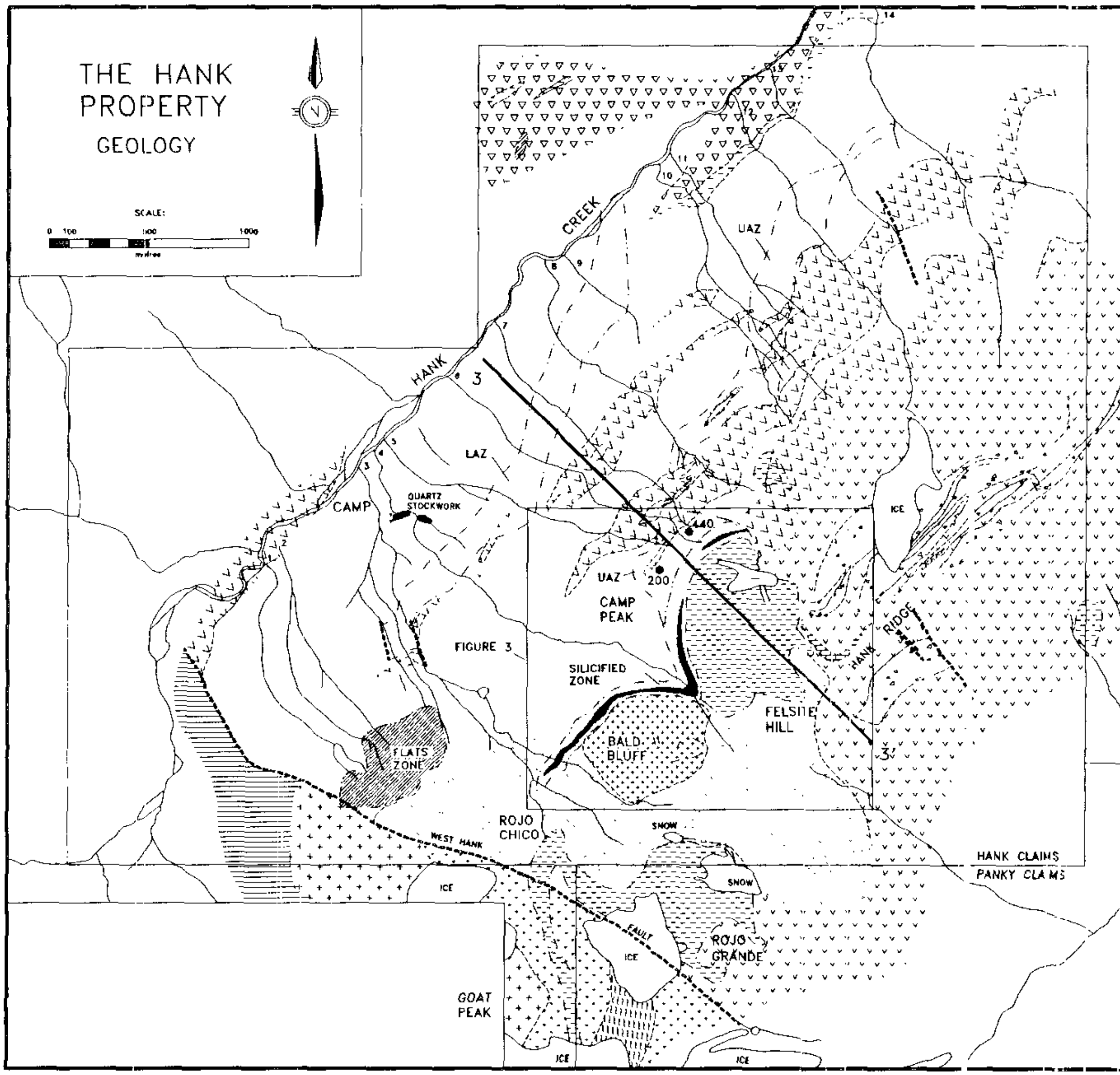


Figure 2. Geology of the Hank property.

Sedimentary rocks of the Middle Jurassic Ashman Formation of the Bowser Lake Group are exposed along the Iskut River valley to the east (Evenchick, 1991).

To the west of the property a northwest-striking fault is mapped at the head of Hank Creek (Souther, 1972). A subparallel fault, informally named the West Hank fault, adjacent and to the east of the regional fault, is exposed on the ridge to the northwest of the claims and traces across the southwest corner of the property (Figure 2).

