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EAGLE BAY PROJECT: SURFICIAL GEOLOGY OF THE ADAMS PLATEAU (82M/4) AND NORTH BARRIERE LAKE (82M/5) MAP AREAS

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INTRODUCTION

Surficial geological mapping and drift exploration work was undertaken in 1996 by the BC Geological Survey Branch northeast of Kamloops in NTS map sheets 82M/4 (Adams Plateau) and 82M/5 (North Barriere Lake). The map area encompasses some 2000 square kilometres of rugged drift-covered terrain, overlying economically interesting Devono-Mississippian low-grade metamorphic rocks of the Eagle Bay Assemblage. Previous mining operations in volcanogenic sulphide-barite deposits such as Samatosum Mountain (MINFILE 082M 244) and Homestake (MINFILE 082M 025) confirm the high mineral potential of the region. Published detailed bedrock mapping of the area by Schiarizza and Preto (1987) and recent successful mineral discoveries in correlative rocks located in the Yukon (*i.e.* Kudz Ze Kayah and Wolverine) provided the primary impetus for renewed exploration activity in this area for VMS type mineralization. This exploration included mineral deposit studies (Höy, 1997), a stream water survey and geochemical orientation (Sibbick *et al.*, 1997), as well as 1:50 000 scale surficial mapping and drift exploration sampling. The latter two components provide vital information for mineral exploration in regions where unconsolidated sediments of variable thickness mask the underlying bedrock (Bobrowsky *et al.*, 1995).

The purpose of this paper is to describe surficial mapping methods and preliminary results focusing on the types of sediments observed, including their distribution and general character. Terrain maps showing the distribution of sediment type, estimated thickness and other terrain constraints are available at 1:50 000 scale as separate Open Files (Dixon-Warren *et al.*, 1997; Leboe *et al.*, 1997). Data pertaining to the drift exploration component of the Quaternary investigations, including till geochemistry and pebble lithology studies appear elsewhere (Bobrowsky *et al.*, 1997).

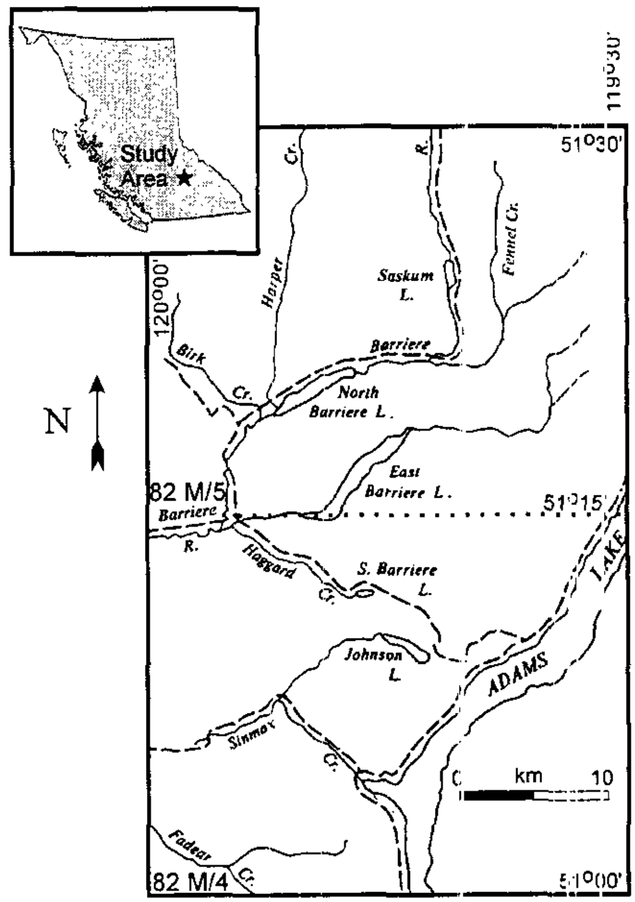

Figure 1. Location of the Adams Plateau (82M/4) and North Barriere Lake (82M/5) map areas.

