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PRELIMINARY REPORT ON THE HEDLEY MAPPING PROJECT (92H/8, 82E/5)

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INTRODUCTION

The Hedley area is situated approximately 40 kilometres east-southeast of Princeton, in southwestern British Columbia. The main objectives of this three-year project, which was initiated in 1985, include:

(a) To geologically map, at a scale of 1:20 000, the Hedley area.
(b) To examine the geochemistry, controls, and regional setting of the numerous gold deposits in the Hedley district, including the former Nickel Plate, Hedley Mascot, Canty, French, and Goodhope mines.
(c) To outline a stratigraphic succession for the Mesozoic sedimentary sequence in the Hedley district and establish, if possible, its structural history and its relationship to both the Paleozoic sequences to the east and the predominantly volcanic Upper Triassic Nicola Group to the west.
(d) To date the limestones in the area by conodont extraction, and the dioritic Hedley intrusions by K/Ar and U/Pb methods. These intrusions are believed to be genetically related to some of the gold-bearing skarns in the district.
(e) To determine what changes take place in whole rock and trace element geochemistry across the Nickel Plate mine ore zone. This will also enable a geochemical comparison to be made between the precious metal-bearing skarns at Hedley and at Tillicum Mountain (*see* Ray, *et al.*, this volume).
(f) To compare the geochemistry between the skarn-altered and unaltered Hedley intrusions.

REGIONAL GEOLOGY

Placer gold was discovered in the Hedley area in the 1860's, but it was not until the turn of the century that gold-bearing garnet pyroxene skarns were found near the summit of Nickel Plate Mountain (Fig. 12-1). This led to the opening of several mines on the Nickel Plate property which were in operation until the mid-1950's; these produced approximately 46 million grams (1.5 million ounces) of gold. Due to their economic potential, the areas around the gold producers were mapped and studied in detail (Camsell, 1910; Warren and Cummings, 1935; Billingsley and Hume, 1941; Dolmage and Brown, 1945; Lee, 1951); less attention was devoted to either the regional geology or comparing the various gold deposits in the district. Important publications relevant to the regional geology include those by Bostock (1930, 1940a, 1940b), Rice (1947), and Little (1961).

The Hedley region lies within the Intermontane Belt of the Canadian Cordillera. The area between Whistle Creek and Stemwinder Mountain (Fig. 12-1) is largely underlain by a predominantly sedimentary sequence belonging to the Upper Triassic Nicola Group (Rice, 1947). This sequence has been subdivided by various geologists into numerous formations (*see* Rice, 1947, p. 13) but for the purposes of this report it is informally separated into a younger 'Whistle Creek sequence' to the west and an older 'Hedley sequence' to the east (Fig. 12-1). The latter comprises a generally west-dipping succession of thin-bedded, calcareous and cherty siltstones and argillites with thin, impure limestones; some beds in the sequence contain appreciable amounts of fine-grained volcaniclastic material. Limestone samples collected from the succession by Monger and Tempelman-Kluit of the Geological Survey of Canada, yielded conodonts of Carnian to Early Norian age (M. J. Orchard, pers. comm., 1985). One 30-metre-thick limestone bed, the 'Sunnyside limestone' (Figs. 12-1 and 12-2) is traceable for several kilometres along strike (Camsell, 1910; Bostock, 1930, 1940a).

West of Henri Creek (Fig. 12-1), the Hedley sequence passes stratigraphically up into the Whistle Creek sequence. This contains some thin-bedded siltstones and argillites in its lower portion, but higher in the succession it is characterized by wackes, crystal tuffs, volcanic breccias, and minor volcanic flows (Fig. 12-2). One distinguishing feature is its general lack of limestones, and the presence at its base of a limestone boulder conglomerate which is informally named the 'Henri Creek conglomerate' (Fig. 12-1). Sedimentary indicators show that the Hedley and Whistle Creek sequences in this section consistently young westward. Measurements of crossbeds and flame structures indicate that the entire Hedley sequence, and the lower, thin-bedded section of the Whistle Creek sequence, were deposited by north to northeast-directed paleocurrents (Fig. 12-1).

East of Winters Creek (Fig. 12-1) is a highly deformed package of cherts, argillites, and greenstones which have been divided into the Independence, Bradshaw, Old Tom, and Shoemaker Formations (Bostock, 1940a; Little, 1961). Relationships between these units is uncertain. Upper Devonian and Triassic microfossils have been recovered from some of these rocks (J.W.H. Monger, pers. comm., 1985), and a faulted unconformity may separate this Paleozoic package from the Hedley sequence further west (Fig. 12-2).

