

sulfide system formed in a subaqueous environment, and are of the bimodal siliciclastic massive sulfide type, which has the largest average size of all volcanogenic massive sulfide types.

Soil geochemical surveys effectively identify altered and mineralized segments of the prospective belt, which is covered by an extensive, but thin, veneer of overburden; the surveys are used extensively to guide ongoing early-stage exploration. Recognition of the structural style, stratigraphic position, felsic dome formation, and alteration vectors led to the discovery of the blind South Naranjo, El Largo, and El Rey deposits, and the recognition is currently being used

to guide exploration within Farallon's mineral concessions.

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### 13. THE ESKAY CREEK Au-Ag MINE: OPPORTUNITIES IN A COMPLEX MINERALIZED SYSTEM IN NORTHWESTERN BRITISH COLUMBIA

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#### INTRODUCTION

The Eskay Creek mine, owned by Prime Resources Group Inc. and operated by Homestake Canada Inc., is about 80 km north of Stewart, British Columbia. Eskay Creek is one of the highest grade Au and Ag deposits in the world. Since the commencement of exploitation in January 1995, production to the end of June 1997 from the Eskay Creek 21 Zone has totaled 16,133 kg Au and 870,900 kg Ag (518.685 and 28.0 million oz, respectively). Proven and probable ore reserves at the beginning of 1997 were 1.27 Mt grading 59.3 g/t Au and 2719 g/t Ag. The bulk of the ore is contained in the 21B zone (Britton *et al.* 1990; Edmunds *et al.* 1994; Roth *et al.* 1997; Sherlock *et al.* 1994), and is shipped directly to smelters in Japan and Eastern Canada. The other reserves are contained in subzones which have different mineralogical and metallurgical characteristics, and which are amenable to concentration through a gravity and flotation circuit. Construction of an on-site mill to process these ores has commenced and is scheduled for completion by the end of 1997.

#### GEOLOGICAL SETTING

The Eskay Creek deposit is hosted by Middle Jurassic volcanic and sedimentary rocks in the upper part of the Hazelton Group. The mine sequence comprises an upright stratigraphic succession of andesite, marine sediments, intermediate to felsic volcanoclastic rocks, rhyolite,

mudstone hosting stratiform mineralization (termed the contact mudstone), and basaltic sills and flows which are intercalated with turbiditic mudstones. The lower part of the sequence is intruded by porphyritic monzodiorite to diorite, and by younger felsic dykes and sills which are feeders to the rhyolite package. Basaltic dykes and sills that feed the hangingwall basaltic package crosscut all strata in the mine sequence. Regional metamorphic grade in the area is lower greenschist facies.

The mine stratigraphy is folded into a N-NE-trending upright open fold, plunging gently to the north. Stratiform mineralization in the 21 Zone occurs on the western limb of the fold, near the fold closure, and generally dips 30 to 45° W. Stratigraphy is disrupted by a series of NW-trending faults, as well as by N-NW axial planar faults.

#### EXPLORATION HISTORY

Exploration in the area began in 1932 when prospectors were drawn to the area by prominent gossanous bluffs formed by the altered felsic intrusive rocks which feed the rhyolite. Two adits were driven on precious-metal-rich stockwork veins in the felsic intrusive and footwall rhyolite. Numerous companies explored the property in the following years, mainly concentrating on stockwork mineralization.

In the mid 1980s a junior company, Kerrisdale Resources, drilled four holes near the 21 Zone, including one that encountered stratiform mineralization in the 21A Zone. Follow-up drilling in 1988 by joint-venture partners

**Table 1. Summary of mineralization styles in the Eskay Creek 21 Zone**

Zone	Characteristics	Stratigraphic Position
21A	Stratiform lens of massive to semi-massive sulfides (realgar, stibnite, cinnabar, arsenopyrite) underlain by disseminated stibnite, arsenopyrite, and tetrahedrite, and veinlets of pyrite, sphalerite, galena, tetrahedrite, ± chalcopyrite. Exploration target.	same horizon as 21B Zone, at base of contact mudstone; overlies disseminated mineralization within rhyolite
21B	Stratiform, bedded clastic sulfides and sulfosalts including: sphalerite, tetrahedrite - freibergite, Pb-sulfosalts (including boulangerite, bournonite, jamesonite), stibnite, galena, pyrite, "electrum", mercurian silver. High grade Au-Ag. Ore is shipped directly to smelter.	at or near base of contact mudstone
East Block of 21B	Fine-grained massive to locally clastic sulfides and sulfosalts. Massive flooding by silica and by pyrite in rhyolite, grading upward into massive sulfides and sulfosalts. Ore is shipped directly to smelter; some millable ore.	within fault-bounded block, at contact between rhyolite and mudstone
NEX	Massive to locally clastic bedded sulfides with fewer sulfosalts than in the 21B Zone, and local overprint of chalcopyrite stringers. Millable ore.	same horizon as 21B zone, at base of contact mudstone
21C	Massive to bladed barite associated with very fine-grained disseminated sulfides, including pyrite, tetrahedrite, sphalerite, and galena. Exploration target.	same horizon as 21B Zone, at base of contact mudstone
Hanging Wall (HW)	Massive, fine-grained stratabound sulfide lens dominated by pyrite, sphalerite, galena, and chalcopyrite (mainly as stringers). This zone has generally lower Au-Ag grades and higher base metals relative to the 21 zones. Portions shipped directly to smelter.	within mudstone; at a higher stratigraphic level than the 21 zones; generally above first basalt sill
109	Stockwork veins of quartz, sphalerite, galena, pyrite, and visible gold associated with silica flooding and fine-grained amorphous carbon alteration. Millable ore.	discordant, within rhyolite
Pumphouse	Very fine disseminations and veinlets of pyrite, sphalerite, galena, and tetrahedrite in rhyolite. Geological resource under evaluation.	discordant, within rhyolite