PHYSIOGRAPHIC AND GEOLOGIC SETTING

The Adams Plateau and North Barriere Lake map areas are located in south-central British Columbia, approximately eighty kilometres north-northeast of Kamloops (Figure 1). The study area lies within the Shuswap Highland, a region of broad forested mountains of moderate to high relief. Elevations in the two map areas range from about 450 m above sea level along the shores of Adams Lake in the south, to about 2630 m above sea level at Dunn Peak in the northwest. Topography is variable: in the north, several peaks which rise over 600 metres above tree-line punctuate the landscape, in contrast to the area in the southwest, where the Adams Plateau is a high (1680 m a.s.l.), flat and expansive topographic feature. Throughout the two map areas, several prominent valleys trending mainly southeast to southwest occur in the area, the largest represented by the Barriere River valley.

Vegetation

Vegetation is of the Southern Columbia and Interior Subalpine forest regions (Rowe, 1972). Valley bottoms are vegetated with black cottonwood, and have been cleared and planted to suit agricultural purposes. Hillsides and plateaus between valley bottoms (at elevations of approximately 1220 m), support a dense vegetation cover of western hemlock, red cedar, and Douglas fir. Upper valley slopes up to tree-line support a community of western white and Englemann spruce, and alpine fir. Above tree-line, slopes are either devoid of plant cover or sparsely vegetated with low-lying hardy shrubs. Alder and lodgepole pine are abundant in many disturbed areas.

Hydrologic system

Lakes are a conspicuous feature of the landscape. Excluding Adams Lake in the southwest, other moderately-sized water bodies include North, South and East Barriere lakes all located near the border of the two map sheets, Johnson Lake near the centre of 82 M/4, and Saskum Lake near the centre of 82 M/5. Sinmax Creek, and numerous minor creeks, drain southeastward into Adams Lake, whereas Harper, Fennel, Fadear and Haggard creeks drain via the Barriere River westward into the Thompson River.

Geologic setting

Underlain by rocks of the Kootenay Terrane, the region contains economically attractive lithologies represented by the Eagle Bay Assemblage and the Fennell Formation. These complexly deformed low-grade metamorphic rocks of Paleozoic age are flanked to the east by high-grade metamorphics of the Shuswap Complex and to the west by Intermontane rocks (Schiarizza and Preto, 1987). In the north, much of 82M/5 is underlain by a mid-Cretaceous granodiorite and quartz monzonite intrusion (Baldy Batholith). Known mineral occurrences are mainly associated with the Eagle Bay Assemblage and Fennell Formation. Massive sulphide deposits include SEDEX Pb-Zn-Ag and BESSHI Cu-Zn-Ag deposits, as well as polymetallic Cu-Pb-Zn deposits.

SURFICIAL MAPPING

The surficial geology component of the Quaternary geology program consisted of terrain mapping at a scale of 1:50 000 and Terrain Survey Intensity Level B (Resources Inventory Committee, 1996). Work first consisted of compiling and evaluating all existing terrain information available for the area. Soil and landscape maps produced by the Resource Analysis Branch of the British Columbia Ministry of Environment in 1975 provided background data on the type of materials likely to be encountered (Kowall, 1975a and b). Regional Quaternary mapping studies by the Geological Survey of Canada (e.g. Fulton *et al.*, 1983) contributed additional information on the types and distribution of sediments.

Air photographic interpretation and 'pretyping' followed the methodology of RIC (1996) and the terrain classification system of Howes and Kenk (1988). Air photos at a scale of 1:40 000 (approx.) (flight lines 15BCC-95014 and 15BCC-95009) were used in the map generation. Preliminary polygon interpretations were then verified through ground-truthing.

STRATIGRAPHY

Seventeen stratigraphic sections were examined and described in detail within the Adams Plateau map area. At each section, the following non-genetic observations were compiled: location, height of exposure, and description of units including sediment texture, clast size, angularity, and percentage, unit thickness, and the nature of contacts between units. Sketch diagrams were made, photographs were taken, and an initial genetic interpretation was made at each section. Sediments observed represented a variety of depositional environments ranging from glacigenic to lacustrine and fluvial. All of the deposits observed were correlative to the Late Wisconsinan and/or Holocene. Sediments older than the Late Wisconsinan were not encountered. Work by others indicates that this area was last glaciated sometime after 20 230 ± 270 years BP (Dyck *et al.*, 1965) and deglaciated sometime after about 11.3 ka.