Two plutonic suites intrude the Hedley and Whistle Creek sequences (Figs. 12-1 and 12-2). The oldest is believed to be Middle Jurassic in age and comprises massive, coarse-grained diorites, gabbros, and quartz diorites of the Hedley intrusions (Rice, 1947). They form major stocks up to 1.5 kilometres in diameter as well as swarms of thin sills, up to 200 metres in thickness and over 1 kilometre in length. The second plutonic suite, the Similkameen intrusions, comprises coarse, massive granodiorite of presumed Middle to Late Jurassic age. These intrusions generally form large bodies such as the Pennask pluton which outcrops west of Stemwinder Mountain, and a granodiorite body outcropping between Winters Creek and Hedley township, which is informally named the Cahill Creek pluton (Fig. 12-1).

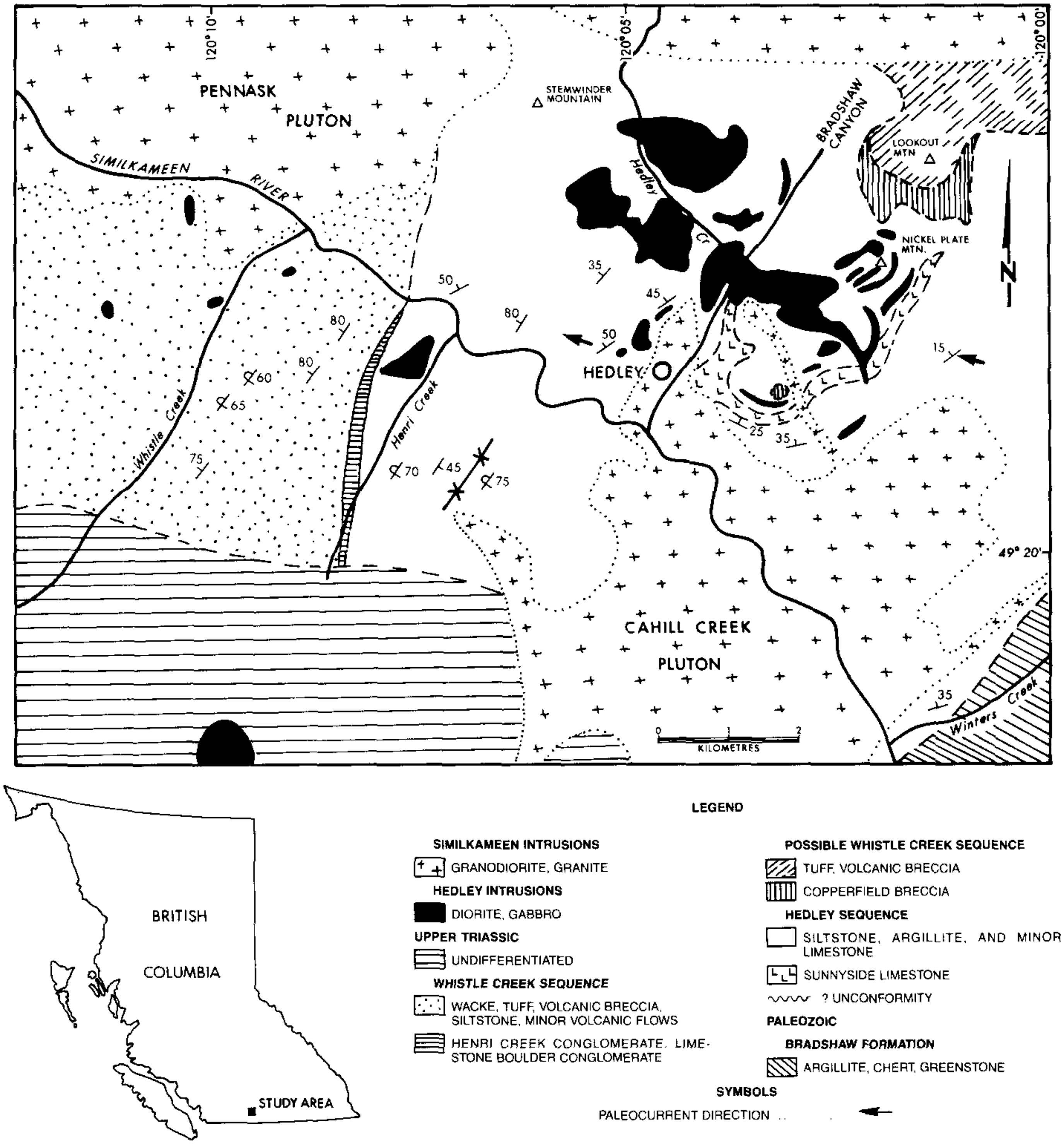

Figure 12-1. Simplified geology of the Hedley area. (Adapted after Bostock (1940a) and data obtained during this preliminary study).

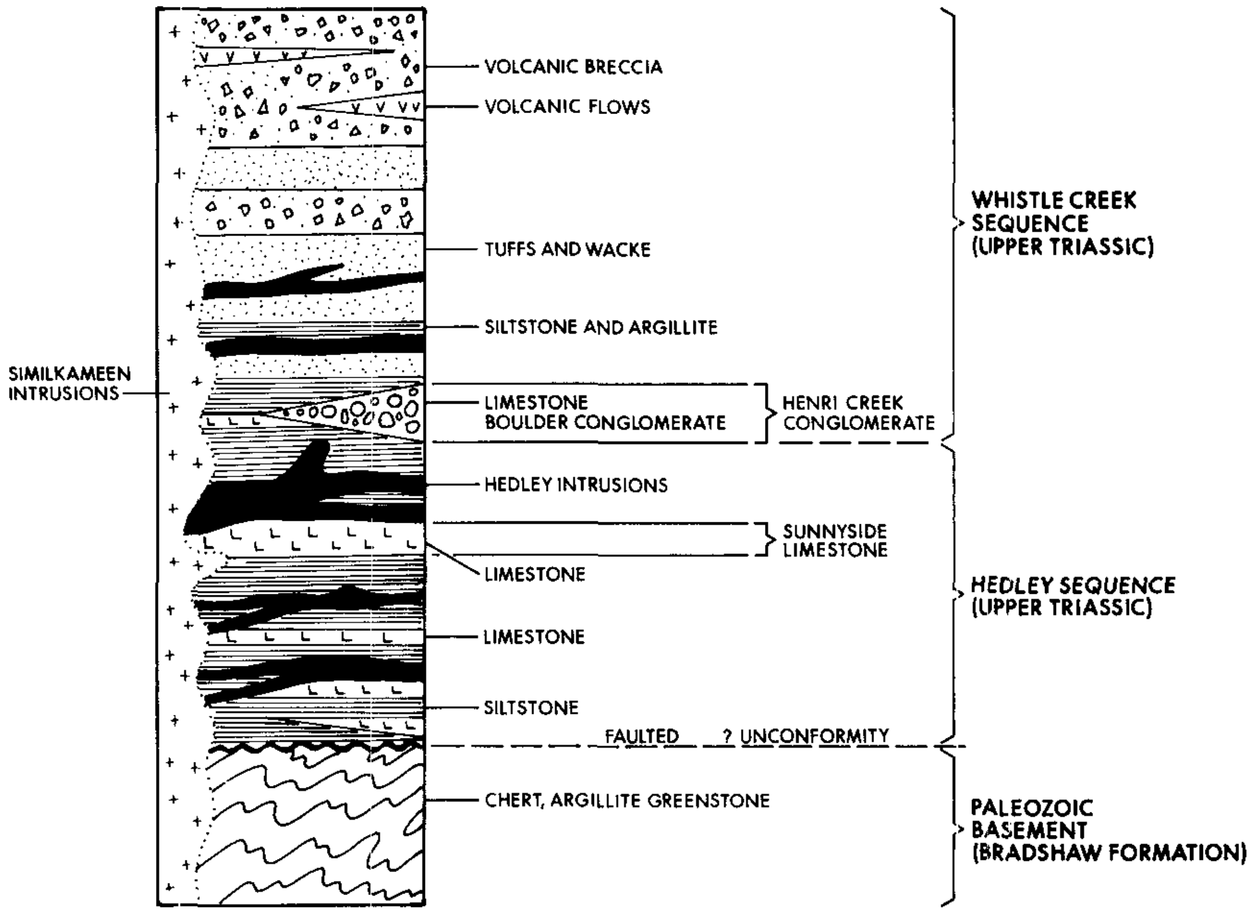

Figure 12-2. Schematic section illustrating the stratigraphy of the Hedley area.

