Casino porphyry copper-gold-molybdenum deposit, central Yukon (Yukon MINFILE 115J028)

S.G. Casselman*
Yukon Geological Survey

H. Brown
Western Copper and Gold Corporation

Casselman, S.C. and Brown, H., 2017. Casino porphyry copper-gold-molybdenum deposit, central Yukon (Yukon MINFILE 115J028). *In:* Yukon Exploration and Geology Overview 2016, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 61-74, plus digital appendices.

ABSTRACT

The Casino deposit is located in west-central Yukon, 300 km northwest of Whitehorse. Porphyry-style mineralization was discovered on the property in 1969 and the property has experienced exploration on and off since that time. Casino is a calc-alkaline porphyry copper-gold-molybdenum deposit hosted in Late Cretaceous quartz monzonite of the Casino suite and associated breccia along the margins of the intrusion. The deposit exhibits typical alteration assemblages of a porphyry copper deposit, with a central core of potassic alteration grading outwards to concentric phyllic and propylitic zones. The Casino deposit is unique among Canadian porphyry deposits in that it has a substantially preserved, outcropping leached cap; an upper, copper oxide supergene mineralized zone; a lower, copper sulphide supergene mineralized zone; as well as an underlying hypogene zone. The total resource of the Casino deposit in the measured, indicated and inferred category includes 101 million tonnes grading 0.39 g/t Au in the oxide gold zone, 87 million tonnes grading 0.25% Cu, 0.29 g/t Au, 0.02% Mo and 1.7 g/t Ag in the supergene oxide enriched zone and 2.7 billion tonnes of sulphide ore grading 0.16% Cu, 0.19 g/t Au, 0.02% Mo and 1.5 g/t Ag in the combined supergene sulphide and hypogene zone.

* scott.casselman@gov.yk.ca

INTRODUCTION

The Casino porphyry copper-gold-molybdenum deposit (Yukon MINFILE 115J 028) is located at the headwaters of Canadian and Casino creeks, on Patton Hill in northeastern Stevenson Ridge of the Dawson Range Mountains. It is centered at 62°44′16″ N latitude and 138°49′41″ W longitude, 21 km south of the Yukon River, 300 km northwest of Whitehorse, and 120 km due west of Pelly Crossing, Yukon (Fig. 1).

The deposit was discovered in 1969 and it has a long history of exploration and ownership. The discovery was made by the Brynelsen Group, which consisted of Brameda Resources, Quintana Minerals and Tech Corporation. In 1991, Archer Cathro & Associates (1981) Ltd. optioned the property and assigned the option to Big Creek Resources Ltd. The following year, Big Creek amalgamated with Pacific Sentinel Gold Corp. In 2003, First Trimark Resources and CRS Copper Resources acquired the property and in 2004 they combined to form Lumina Copper Corporation. Western Copper Corporation acquired Lumina in an all shares deal in 2006, and in 2011, Western Copper reorganized and changed their name to Western Copper and Gold Corporation.

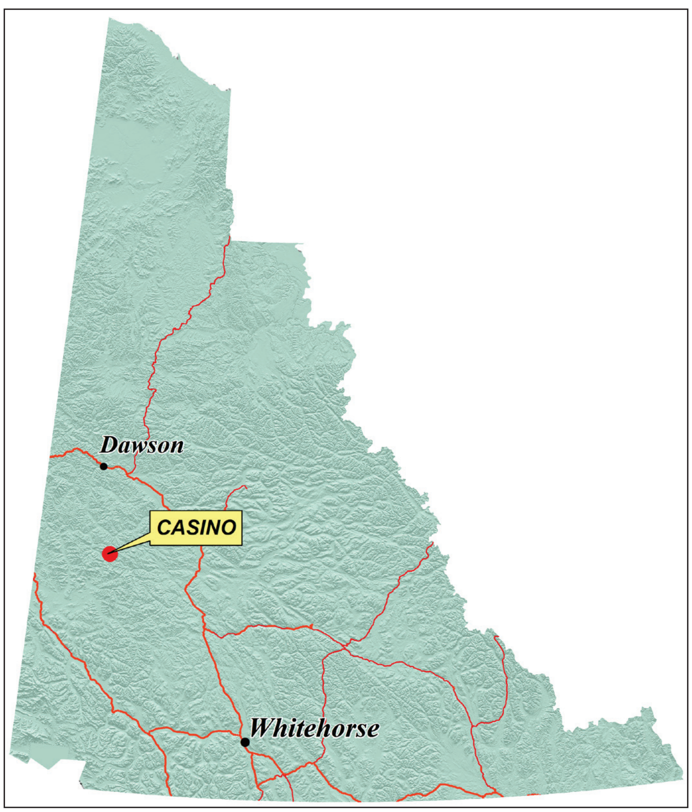


Figure 1. *Casino deposit location.*

The exploration history of the property includes property scale mapping, soil sampling, ground geophysical surveys (VLF-EM, HLEM, magnetics, Titan-24 DC Resistivity, IP and MT Resistivity), bulldozer trenching, reverse circulation drilling (5188 m) and diamond drilling (117 334 m), including drilling for geotechnical, hydrogeological and metallurgical purposes (11 466 m).

The Casino deposit is unique among Canadian porphyry deposits in that it has a substantially preserved, outcropping leached cap; an upper, copper oxide-enriched supergene mineralized zone; a lower, copper sulphide-enriched supergene mineralized zone; and underlying hypogene mineralized zone. In 2013, Western Copper and Gold updated the mineral resource estimate of the deposit in the measured, indicated and inferred (M, I & I) resources for the leached cap of 101 million tonnes grading 0.38 g/t gold at a 0.25 g/t gold cut-off. The M, I & I resource of the combined supergene sulphide and hypogene zone, at a 0.25% copper equivalent cut-off, is 2.7 billion tonnes grading 0.16% copper, 0.186 g/t gold, 0.021% molybdenum and 1.49 g/t silver for an equivalent copper grade of 0.42%.

REGIONAL GEOLOGY

The regional geological setting of the northeastern Stevenson Ridge area consists of metamorphosed and poly-deformed Paleozoic basement rocks of the Yukon-Tanana terrane intruded by relatively little-deformed mid to Late Cretaceous granitoids (Fig. 2; Ryan *et. al.*, 2013).