SURFICIAL SEDIMENTS

Seven main types of deposits were observed including: basal till, ablation till, glaciofluvial, glaciolacustrine, fluvial, organic, and colluvial. The relative abundance and distribution of each, a reflection of preservation potential, is largely controlled by immediate topography and postglacial erosional processes. As a general observation, the plateaus and hills are mainly covered by combinations of till, colluvium, and glaciofluvial deposits, whereas fluvial, glaciofluvial and glaciolacustrine sediments are more common in valley settings. Colluvial deposits predominate on steeper slopes, whereas till and glaciofluvial sediments are more abundant on gentler slopes. Organic deposits occur locally in all types of terrain.

Basal Till

Throughout much of the region, bedrock is mantled by variable amounts of massive, very poorly sorted matrix-supported diamicton (Photo 1). Attributes of these diamictons suggest that they are most likely basal till accumulations (*cf.* Dreimanis 1988). Deposits of diamicton ranged in thickness from less than one metre (veneer) on steeper slopes and upland areas, to several tens of metres (blankets) on the low relief terrain and gentler slopes. The surface expression of these deposits ranges from gently rolling and hummocky to ridged and streamlined.

Two types of basal till were identified, essentially reflecting the type of bedrock from which they were derived. In the south, basal till deposits are primarily massive to poorly stratified with a sandy silt to silty clay texture, and a fissile matrix. Deposits are dense, compact, cohesive with irregular jointing patterns. Clast content ranges from 10-30%, usually averaging about 25%, and clasts range in size from granules to boulders averaging some 1-5 cm (small to medium pebble size). They are mainly subrounded to subangular in shape, and consist of both local and distantly derived lithologies. A number of clasts (mainly prolate in shape) have striated, faceted surfaces. Apparent pebble fabrics are interpreted to be well-defined and appear to be aligned parallel to paleo-ice flow. Colour is variable, and is often reflective of the underlying bedrock. The presence of gossan flecks within till matrix was noted on a number of occasions.

To the north, basal till in the vicinity of the Baldy Batholith is characteristically sandier in texture. In these areas, the till accumulations are highly consolidated, light to medium grey in colour, with a clayey sand matrix. All these attributes are indicative of the granitic and granodioritic bedrock source. The modal grain size of the fine fraction is about 0.25 to 0.50 cm (coincident with the size of crystals within granodiorite outcrops), but clasts range from granule to boulder in size. Clast content ranges from 5-30% and averages about 15%.

Ablation Till

Boulder fields and massive clast-supported diamicton mantle both bedrock and basal till deposits at several locations in the high plateaus in the central and northern parts (Photo 2). In contrast to the basal tills, these diamictons are generally less compact, dense and cohesive. The sandy matrix is poorly consolidated and usually deficient in silt and clay. Clast content is higher, ranging from 20-45%. As with the basal tills, the sediments are very poorly-sorted with clast size ranging from granule to boulder (latter often abundant), but mean clast size is generally larger (about 4 cm). Clast provenance is sometimes variable, but often deposits are almost entirely monolithologic in character (Baldy Batholith origin). However, mixed lithologies including Eagle Bay Assemblage rocks increase in abundance gradually to the south. These diamictons are interpreted as supraglacial or ablation till deposits, resulting from deposition by stagnating glacier ice (*cf.* Dreimanis, 1988).