Stikine Resources Limited and Calpine Resource Inc. confirmed stratiform discordant, within rhyolite mineralization in the 21A Zone; high-grade mineralization in the 21B Zone was subsequently encountered about 200 m to the north of the discovery hole. Step-out drilling intersected the 109 Zone, which was later delineated from underground drill-stations. In 1995, drill testing of the productive rhyolite-contact horizon to the north of the 21B Zone delineated the North Extension (NEX) Zone. In contrast to the 21B Zone, portions of the 109 and NEX zones will be concentrated through gravity and flotation.

#### MINERALIZATION

The 21 Zone contains a number of subzones

distinguished by variations in mineralogy, textures, grades, and metallurgical characteristics (Table 1). Stratiform mineralization is hosted in marine mudstone at the contact between underlying rhyolite and overlying basalt packages. The 21A, 21B, 21C, and NEX zones occur at this stratigraphic contact. The HW Zone is stratigraphically higher in the sequence, usually above the first basaltic sill. Stockwork vein and disseminated mineralization are present in the rhyolite, most notably in the 109 and Pumphouse zones.

The 21B Zone contains the bulk of the ore and consists of clastic sulfide-sulfosalt beds. Sedimentary facies variations are well-preserved locally, although commonly overprinted by later sulfosalts and locally by stibnite ± cinnabar in the core of the deposit. The thickest beds and

coarsest clasts occur at the core of the orebody. Clast size and bed thickness typically decrease stratigraphically upward and laterally outward, progressively thinning to fine laminations and disseminated sulfides and sulfosalts in mudstone.

Although the depositional environment, geometry and associated alteration of the Eskay Creek deposit most closely resemble a VMS model, the high grades of precious metals, association with an Sb-Hg  $\pm$  As element suite, and the importance of bedded clastic sulfide-sulfosalt ore indicate that processes more commonly associated with epithermal environments were active at the time of formation.

#### EXPLORATION OPPORTUNITIES

The main focus of exploration around the Eskay Creek mine has been at the stratigraphic horizon that hosts the 21B Zone. This strategy resulted in successful identification of the NEX zone, and in a significant increase in proven and probable reserves on the eastern limb of the 21B Zone in 1996.

The synergy of the established smelter production base and the new mill ores provides increased economic incentive to search for both stratabound and discordant feeder-style mineralization. Many opportunities remain untested.

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## 14. EPITHERMAL GOLD MINERALIZATION AT THE VIRGEN PROPERTY, PERU

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The Virgen property is 160 road kilometers east of Trujillo, in north-central Peru. The property is located on the continental divide, at elevations of 3,600 to 4,100 m. The property is underlain in part by Cretaceous sedimentary rocks of the Chicama Formation (shale), the Goyllarisquizga Group (a shallow marine to deltaic siliciclastic sequence), and the Inca Formation (limestone and calcarenite). Early Tertiary deformation has produced regional northeast-verging folds and west-dipping thrust faults. Metamorphic rank is sub-greenschist.

Tertiary-age Calipuy Group subaerial volcanic rocks unconformably overlie older sedimentary rocks. The unconformity surface is marked by a regolith, characterized by blocks of quartz arenite. The Calipuy Group is dominated

by intermediate feldspar-phyric flows, block breccia, welded tuff, and volcanoclastic sedimentary rocks. Extensive outcrop areas of Calipuy Group begin 3 km west of the property, and on the property these units form hill-capping outliers and valley-fill deposits. The Calipuy Group is moderate to shallow west-dipping, faulted, and is intruded by numerous feldspar and hornblende-phyric dykes and stocks.

Gold mineralization at the Virgen property is hosted in zones of "hydrothermal breccia". Two breccia types occur: one has only sedimentary clasts, and the other is polyolithic, containing both sedimentary and igneous clasts. Breccia forms crosscutting bodies that are lenticular and are bedding-parallel to dyke-like in shape, with irregular to sharp contacts. Discrete breccia bodies vary from a few

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