YUKON-TANANA TERRANE

The oldest rocks of the Yukon-Tanana terrane are the pre-Devonian Snowcap assemblage (unit PDSs) which consists of mostly amphibolite facies siliciclastic rocks including quartzite, micaceous quartzite and psammitic quartz-muscovite-biotite (± garnet) schist. Marble occurs as decametre-thick lenses interlayered with amphibolite and garnet amphibolite (Ryan *et. al.*, 2013). The amphibolite is interpreted as the metamorphosed equivalent of mafic sills and dikes (Ryan *et. al.*, 2013).

Southwest of the Casino property the Late Devonian-Early Mississippian Finlayson assemblage (unit DMFbp), locally termed the Stevenson Ridge schist (Ryan *et al.*, 2013) forms a monotonous sequence of grey to black, carbonaceous quartzite, psammite and phyllite. Protoliths likely include carbonaceous, siliceous shale, pelite and chert (Ryan *et al.*, 2013).

Highly foliated to gneissic hornblende-biotite and biotite granodiorite rocks, of the Mississippian Simpson Range suite (unit MgSR), are located north of the property, along Britannia Creek and north of the Yukon River. Locally, these rocks are thrust over the Snowcap assemblage along the Yukon River thrust, however, regionally they are known to intrude the Snowcap assemblage (Ryan *et. al.*, 2013).

Both the Snowcap and Finlayson assemblages are intruded by K-feldspar porphyroblastic augen granite of the Permian Sulphur Creek suite (unit PqS); the extrusive equivalent is the Klondike schist (unit PKf). Both of these units are mapped west of the Casino property.

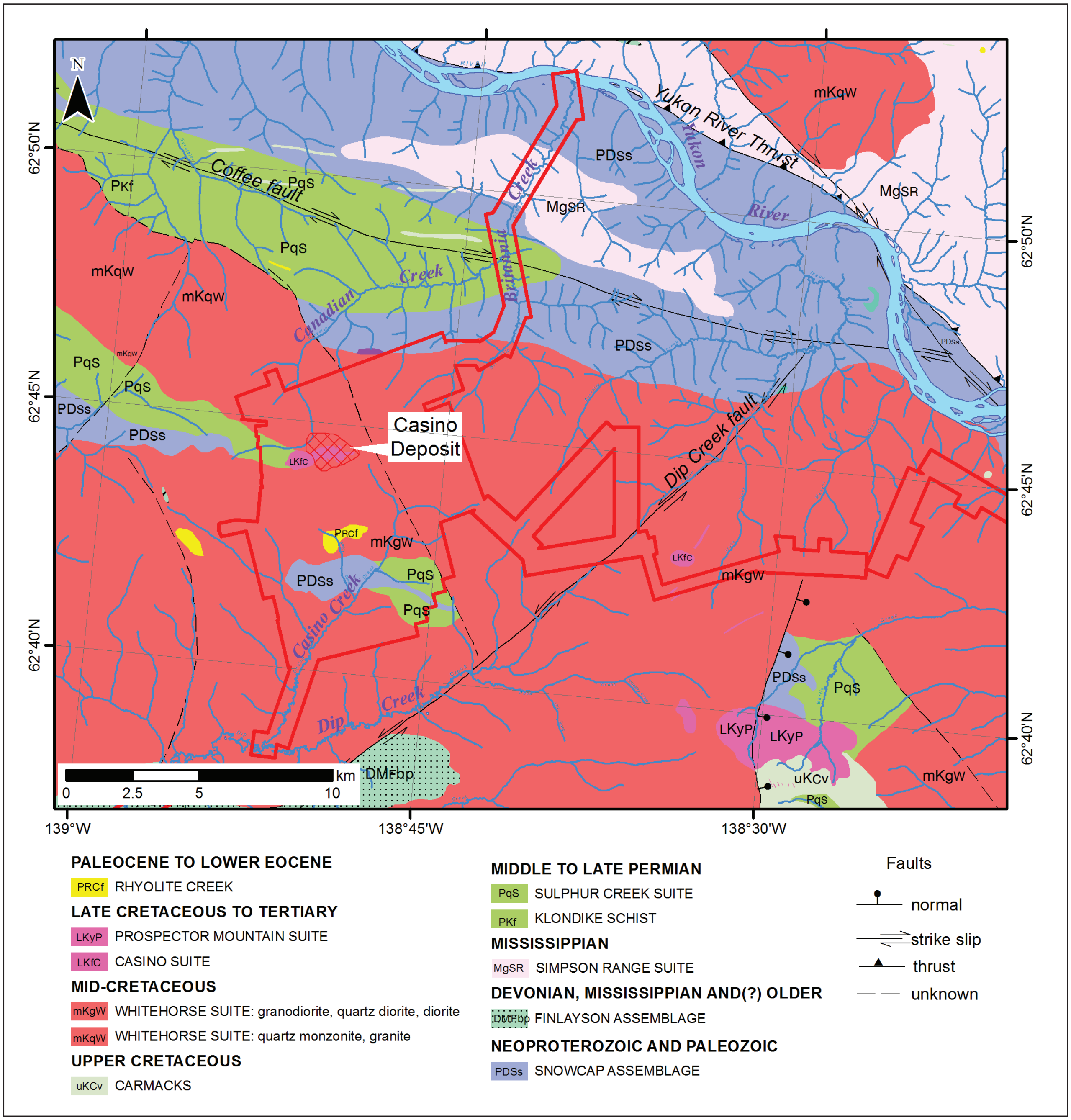


Figure 2. *Regional geology map modified from Ryan et. al. (2013).*

MESOZOIC IGNEOUS ROCKS

The central part of the northeastern Stevenson Ridge area is dominantly middle Cretaceous (104±0.5 Ma; Selby and Nesbitt, 1998) Whitehorse suite granitoid of two distinct phases. The more voluminous Dawson Range phase (unit mKgW) is composed of white to beige, hornblende-biotite granodiorite and lesser granite, tonalite, quartz diorite and diorite. It is characteristically blocky weathering, hornblende-phyric and medium to coarse-grained. Foliation is weak to absent. The less voluminous Coffee Creek phase (unit mKqW) is composed of unfoliated pink to beige, biotite monzogranite. It is medium to coarse-grained, characterized by smoky quartz phenocrysts, and is locally pegmatitic. The Dawson Range and Coffee Creek phases generally occur as distinct plutons.