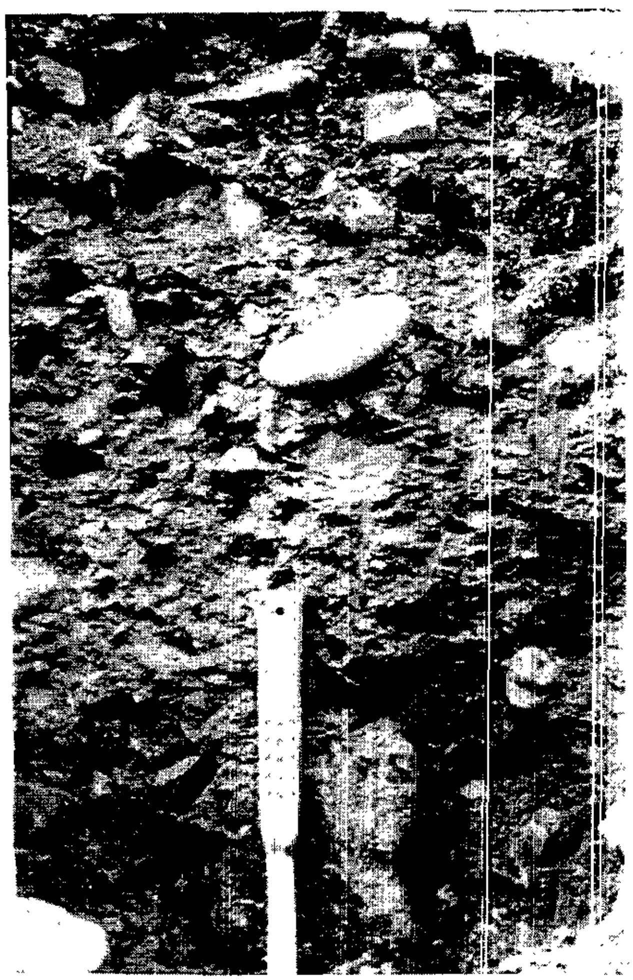

Photo 1: An exposure of basal till. Note massive nature of the matrix-supported diamicton.

Photo 2: Ablation till. Photo shows boulder field of granitic rocks. Typically observed on plateaus within the central and northern parts of the study area.

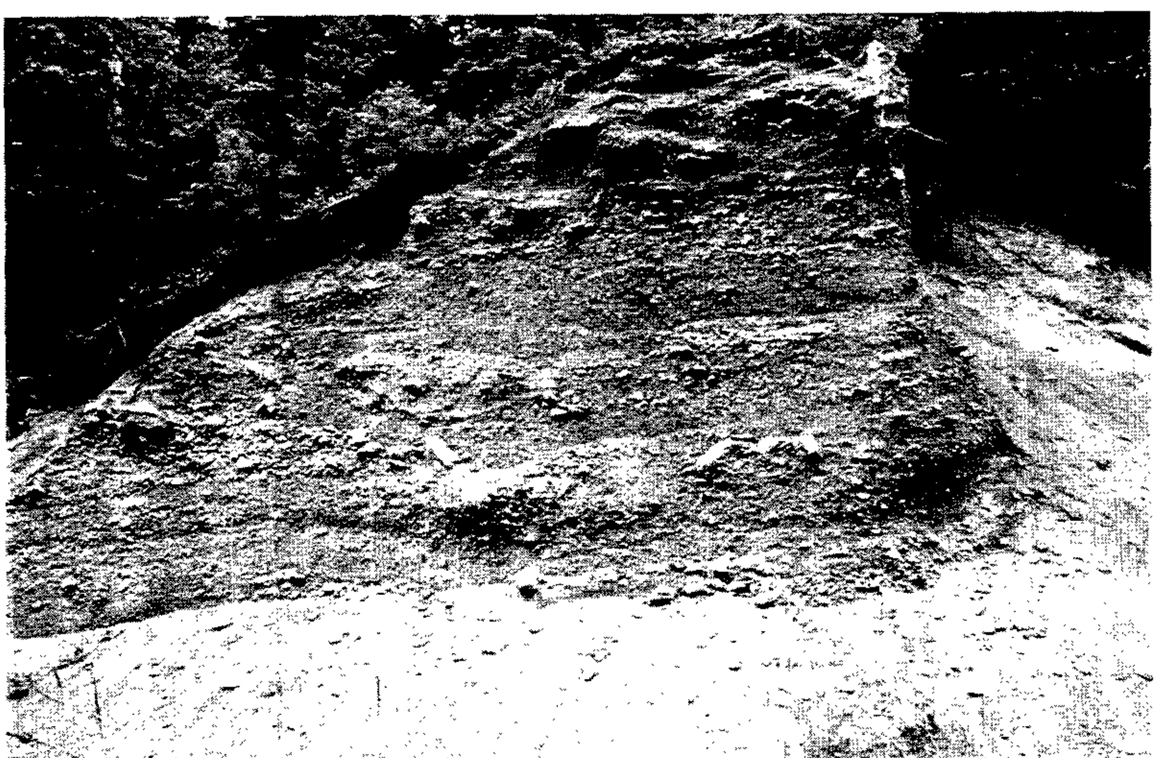

Photo 3. Well-stratified glaciofluvial gravel and sand observed several hundred metres above Adams Lake.