Varying degrees of sulphide-bearing skarn alteration are developed along the margins of many of the Hedley intrusions in the district. Some previous workers (Billingsley and Hume, 1941; Dolmage and Brown, 1945) considered this plutonic suite to be genetically related to the gold mineralization at the Nickel Plate and Hedley Mascot mines. Country rocks up to 1.5 kilometres from the margins of the younger Similkameen intrusions are commonly hornfelsed; some skarn alteration is also locally present adjacent to the Cahill Creek pluton, but it is generally sulphide poor and not auriferous.

GEOLOGY OF THE HEDLEY AND WHISTLE CREEK SEQUENCES

North of the Similkameen River the Hedley sequence underlies an area between Winters Creek and Stemwinder Mountain, while south of the river it lies between Henri Creek and the western margin of the Cahill Creek pluton (Fig. 12-1). In the east its stratigraphic base probably lies close to Winters Creek where it may unconformably (?) overlie the highly deformed Paleozoic Bradshaw Formation basement. North of the Similkameen River, the Hedley sequence dips west to northwest at angles between 15 and 85 degrees; consistent sedimentary top indicators show that the sequence in this area is structurally upright (Fig. 12-1). South of the river, the Hedley and Whistle Creek sequences are generally west dipping, except in the Henri Creek area where they are locally overturned.

The Hedley sequence mainly comprises a thin-bedded succession of siltstones, black argillites, and minor wackes that are commonly interbedded with 1 to 10-metre-thick impure limestone beds; some calcareous units are finely tuffaceous. The siltstones and argillites are either calcareous or siliceous and cherty; sedimentary structures, such as graded beds, crossbeds, ball-and-pillow structures, and flame structures are locally preserved. The Hedley sequence is interpreted to represent a distal turbidite succession with some minor pelagic material.

The base of the Whistle Creek sequence south of the Similkameen River is marked by the Henri Creek conglomerate, which reaches 200 metres in thickness, and is traceable for more than 3 kilometres along strike; its northern extension across the river is not known. The conglomerate varies from clast to matrix supported and is characterized by abundant, well-rounded to angular pebbles, cobbles, and boulders of limestone up to 1 metre in diameter. Rare clasts of argillite, siltstone, wacke, chert, crystalline quartz, and both felsic plutonic and volcanic rocks are also present. The limestone clasts vary considerably in appearance, from grey to buff to pink in colour, from fine to coarse grained, and from massive to thin bedded; some limestone boulders contain abundant fragments of bivalve shells and crinoid stems. A few boulders are composed of a limestone conglomerate comprising grey limestone clasts cemented in a calcareous matrix; other, less common boulders consist of chert pebble conglomerate with a gritty calcareous matrix.

Some of the larger, elongate, siltstone clasts are deformed and exhibit soft sediment deformation structures, which suggests that they were unlithified when incorporated into the conglomerate. The conglomerate matrix varies from massive to thin bedded and locally shows evidence of chaotic slumping and soft sediment disruption. Conodonts extracted from some limestone boulders give Carnian ages (J.W.H. Monger and M. J. Orchard, pers. comm., 1985), while radiolarians of Permian age were extracted from one chert pebble (F. Cordey, pers. comm., 1985). The Henri Creek conglomerate is interpreted to be an olistostrome; it probably results from the sudden slumping of an unstable accumulation of reef debris down a steep submarine slope, and the chaotic deposition of this mass onto a sequence of unlithified, deeper water turbidites.

Stratigraphically overlying the Henri Creek conglomerate are some thin-bedded siltstones and argillites, which pass upward into poorly bedded to massive, coarser grained wackes, crystal and crystal-lithic tuffs, and volcanic breccias (Fig. 12-2). In contrast to the underlying Hedley sequence, limestones and calcareous sedimentary rocks are generally absent and the presumed upper parts of the succession contain thin volcanic flows which may be equivalent of Norian-age Nicola Group volcanic rocks deposited further west in the Merritt and Princeton areas (McMillan, 1979; Preto, 1979).