The Late Cretaceous (72.4±0.5 Ma U-Pb zircon; Selby and Nesbitt, 1998) Casino suite (unit LKfC) comprises sparse, small volume porphyritic quartz monzonite plutons that host the Casino Cu-Au porphyry and other intrusion-related mineralization in the region (*e.g.*, Sonora Gulch, Revenue). Casino suite intrusions are fine to medium-grained, and are alkali feldspar-plagioclase-biotite-quartz-phyric. The Prospector Mountain Suite (unit LKyP) is largely co-spatial with the Casino suite and is characterized by light grey to pink alkali feldspar-biotite-hornblende porphyritic, fine to medium-grained quartz monzonite dikes, sills and hypabyssal plugs.

The Late Cretaceous Carmacks Group (unit uKCv) comprises an intermediate to mafic volcanic and volcaniclastic lower sequence, and a more mafic, flow-dominated upper sequence (Colpron, *et. al.*, 2016). Basalt to andesite flows, sills, and tuff-breccia are the most abundant rock type, and are in part coeval with the Prospector Mountain Suite. The Carmacks Group is widespread throughout west-central Yukon.

The Paleogene Rhyolite Creek complex (unit PRCf) constitutes small erosional remnants and intrusions in the southwestern part of the area. Quartz (generally smoky) and feldspar-porphyritic dikes predominate, with less common flow-banded rhyolite and locally grey-green to mauve andesitic volcanic to hypabyssal rocks. These are easily confused with similar looking hypabyssal varieties of the Casino suite and the Coffee Creek phase.

STRUCTURAL GEOLOGY

The central belt of Yukon-Tanana terrane is characterized by at least two phases of isoclinal folding and development of transpositional foliation (Ryan *et. al.*, 2013). The main foliation developed at upper greenschist to amphibolite facies conditions. The second regionally pervasive foliation is present in Permian and older rocks, and is thought to have developed in the late Permian Klondike orogeny. The main structural feature in the region is the Yukon River thrust, which emplaces Simpson Range suite rocks on top of Snowcap and Sulphur Creek rocks south of the Yukon River. Mid to Late Cretaceous strike slip and normal faults in the Dip Creek and Casino Creek valleys appear to have long strike length, but do not have significant offset (Ryan *et. al.*, 2013).