PROPERTY GEOLOGY

The Hank property is underlain by a succession of flows, sills, volcaniclastic and minor sedimentary rocks divided into five units and described in detail by Kaip and McPherson (1992; Figure 2). On the northeast side of the West Hank fault the stratigraphy consists of Upper Triassic Stuhini Group pyroxene-feldspar-phyric flows, sills, breccias and minor limestone overlying hornblende-pyroxene-feldspar-phyric flows, sills, and volcaniclastic breccias with intercalated siltstones, sandstones, biotite-phyric flows and breccias. On the property the Stuhini volcanic rocks strike northeast along Hank Ridge and dip 30 to 50° to the southeast.

Lower Jurassic calcareous siltstones, sandstones, wackes and pebble conglomerates which locally contain abundant fossilized wood fragments unconformably overlie the volcanic succession. The Lower Jurassic sediments are folded about a southeast-plunging syncline exposed between Felsite Hill and Rojo Grande (Figure 2). Diamond drilling by Homestake Canada Ltd. to the southeast of the flats zone intersected sedimentary rocks of this unit (Figure 2), and extended the known extent of unit 4 to the upper margin of the flats zone.

On the west side of the fault, well-bedded, feldspar-rich, volcanic derived sandstones, conglomerates, greywacke and thin bedded siltstones of the Upper Triassic Stuhini Group are exposed along the north flank of Goat Peak (Logan *et al.*, 1992).

A wedge of possible Middle Jurassic interlayered aphyric vesicular basalt flows and flow-banded rhyolites and minor volcaniclastic sediments exposed along the eastern flank of Goat Peak are bounded by the West Hank fault on the northeast side and hornblende diorite to the west (Figure 2).

Two intrusive plugs are exposed on the property, an orthoclase-megacrystic, hornblende-phyric monzonite which underlies the prominent knoll, Bald Bluff, and an elongate medium-grained hornblende diorite intrusion which crops out on Goat Peak. A sample of the Bald Bluff intrusion collected during the 1992 field season for zircon dating yielded a preliminary age of 185±3 Ma (J. K. Mortensen, personal communication, 1993).

ALTERATION

Seven alteration zones are present on the Hank property with characteristic alteration assemblages described by Kaip and McPherson (1992). They include: the quartz stockwork consisting of quartz veining and silica flooding within chlorite+carbonate+pyrite altered volcaniclastic breccias of unit 1a; the lower alteration zone, dominated by intense sericite+pyrite±carbonate alteration; the upper alteration zone, dominated by sericite+pyrite±chlorite±clay±carbonate alteration; the Flats zone at the head of Creeks 1 to 3 and characterized by quartz+sericite+pyrite alteration hosting pods of more intense clay+pyrite±quartz alteration and quartz+ potassium feldspar+pyrite alteration; the silicified zone characterized by intense silicification with or without pyrite and barite which displays multiple phases of brecciation; Felsite Hill and Rojo Grande dominated by intense quartz+clay+pyrite alteration and lesser quartz+clay±pyrite and clay±quartz alteration (Figure 2). Based on X-ray diffraction studies on type alteration assemblages, sericite refers to fine-grained muscovite, and clay refers to a mixture of dickite and kaolinite.

SECTIONS 1 AND 2

Sections 1 and 2 (Figure 4), are located on Figure 3 and incorporate data collected from recent drilling on Felsite Hill and relogging of core from the 200 pit area of the lower alteration zone. Hydrothermal alteration in this area is continuous from the base of the lower alteration zone to the top of Felsite Hill and provides the opportunity to characterize the vertical changes in alteration style within a low-sulphidation epithermal environment.

UPPER ALTERATION ZONE

The upper alteration zone is less continuous in the vicinity of the 200 pit area and comprises green sericite+pyrite+carbonate±chlorite alteration near the base and pale grey, intense clay+sericite+pyrite± carbonate alteration near the upper contact with the silicified zone (Figure 3). This change in style is characterized by a decrease in competency of core as clay becomes more abundant. In this area the upper zone strikes northeast and dips semiconformably to stratigraphy within volcaniclastic breccias of unit 1a. In outcrop and drill core the footwall to the upper alteration zone is defined by a flow or sill of unit 1d.

Six types of veining are recognized: quartz-carbonate veins carrying sphalerite, pyrite and minor chalcopyrite; barite±pyrite veins; quartz-pyrite veins; pyrite veinlets; white to pink carbonate veins and crustiform calcite veins.