The Henri Creek conglomerate shows many similarities in composition, texture, and stratigraphic position to a controversial unit, the 'Copperfield breccia' (Camsell, 1910; Bostock, 1930; Billingsley and Hume, 1941) which outcrops south of Lookout Mountain (Fig. 12-1). The Copperfield breccia contains abundant limestone clasts and, like the Henri Creek conglomerate, apparently separates two contrasting sequences. Stratigraphically and structurally underlying the Copperfield breccia is the thinly bedded Hedley sequence, while structurally above it, north and northwest of Lookout Mountain, are tuffs and volcanic breccias (Bostock, 1940a; Lee, 1951). The Copperfield breccia is locally silicified and skarn altered; some altered outcrops contain rounded cavities up to 15 centimetres in diameter lined with coarse crystals of the scapolite group mineral, mizzonite $(Na,K)Ca(Si,Al)_6O_{12}Cl$ (J. Kwong, pers. comm., 1985); these cavities were probably formed by the solution and removal of some clasts.

The Henri Creek conglomerate and the Copperfield breccia are possibly correlative which could mean that the tuffs and volcanic breccias near Lookout Mountain belong to the Whistle Creek sequence. This correlation has implications regarding the geology between Lookout and Stemwinder Mountains, since the absence of the Copperfield breccia and overlying tuffaceous rocks west of Bradshaw Canyon (Fig. 12-1) supports previous suggestions of high-angle, easterly directed reverse faulting along the creek (Camsell, 1910; Billingsley and Hume, 1941). (Note: Bradshaw Canyon is situated approximately 3 kilometres northeast of Hedley (Fig. 12-1); it should not be confused with Bradshaw Creek situated 2 kilometres south of Winters Creek).

STRUCTURAL GEOLOGY IN THE HEDLEY AREA

Sedimentary rocks north of the Similkameen River consistently dip west to northwest at gentle to steep angles with no evidence of structural overturning. However, south of the river both the Hedley and Whistle Creek sequences are locally overturned and dip steeply eastward. A weak, steeply inclined fracture cleavage and associated bedding-fracture cleavage intersection lineation are locally seen west of Bradshaw Canyon and south of the Similkameen River (Fig. 12-1). These indicate that the sequences occupy the western limb of a major anticline, whose axis plunges 20 to 35 degrees in a south to southwest direction; this anticline is presumably cored by the older Paleozoic rocks east of Winters Creek. No fracture cleavage or mineral lineations were seen west of Bradshaw Canyon; consequently the plunge direction of the anticlinal axis in that area is unknown. No related small-scale folds were observed in the Hedley and Whistle Creek sequences; however, a large-scale, overturned syncline with a southerly plunging fold axis and an axial plane dipping 60 degrees east is present east of Henri Creek (Fig. 12-1).

In contrast to the Hedley and Whistle Creek sequences, the Paleozoic rocks east of Winters Creek contain some tight minor folds; these folds support the interpretation that these rocks represent a basement that was folded prior to the unconformable (?) deposition of the Hedley sequence.

CONCLUSIONS

The Hedley district is underlain by a predominantly Upper Triassic sedimentary succession that is divisible into a younger Whistle Creek sequence to the west, and an older Hedley sequence to the east. The Hedley sequence overlies, possibly unconformably, a deformed basement that includes the Bradshaw Formation (Figs. 12-1 and 12-2).

The Hedley sequence hosts Nickel Plate and Hedley Mascot gold-bearing skarn mineralization. It largely represents a distal turbidite succession characterized by thin-bedded, impure calcareous sedimentary rocks. The stratigraphically overlying Whistle Creek sequence is marked by the presence of coarser grained volcanogenic sedimentary rocks and volcanic breccias, and an absence of calcareous rocks. Both the Hedley sequence and the lower, turbiditic portion of the Whistle Creek sequence were deposited by paleocurrents moving in a west to northwest direction. Thin volcanic flows at the top of the Whistle Creek sequence may be an easterly extension of Nicola Group volcanic rocks. Thus sedimentation in the Hedley district initially involved the deposition of distal turbidites originating from an easterly source, followed by coarse volcanogenic sedimentation, possibly derived from the Nicola volcanic arc further west.

The base of the Whistle Creek sequence is the Henri Creek conglomerate which is interpreted to be a limestone-boulder-bearing olistostrome. This conglomerate may be correlative with the 'Copperfield breccia' which outcrops north of the Similkameen River on Lookout Mountain; thus tuffaceous rocks on Lookout Mountain and volcanic breccias further northeast could belong to the Whistle Creek sequence.