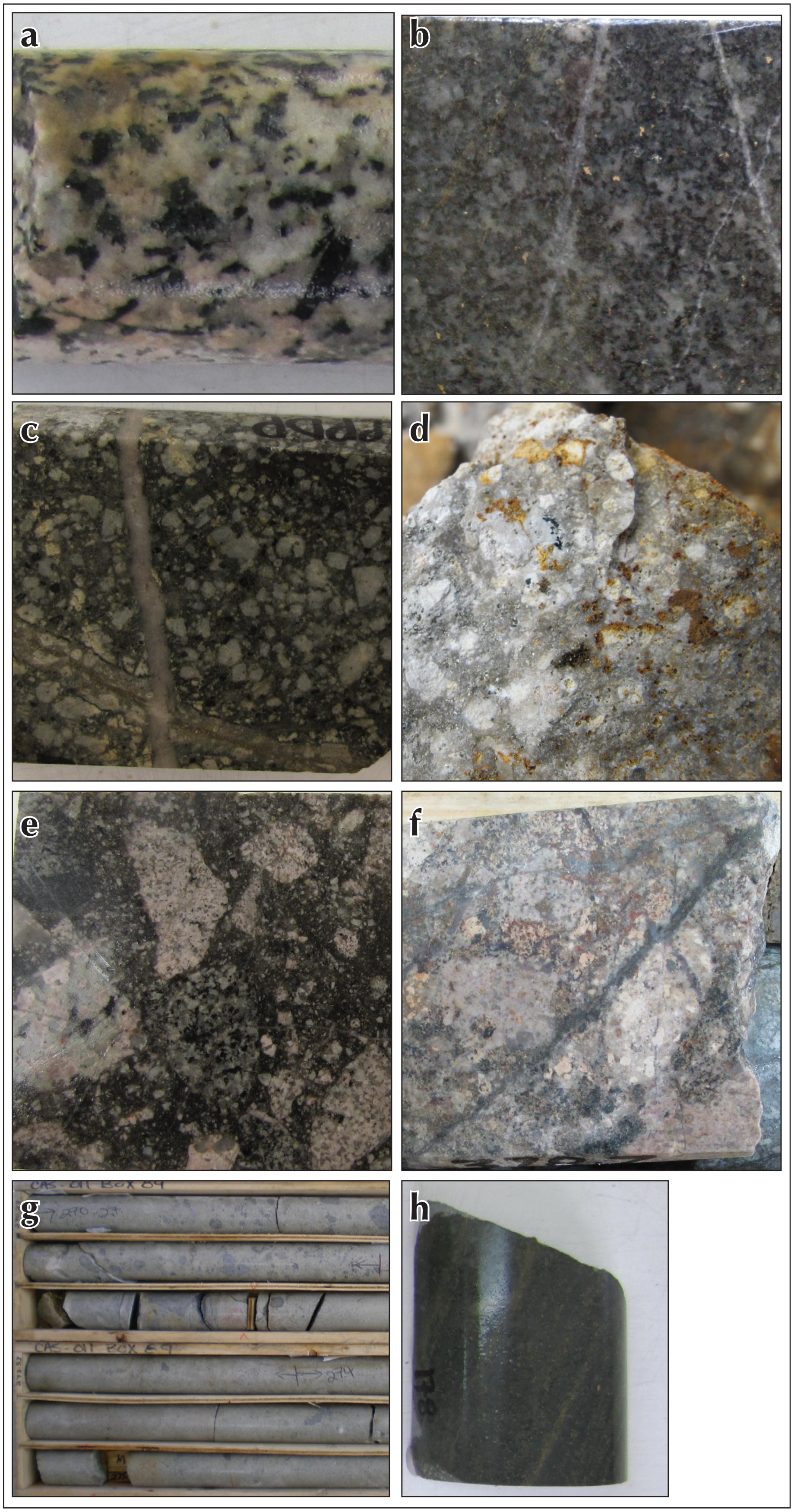
DEPOSIT GEOLOGY

Casino is classified as a calc-alkaline porphyry deposit. The geology near the deposit consists of five main units: the Dawson Range phase of the Whitehorse suite and four Casino suite units. These are locally named *Patton Porphyry, Intrusion Breccia*, *Explosion Breccia and Patton Dikes*. The majority of the ore at Casino is hosted in the Dawson Range phase, *Patton Porphyry* and *Intrusion Breccia*. Secondary supergene mineralization does spread into the upper few hundred metres of all units listed; including the *Explosion Breccia*.

WHITEHORSE SUITE - DAWSON RANGE PHASE

The mid-Cretaceous Dawson Range phase of the Whitehorse suite is the main country rock of the deposit area and, locally is a biotite-hornblende granodiorite (Fig. 3a), hornblende-biotite-quartz diorite, hornblende-biotite diorite (Fig. 3b). Hornblende-biotite bearing phases are common throughout the deposit, and lesser biotite-hornblende bearing phases are generally north of Patton Hill. Diorite is concentrated north and northeast of the deposit, and is considered to be the earliest phase of the batholith (Godwin, 1975).

The diorite is typically dark grey to brown and inequigranular. Average grain size is less than 1 mm, dominated by locally aligned and/or zoned plagioclase, hornblende, and interstitial, anhedral quartz. In places, primary biotite is more abundant than hornblende. Accessory minerals include up to 1% apatite and trace sphene. Some intrusions show foliation and increased mafic content near their margins, particularly north of the deposit and in the block east of the Casino Creek fault (Bower *et al.*, 1995). Locally, mafic diorite is cut by later, more felsic phases of the Dawson Range batholith (Johnston, 1995).



Granodiorite units are generally pale grey, medium to coarse grained and equigranular to porphyritic. They can be distinguished by scattered, subhedral hornblende phenocrysts averaging 0.5 to 1.2 cm long; poikilitic K-feldspar; zoned plagioclase; and 10 to 20% mafic minerals, which may be layered. Plagioclase shows minor myrmekitic rims when in contact with K-feldspar. Anhedral quartz and K-feldspar are interstitial to earlier subhedral plagioclase, hornblende and biotite. Locally, quartz forms interlocking aggregate of slightly, to moderately strained grains. Accessory minerals include honey-coloured sphene and apatite to 1% each.

CASINO SUITE

Late Cretaceous igneous activity of the Casino suite is locally represented by the *Patton Porphyry* intrusive and associated breccia. The main body of the *Patton Porphyry* (Fig. 3c,d) is an irregular hypabyssal intrusion that is surrounded by an intrusive breccia in contact with rocks of the Dawson Range phase of the Whitehorse suite. The *Patton Porphyry* intruded as a relatively narrow pipe-shaped body on the east side of Patton Hill and blossomed upwards and westwards into a sill-like body that measures 600 by 800 m in plan and is up to 300 m thick, thinning to the west (Fig. 4). Contacts between the hypabyssal intrusion and breccia are variable and range from sharply intrusive (as in the case of the later *Explosion Breccia*) to

Figure 3. *Representative rock samples from the Casino deposit.* ***(a)*** *Dawson Range suite granodiorite,* ***(b)*** *Dawson Range suite diorite,* ***(c)*** *Patton Porphyry (fresh),* ***(d)*** *Patton Porphyry (weathered),* ***(e)*** *Intrusion Breccia,* ***(f)*** *phyllic altered Intrusion Breccia,* ***(g)*** *Explosion Breccia,* ***(h)*** *Patton Dike.*

gradational and brecciated (as in the case of the *Intrusion Breccia*). It has been suggested by Bower *et al.* (1995) and Selby and Creaser (2000) that this suite consists of two or more episodes of high-level intrusions.

The *Patton Porphyry* has an overall composition of rhyodacite (Bower *et al.*, 1995). It most commonly occurs as distinct, euhedral, phenocrysts of plagioclase (generally 4 to 7 mm, locally up to 2.5 cm in length) that can comprise up to 50% of the rock, and lesser biotite, hornblende, quartz and opaque minerals. Biotite is subhedral, generally chloritized and kink banded, 2-3 mm across, and makes up 1-5% of the rock. Hornblende phenocrysts are generally altered and difficult to recognize in hand sample; they have generally been replaced by chlorite and other opaque minerals, but can be recognized by their diamond cross section. Quartz phenocrysts are not always present but can be anhedral, embayed, and 3-5 mm in size. K-feldspar phenocrysts are rare but the mineral is abundant in the microcrystalline matrix that is commonly medium to dark green.

The *Intrusion Breccia* (Fig. 3e,f) surrounding the main *Patton Porphyry* body consists of angular blocks and fragments of granodiorite, diorite and lesser meta-igneous and metasedimentary xenoliths of Snowcap assemblage and Sulphur Creek suite origin, in a finer grained rhyodacitic matrix of *Patton Porphyry* origin. The *Intrusion Breccia* formed along the margins of the *Patton Porphyry* by the stoping blocks of country rock. Fragments range in size from less than 1 cm to greater than several metres, and are generally found proximal to similar country rock, indicating limited transport and/or mixing (Bower *et al.*, 1995). For example, fragments of the Dawson Range phase granitoid increase along the southern margin of the breccia body; older metamorphic fragments are more common to the north; and bleached diorite to the east.