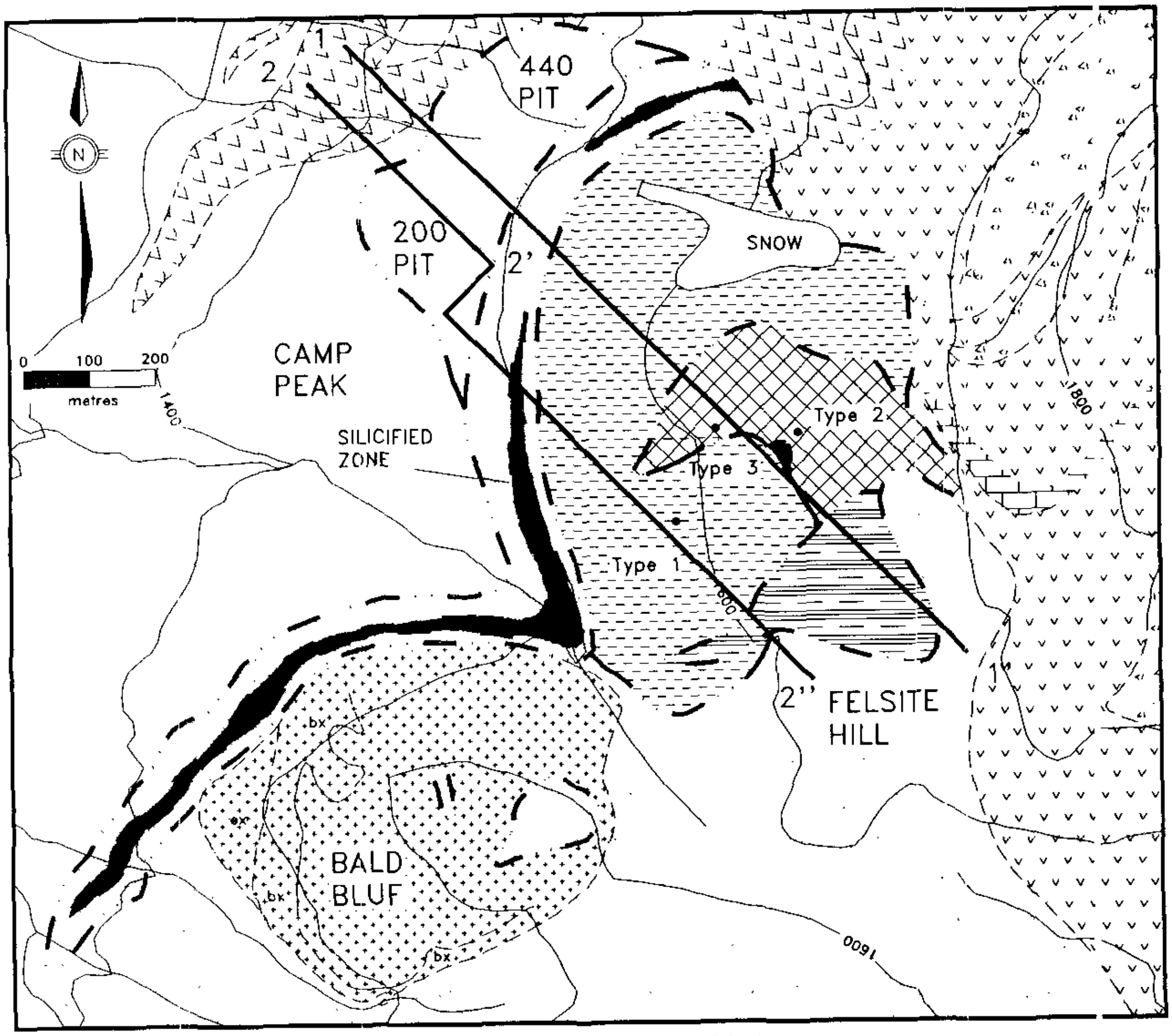


Figure 3. Distribution of alteration assemblages and of breccias types on Felsite Hill.

Barite veins are characterized by coarse-grained bladed barite with minor disseminated pyrite and frequently contain wallrock fragments. Quartz-pyrite veins, commonly less than 10 centimetres wide, contain euhedral coarse-grained pyrite concentrated along the margins. Pyrite veinlets, less than 1 centimetre in width are abundant in the upper zone and cut and are cut by white to pink carbonate veinlets. Crustiform calcite veins up to 1 metre wide are exposed in the 200 and 440 pit area of the upper alteration zone. These veins contain minor pyrite and bladed quartz after calcite.