Glaciofluvial Sediments

Sequences of clast-supported gravel and interstratified beds of sand and silt occur in uplands and lower portions of valley slopes (Photo 3). The thickest accumulations are found along valley floors. Gravels are composed of poorly sorted, rounded clasts of variable lithologies, often ranging in size from pebbles to boulders. Deposit characteristics vary considerably from massive and crudely stratified to very well-stratified, and with normal, reverse or no grading. Open-work and matrix-filled beds were observed. Pebble imbrication and cross-stratification are present in many cases, providing indications of paleo-stream flow direction during deposition. The proportion of silty sand to coarse sand interbeds is also variable in the gravel deposits. The finer beds range from well to poorly sorted, often with cross-bedding structures and rarely with load features such as flame structures. In some cases, very coarse accumulations of sand and gravel are highly disrupted with steeply dipping, variably oriented, strongly faulted features. In other cases, deposits are well-stratified, horizontally bedded and moderately well-sorted consisting of alternating layers of sand and gravel. This range in characteristics is interpreted to reflect differences in proximity to ice during deposition, from ice-proximal to ice-distal. The deposits are all interpreted to represent glaciofluvial environments (*cf.* Miall, 1977; Collinson, 1978).

Glaciolacustrine Sediments

Along certain sections of the valley bottoms of Cicero Creek and Barriere River, and parts of the shorelines of Adams Lake, outcrops of rhythmically laminated silts are common (Photo 4). Flat, tabular horizontally stratified laminations are the most common, but ripple drift laminated beds, and ball and pillow structures also occur. Individual beds and laminations generally show sharp basal contacts, and vary in thickness from a few millimetres to several tens of centimetres. Massive, normally and reversely graded beds are present. Convolutions, rip-up clasts and load structures are occasionally present. Texturally, deposits range from sandy silt with isolated stones to clay and clayey silt with few particles coarser than sand. Penetrative structures underlying many isolated clasts indicate they are dropstones. These sediments are interpreted as being