Two late stage breccia pipes are observed in the deposit area, one on the eastern edge of the deposit and one on the western edge (Fig. 5). These host the *Explosion Breccia*. The pipes are steep-sided, heterolithic,

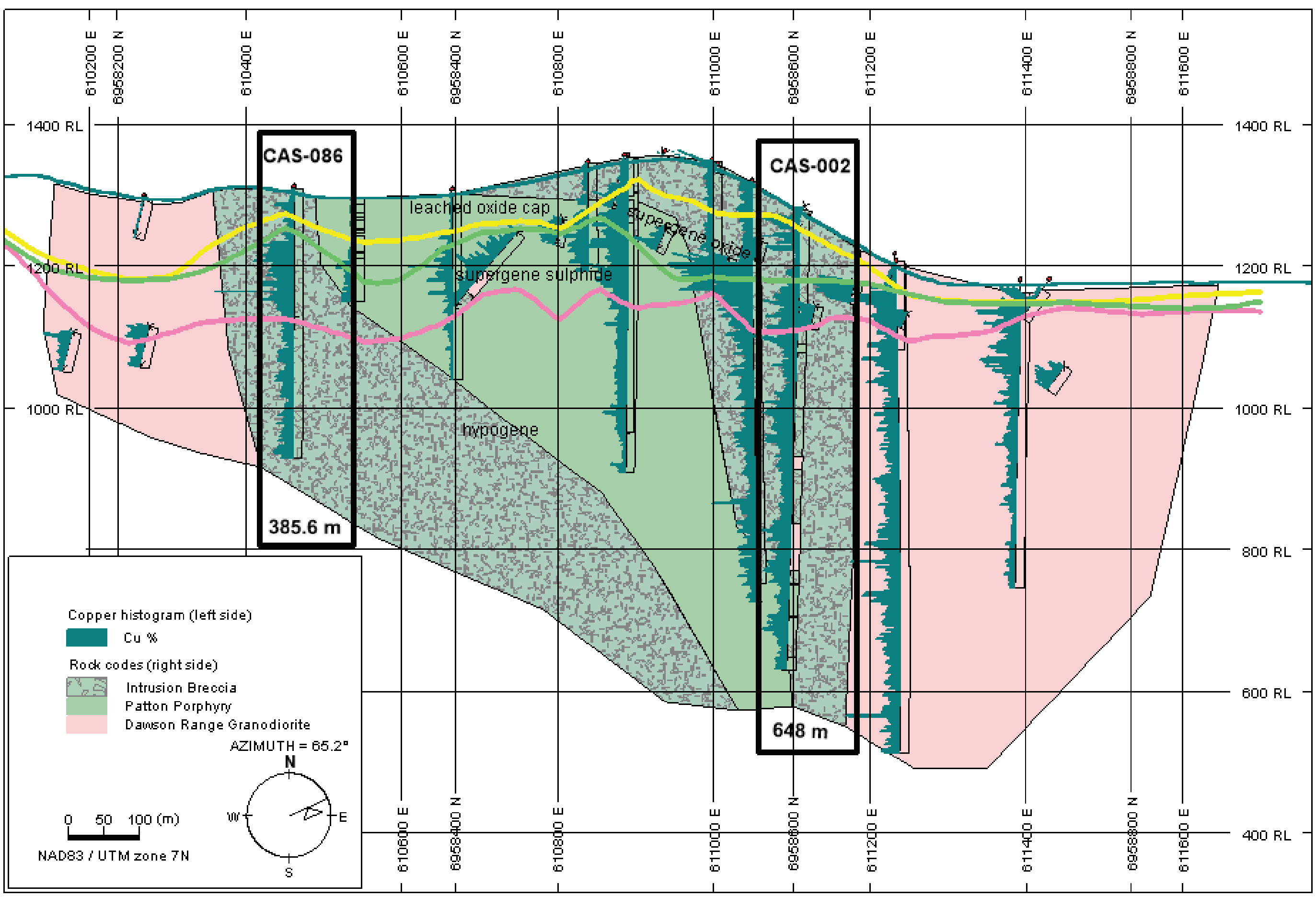


Figure 4. *Cross section C-C′; east-west cross section through the Casino deposit including diamond drill holes CAS-002 and CAS-086.*