Structurally, the Hedley and Whistle Creek sequences occupy the western limb of a major anticline which has a steep, easterly dipping axial plane and a southerly plunging fold axis; this anticline is apparently cored further east by Paleozoic rocks of the Bradshaw Formation.

Throughout the district many of the older Hedley diorite intrusions are spatially associated with sulphide-rich skarn alteration which sporadically carries gold. However, the margins of the younger Similkameen intrusions are also locally associated with weak skarn alteration, which is generally sulphide poor and appears to be barren.

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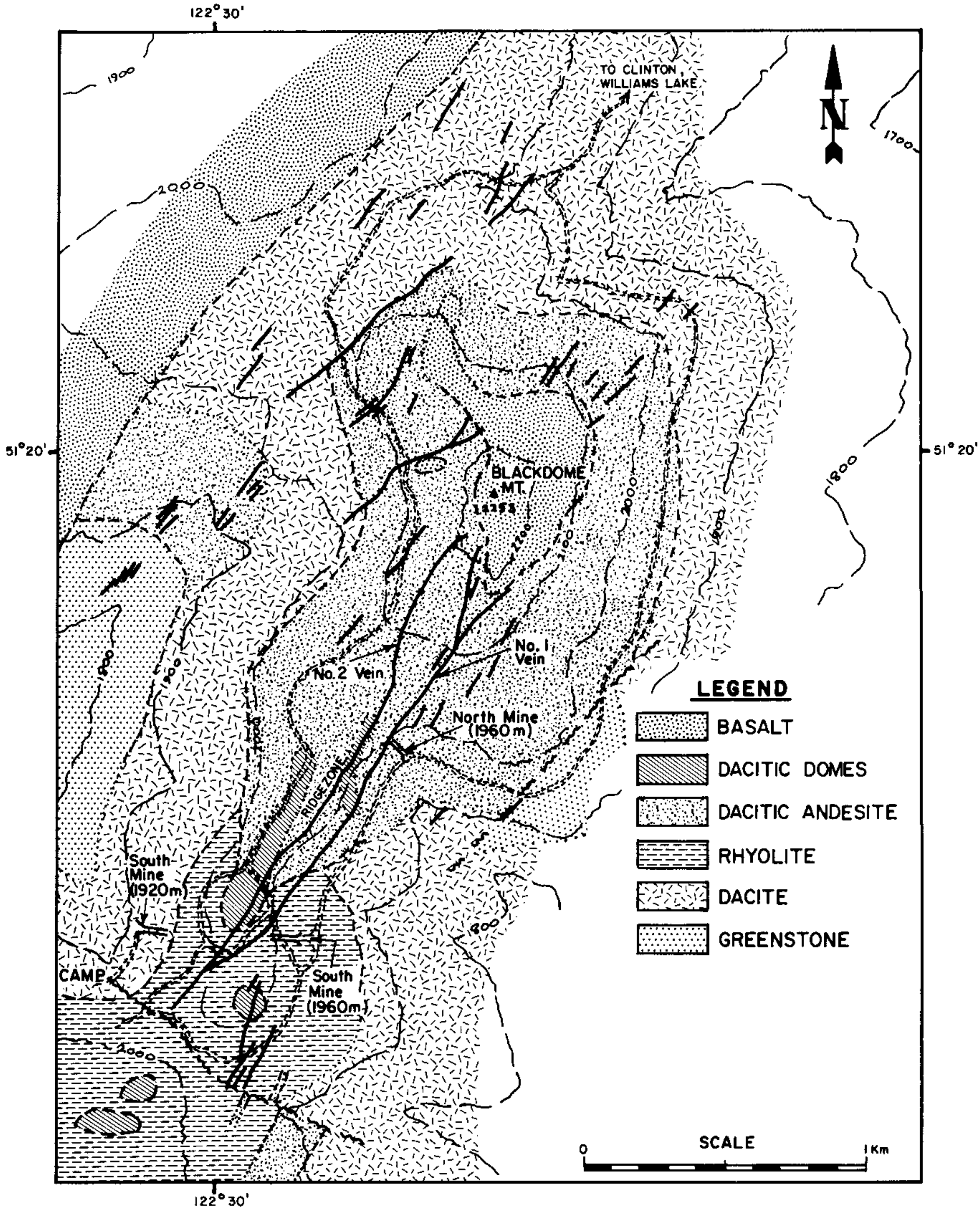

Figure 13-1. Geological setting of the Blackdome gold deposit.