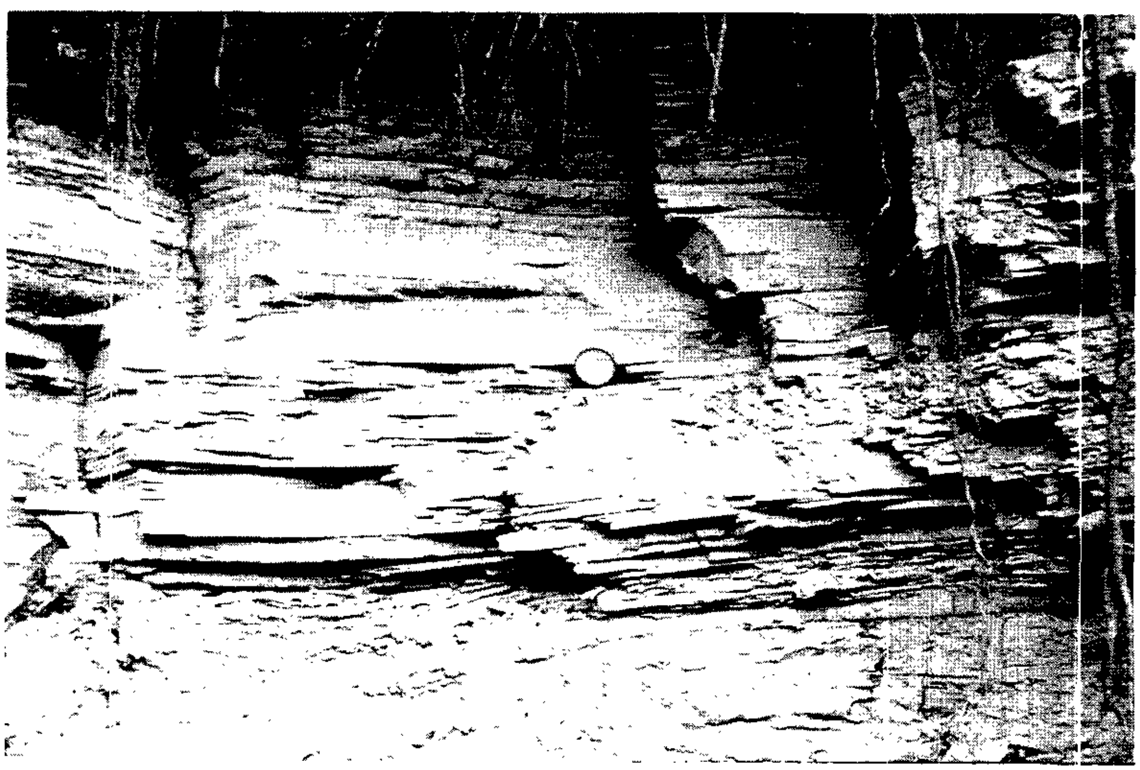

Photo 4. Bedded and laminated glaciolacustrine clayey silt.

deposited in a glaciolacustrine environment (*cf.* Shaw 1975; Catto, 1987). Variations in deposit characteristics indicate differing proximity to glacial ice sources during deposition.

Fluvial Sediments

Throughout the region, streams have incised channels and gullies into bedrock or older drift deposits. Within these areas, accumulations of clean, well-sorted and stratified sand and gravel can be observed. Clasts are generally well-rounded and reflect variable provenance. Restricted to the lower elevations of the study, fluvial deposits appear as small terraced landforms or discontinuous sediment veneers over other types of deposits preserved within the modern floodplains.

Colluvium

The high relief topography in the region accelerates the development and accumulation of colluvial debris. Deposits of colluvium vary in thickness from a few centimetres to a few metres and have been observed to overlie all other types of sediments and bedrock. Colluvial sediments accumulate as a result of gravity-induced downslope movement of fractured bedrock or other unconsolidated sediment such as till, outwash or fluvial sediments. The material contributing to the development of the colluvium strongly influences the character of the final deposit. As a result, colluvium varies from massive to crudely stratified, poorly-sorted to moderately sorted, matrix to clast-supported, monolithic to polylithic. Clast size ranges from granule to boulder and shape can include very angular to well-rounded rocks. Usually, colluvial deposits are thin, dominated by local lithologies and clasts are mainly angular in shape. Bedrock and glacial deposits on steep slopes are commonly covered by colluvium. Given the importance of relief, colluvium dominates the central and northern portions of the North Barriere Lake map area.

Organic Deposits

Extensive organic deposits are located along major meltwater channels, where well-developed streams are not present and drainage is poor. Organic deposits are also established on level upland plateaus where underlying deposits or bedrock also inhibit quick drainage.

CONCLUSION

The contemporary landscape of the Adams Plateau-North Barriere Lake region is the product of a well-documented glacial and postglacial geological history. Although the area has been subjected to several glaciations, it is the effects of the final glaciation during the Late Wisconsinan, coupled with extensive modification during the Holocene that has had the most pronounced impact on the type and distribution of surficial sediments in this area. Much of the area, except the highest peaks in the northwest where bedrock exposures are abundant, is covered by some form of glacigenic material, often a veneer or blanket of basal till, but in some cases also a supraglacial till. The next most ubiquitous type of deposit consists of various types of colluvium usually in the form of veneers less than a metre in thickness which overlie either bedrock or other types of unconsolidated sediment. Stratified outwash deposits are found in valley bottoms often at higher elevations, whereas postglacial fluvial deposits are more common at lower elevations. Although more abundant in surrounding areas beyond the limit of mapping, glaciolacustrine sediments are also found in low-lying depressions and at elevations correlative to regional postglacial lake levels. Finally, in flat areas of poor drainage, organic deposits are commonly found.

Knowledge regarding the type, character, thickness and distribution of unconsolidated sediments covering bedrock is an important element in any regional and local exploration program. Because bedrock is often masked by a cover of overburden, the proper genetic interpretation of these deposits is essential in recognizing and delimiting potential areas of mineralization. Knowledge of paleo-flow direction, responsible for erosion and sediment deposition (both glacigenic and non-glacigenic) is equally critical in any program relying on a drift exploration approach. The surficial sediment information presented here should be integrated with the till geochemistry focus presented elsewhere (Bobrowsky *et al.*, 1996) to ensure success in a regional drift prospecting initiative in this region.

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