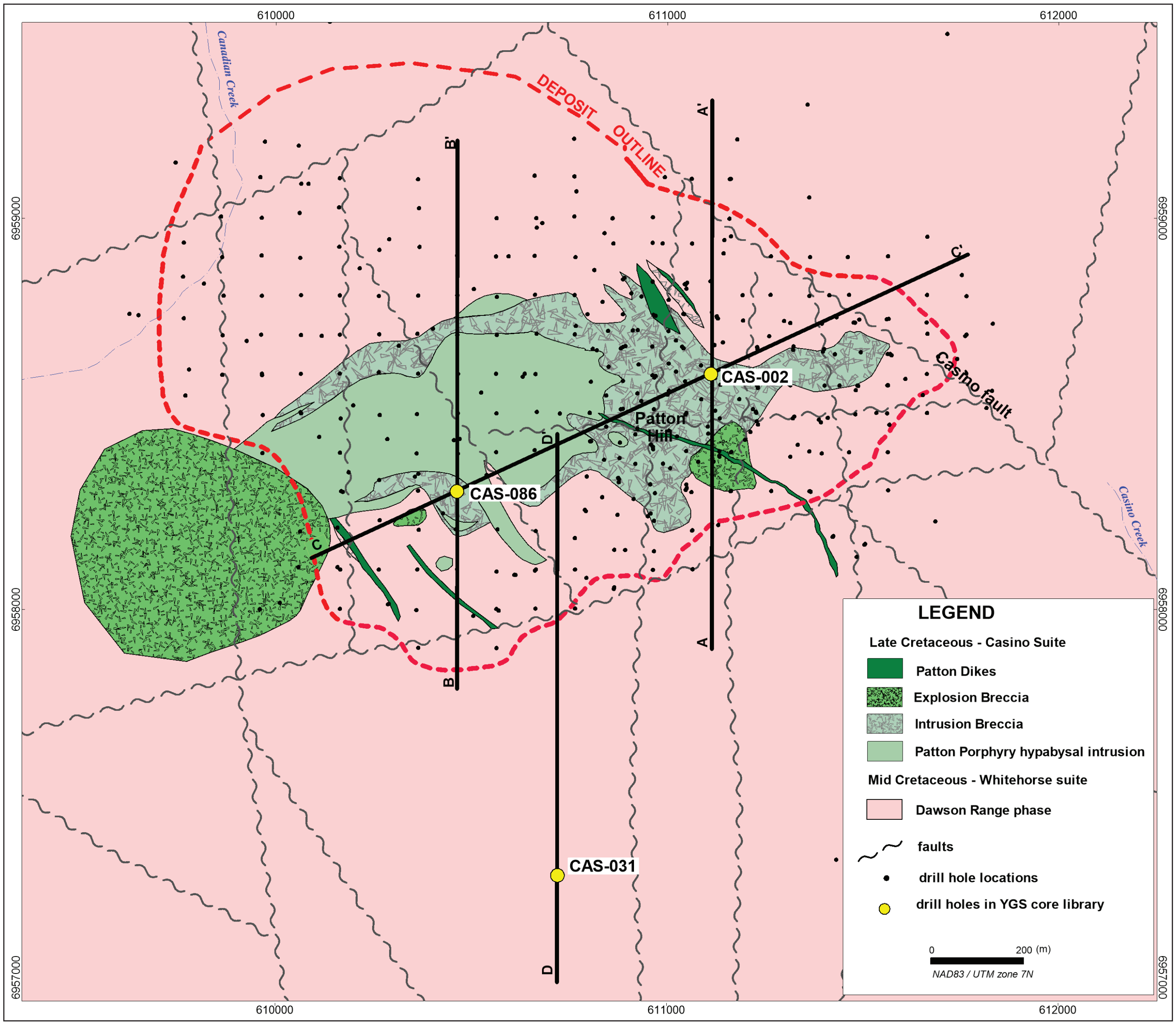


Figure 5. *Casino property geology. Section locations as marked are included in Figure 9 (section A-A'), Figure 10 (section B-B') and Figure 4 (Section C-C'). Section D-D' is included in digital appendix.*

block and bomb breccia (Fig. 3g), that contains 5-50% ragged fragments of *Patton Porphyry*, *Intrusive Breccia*, altered *Intrusive Breccia*, Dawson Range granitoid, and metamorphosed fragments. The matrix is generally white to cream to grey, and can be vesicular with quartz filled amygdules. Locally the groundmass has a very fine grained, interlocking igneous texture; elsewhere it resembles milled rock flour with up to 10% plagioclase and lesser quartz phenocrysts (Bower *et al.*, 1995). The largest plug, on the west side of the property, truncates most of the western margin of the main *Patton Porphyry* intrusion (Fig. 5).

Godwin (1975) concluded that these breccia pipes most likely represent subvolcanic necks, brecciated from explosions caused by the rapid expansion of hot water (phreatomagmatic) and vesiculation of rhyolitic magma, and that any extrusive volcanic rocks related to this event have since been weathered away. Godwin also noted large, angular cavities are a distinctive quality of this unit, measuring up to 10 cm in size. This unit displays multiple episodes of brecciation (Bower *et al.*, 1995).

Dikes of *Patton Porphyry* material in the south-central part of the deposit somewhat resemble the main *Patton Porphyry* body. They are pale to light to dark green with 2 to 5% quartz phenocrysts and up to 35% plagioclase phenocrysts in an aphanitic groundmass (Bower *et al.*, 1995). The dike margins can have a glassy groundmass, and may show flow banding and/or lenticular structures near contacts (Bower *et al.*, 1995). These dikes intruded after the main hydrothermal event and contain only minor base and precious-metal mineralization, as well as locally abundant disseminated pyrite (Godwin, 1975).

ALTERATION

There are two phases of alteration related to the Casino deposit: primary hydrothermal alteration related to the intrusion and cooling of the *Patton Porphyry*; and secondary supergene alteration related to the weathering and erosion of the porphyry copper system. The primary hydrothermal alteration of the Casino deposit is typical of a porphyry copper mineralizing system with a potassic-altered core centered on and around the main *Patton Porphyry* intrusion and *Intrusion Breccia* (Fig. 6). This is bordered concentrically by an inner phyllic zone and an outer propylitic zone. Advanced argillic alteration occurs above the phyllic alteration. The secondary supergene