Gold mineralization occurs within a subhorizontal zone dipping gently to the southeast, approximately 30 metres above the base of the upper zone (Figure 4b). Gold concentrations correlate with an increase in pyrite veining, quartz-carbonate and quartz-pyrite veining enveloped by intense clay+sericite+pyrite±carbonate alteration. Veining strikes northeast and dips steeply to the southeast.

SILICIFIED ZONE

The silicified zone is exposed along the base of Bald Bluff and Felsite Hill (Figure 3). It is hosted by sedimentary rocks of unit 4 and volcanic rocks of unit 1 Above the 200 pit area the trace of the silicified zone was intesected in drill core and consisted of grey, intense silicification hosting very fine-grained disseminated pyrite (Figure 4). The upper and lower margins of the silicified zone display evidence of brecciation with coarse-grained pyrite and barite filling open cavities.

On surface a poorly exposed zone of friable, recessive weathering alteration corresponds to the trace of the silicified zone. In drill core this zone, up to 70 metres wide, is marked by a general decrease in the degree of silicification downward from quartz+clay+pyrite alteration to friable clay+pyrite+carbonate±quartz which grades into typical upper zone alteration (Figure 4a and 4b). This zone is also characterized by a carbonate stockwork composed of white to pink calcite veins 1 to 2 centimetres wide and abundant pyrite veinlets above and below the silicified zone. In addition, within this envelope several intervals of silicification occur above the main silicified zone (Figure 4b).

From surface exposure and the intersection of the silicified zone in core it is apparent that it is semiconformable to stratigraphy, strikes northeast and dips 15 to 20° to the southeast.

FELSITE HILL

Alteration on Felsite Hill is hosted by sedimentary rocks of unit 4 and hornblende-feldspar-phyric flows or sills of unit 1d (Figure 3). Four types of alteration are present: quartz+clay+pyrite; quartz+clay±pyrite; clay± quartz and quartz±pyrite.

Quartz-clay-pyrite alteration is hosted by hornblende-feldspar-phyric flows or sills of unit 1d. Alteration is characterized by clay-altered plagioclase phenocrysts within a groundmass of grey quartz, clay and pyrite. Quartz+clay±pyrite alteration is hosted by units 4 and 1d and varies from texturally destructive vuggy, quartz and clay alteration to less intense alteration with relict primary textures and isolated pods of fine-grained pyrite. Quartz+clay±pyrite alteration overlies and extends to the southeast of quartz+clay+pyrite alteration; from drill core it is apparent that this type of alteration cuts quartz+clay+pyrite alteration along vertical structures which narrow at depth (Figure 4a). Clay±quartz alteration varies dramatically in intensity along the southern margin of the alteration zone on Felsite Hill and is hosted by sedimentary rocks of unit 4. Clay varies from white to maroon in colour and occurs initially as pervasive alteration of the hostrock.