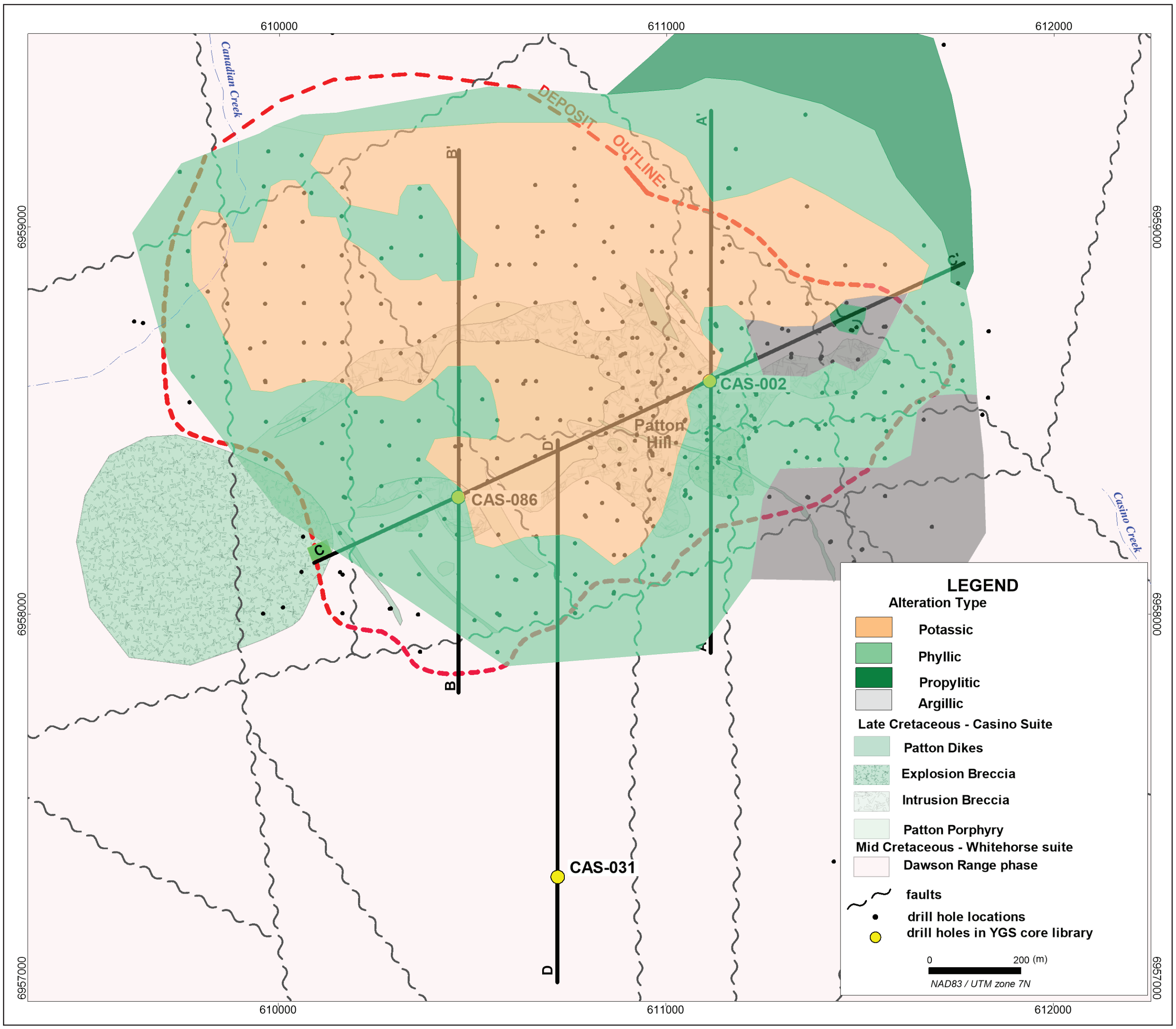


Figure 6. *Casino deposit alteration assemblage map.*

leaching and remobilization is a result of weathering of the exposed sulphide minerals. It is discontinuous and overprints the upper parts of the deposit.

The potassic alteration zone is a broad zone of pervasive biotite and k-feldspar alteration of the *Patton Porphyry* and immediately surrounding breccia and involves K and Fe-metasomatism. Potassic alteration minerals include texturally destructive K-feldspar, biotite, magnetite and quartz with lesser hematite, purple anhydrite and gypsum (Godwin, 1975). Biotite is generally felted and pseudomorphs hornblende (Fig. 7a). Locally, magnetite may form braided veinlets. The potassic zone contains less sulphide minerals than the phyllic zone.

The texturally destructive phyllic zone is found on the periphery of the deposit, is a retrograde alteration assemblage, locally overprinting potassic alteration. It is strongly developed with a distinctive 'bleached' appearance, and somewhat structurally controlled (Fig. 7b). Phyllic alteration is dominated by quartz, sericite and pyrite, but also includes muscovite (after biotite), and tourmaline, as well as minor hematite and/or magnetite towards the potassic zone. Quartz and sericite generally alter potassic and plagioclase feldspars. Biotite alters to muscovite or sphene; hornblende to chlorite, calcite, quartz and biotite (Bower *et. al.*, 1995). Tourmaline forms radiating crystal masses and veinlets. Sulphide content is typically high, with pyrite ranging from 5-10% throughout.

Field relationships show mineralized quartz veins of the phyllically altered zones crosscut those of the potassically altered zones, indicating potassic alteration was first. Re-Os age dating by Selby and Creaser (2000) shows that the dates of the potassic and phyllic alteration are contemporaneous at around 74.4±0.28 Ma.