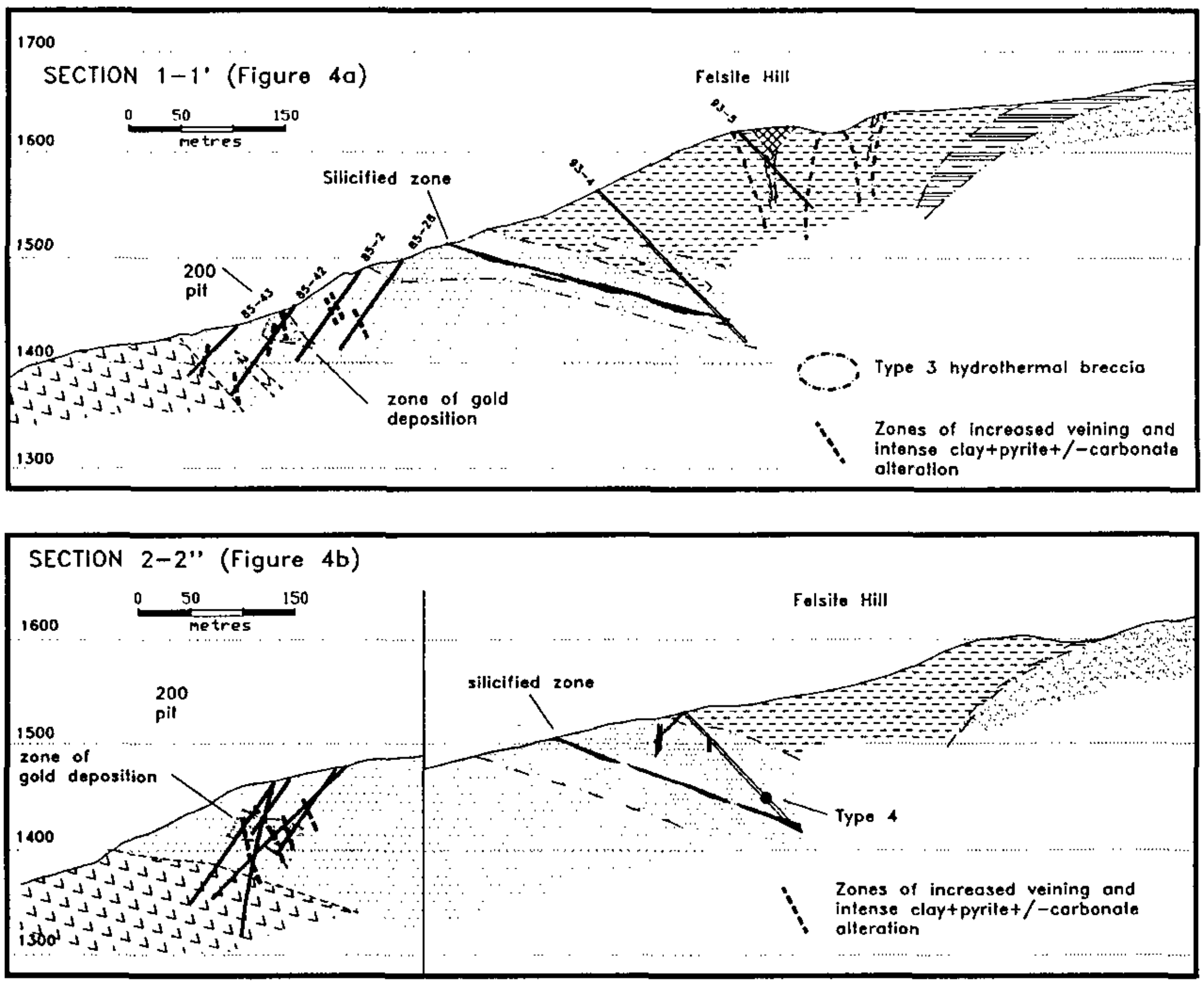


Figure 4: Cross-sections 4a and 4b through the upper alteration zone and Felsite Hill. Sections identify distribution of alteration, hydrothermal breccias, and level at which gold deposition occured.

Four types of hyrothermal brecciation are observed in outcrop and core (Figures 3 and 4). Type 1 breccia is characterized by fragments of white quartz+clay±pyrite and grey quartz+pyrite+pyrite altered fragments within a matrix of quartz, clay and pyrite followed by white porcellanous clay. Type 2 breccia is characterized by white quartz+clay altered fragments within a matrix of black silica. This type of breccia is found in quartz+clay± pyrite altered siltstones with carbonaceous plant fragments. Type 3 breccia consists of quartz+clay+pyrite-altered angular fragments of feldspar-phyric volcanic rock with serrate margins. The matrix of the hydrothermal breccia is composed of quartz, clay and pyrite followed by white porcellanous clay. Diamond-drill hole 93-5 intersected type 3 hydrothermal breccia at depth (Figure 4a). In drill core type 3 breccia is cored by several 2 to 5 metre zones of vuggy quartz and clay alteration with limonite-covered fracture surfaces, similar to quartz+clay±pyrite alteration observed at surface. Type 4 breccia is observed in diamond-drill hole 93-2A, and consists of rounded quartz+clay+pyrite-altered fragments in a matrix of soft clay and pyrite (Figure 4b).

DISCUSSION

The topography, combined with outcrop and diamond-drill hole data from the Hank property provides an excellent cross-section through an epithermal alteration system, as defined by Lindgren (1933). Alteration is characteristic of a low-sulphidation, near-surface environment with sericitic alteration at depth in the lower alteration zone (Kaip and McPherson, 1992) and clay alteration at higher elevations on Felsite Hill and Rojo Grande. The upper alteration zone is transitional between these two styles of alteration with sericite+pyrite+carbonate±chlorite near the base and clay ±sericite+carbonate+pyrite near the upper contact with the silicified zone. The latter is characterized by multiphase silicification within a broad zone of clay+pyrite+carbonate±quartz and carbonate stockwork.

The overall morphology of these alteration zones shown in Figure 5, suggests that the lower alteration zone may be a feeder zone as it cuts stratigraphy at a high angle. The upper alteration zone is semiconformable to stratigraphy, is hosted by rocks of unit 1a, and may indicate lateral movement of hydrothermal fluids along a permeable horizon. The presence of large crustiform banded carbonate veins with silica-replaced bladed calcite crystals suggests that bicarbonate fluids were present and that boiling may have taken place in the upper alteration zone (Simmons and Christienson, 1993). Alteration on Felsite Hill is dominated by clay and pyrite alteration with varying degrees of silicification and displays a vertical and lateral zonation of quartz+clay+pyrite to quartz+clay±pyrite to clay±quartz from core to periphery. Hedenquist (1993), indicates that clay-dominant alteration can occur on the margins of low-sulfidation epithermal environments where temperatures are cooler and alteration products are characteristic of vapour condensates. From drill hole 93-5, it is apparent that vuggy quartz+clay alteration forms along vertical structures and overprints quartz+clay+pyrite-altered hydrothermal breccia. This feature may represent the effects of encroaching surface water on the collapsing hydrothermal system. The silicified zone, which lies above the upper alteration zone and below Felsite Hill, may indicate a zone of increased permeability or the former presence of a paleo-water table. Alternatively, the silicified zone may represent the level at which boiling fluids deposited silica, but this has yet to be determined from mineralogical and geochemical investigations.

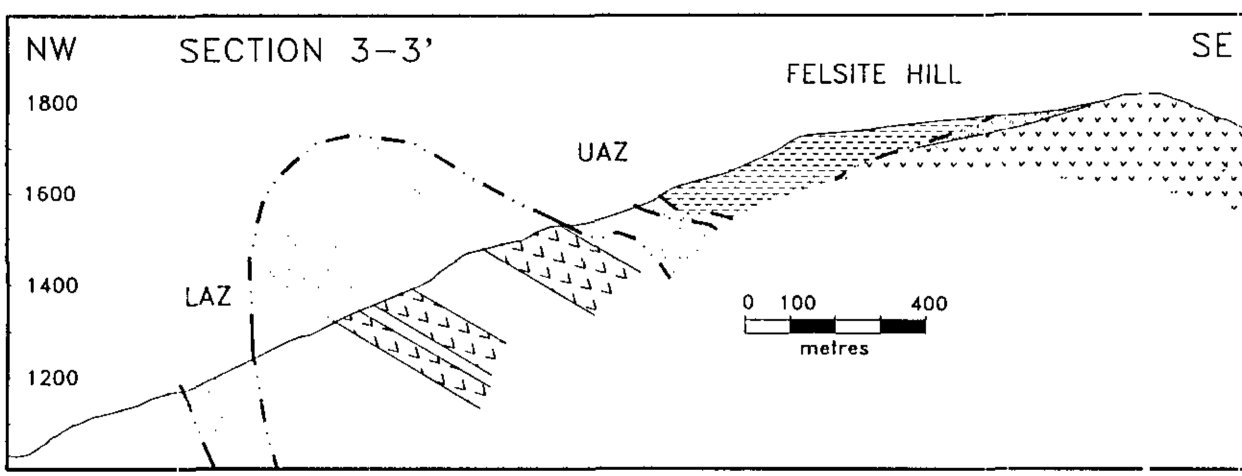


Figure 5. Cross-section 3-3' through the lower and upper alteration zones and Felsite Hill showing zoning in the type of alteration.

Based on field mapping there appears to be a genetic link between the intrusion of the Bald Bluff orthoclase megacrystic porphyry and hydrothermal alteration at the Hank property. This hypothesis is supported by the age of intrusion at 185±3 Ma. and a Middle Jurassic signature obtained from galena in precious metal bearing quartz-carbonate-sulfide veins from the lower alteration zone.

The Hank property is the first known occurance of a Middle Jurassic epithermal system, apparently related to the intrusion of orthoclase megacrystic porphyries within the Iskut region. These porphyries have been shown regionally to be temporaly and spatially related to other types of mineralizing environments in the region.

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