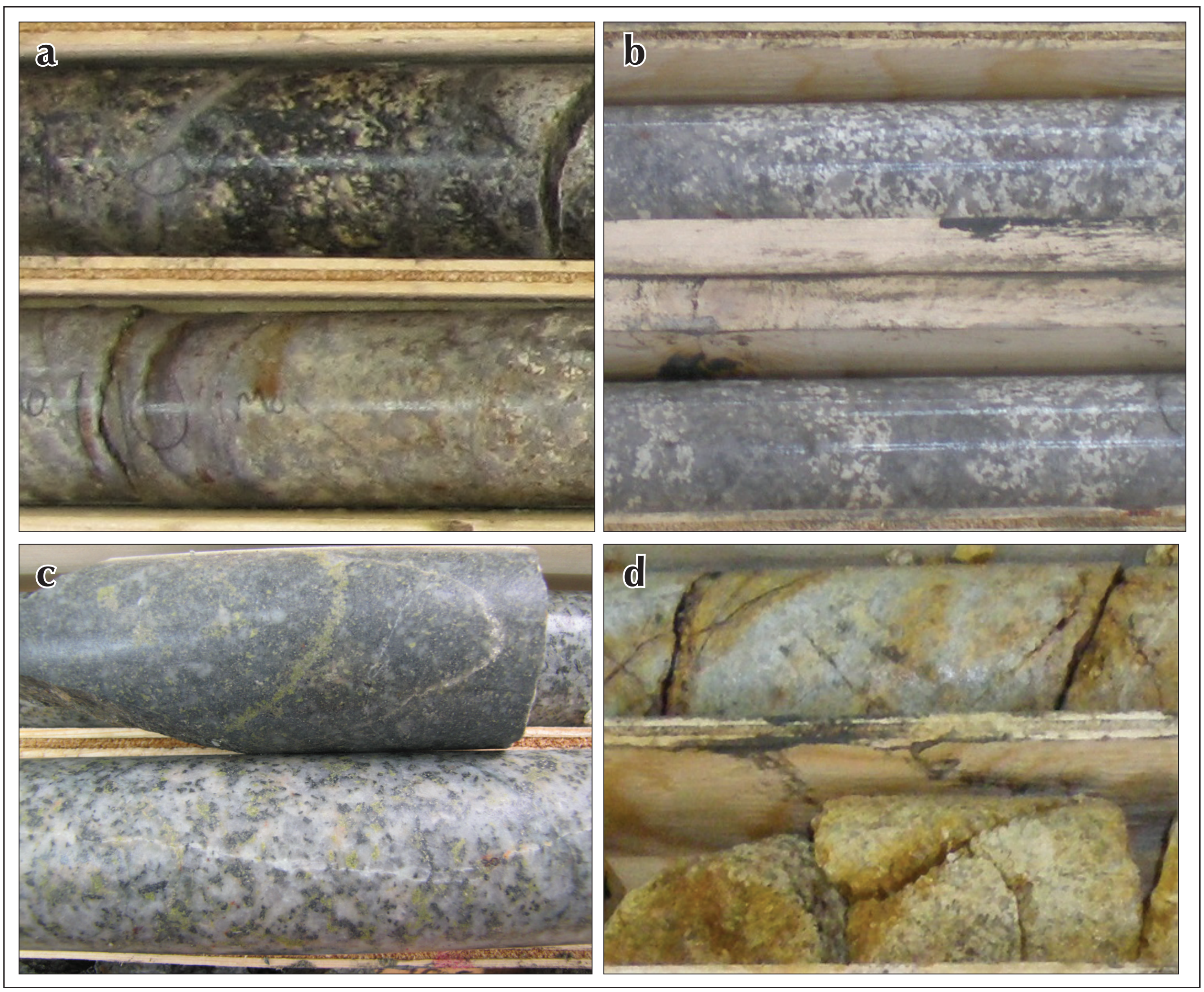


Figure 7. *Representative alteration types from the Casino deposit.* ***(a)*** *Potassic alteration – patchy biotitization of granodiorite,* ***(b)*** *phyllic alteration of Intrusion Breccia,* ***(c)*** *propyllitic alteration – epidote alteration of feldspars and chlorite alteration of mafic minerals,* ***(d)*** *weathering and leaching of cap rocks.*

Propylitic alteration is weakly developed and rarely observed on surface, but forms a wide halo around the deposit and is gradational with the inner phyllic alteration. Alteration minerals include epidote, chlorite and calcite (Fig. 7c), with lesser carbonate, clay, sericite, pyrite and albite. Hornblende and biotite are completely chloritized in the propylitic alteration zone (Godwin, 1975).

Advanced argillic alteration occurs above the phyllic alteration and consists of sericite, chlorite, pyrophylite and other clay minerals such as illite. Copper minerals in the advanced argillic zone are enargite and covellite and occur more commonly in veins.

The secondary supergene alteration is effectively acid leaching of the rock. The alteration is most intense at surface with a gradual decrease at depth and is closely associated with the leached cap and upper supergene zone. In the upper most part of the deposit, acid leaching has converted the sulphide minerals to iron oxide minerals and converted felsic and mafic minerals to kaolinite and montmorillonite clays (Fig. 7d). With depth the intensity of the clay alteration decreases.

MINERALIZATION

The Casino deposit displays a number of mineralization styles. Primary hypogene mineralization can be divided into two phases: copper-gold and molybdenum. Secondary supergene mineralization involves leaching the upper parts of the ore body enriching the supergene layers below. Supergene-enriched mineralization can be further subdivided into an upper, thin and discontinuous supergene oxide layer and a lower supergene sulphide layer of a variable thickness that is laterally extensive.

Hypogene mineralization occurs throughout the various alteration zones. However, the majority of Cu-Au-Mo mineralization occurs in the *Intrusion Breccia*, with lesser mineralization in the altered portions of the Dawson Range phase and *Patton Porphyry*. Mineralization in the potassic zone is mainly finely disseminated pyrite, chalcopyrite, molybdenite, trace sphalerite and bornite. Chalcopyrite commonly occurs in quartz stockwork veins (Fig. 8a), disseminations and irregular patches. In breccia and granodiorite west of the Casino fault, disseminated chalcopyrite is more abundant than chalcopyrite in veins and veinlets; whereas, east of the fault, chalcopyrite is controlled by brittle deformation and found in fractures and open space fillings (Bower *et. al.*, 1995). Pyrite to chalcopyrite ratios range from less than 2:1 in the core of the deposit, to greater than 20:1 in the outer phyllic zone (Bower *et al.*, 1995). Locally, bornite and tetrahedrite can be coarsely intergrown with chalcopyrite (Bower *et al.*, 1995).

Molybdenite is not generally intergrown with other sulphide minerals and occurs as selvages in early, high temperature, potassic quartz veins (Fig. 8b) as discrete flakes and disseminations. Molybdenite is largely unaffected by supergene processes, other than local alteration to ferri-molybdenite.

Native gold is very rarely seen with the naked eye. It occurs as free grains in quartz (50 to 70 microns) and as inclusions in pyrite and/or chalcopyrite grains (1 to 15 microns; Bower *et al.*, 1995).

The supergene oxide mineralization is characterized by copper oxide minerals chalcanthite, malachite and brocanthite, with minor azurite, tenorite, cuprite and neotocite (Bower *et al.*, 1995). These are most often seen as coatings on open space fractures and in vugs.

Supergene sulphide mineralization consists predominantly of chalcocite, diginite and/or covellite which occur on grain borders and fractures in chalcopyrite, bornite and tetrahedrite (Fig. 8c,d; Bower *et al.*, 1995). Chalcocite also coats pyrite grains and clusters in the phyllic alteration zone, and may extend along fractures well into the hypogene zone. Where the supergene enrichment is intense, the secondary sulphide minerals completely replace primary sulphide minerals.

ORE ZONES

The Casino deposit is unique among Canadian porphyry deposits in that it has an outcropping leached cap, an upper, copper oxide supergene mineralized zone, a lower, copper sulphide supergene mineralized zone, and an underlying hypogene zone (Figs. 7, 8, 9 and 10). The development and preservation of the weathered zones is due to the lack of recent glaciation in northern Yukon.

The leached cap (oxide gold zone) is enriched in gold and depleted in copper due to weathering and acid leaching. The mass-loss in the leached cap by the removal of sulphide minerals and the alteration of feldspar and mafic minerals to clays accounts for the gold enrichment. This zone averages 70 m thick and is characterized by boxwork textures filled with limonite, goethite and hematite (Bower *et al.*, 1995). Molybdenum in the cap was generally not mobilized, but rather chemically modified from molybdenite to ferri-molybdenite.

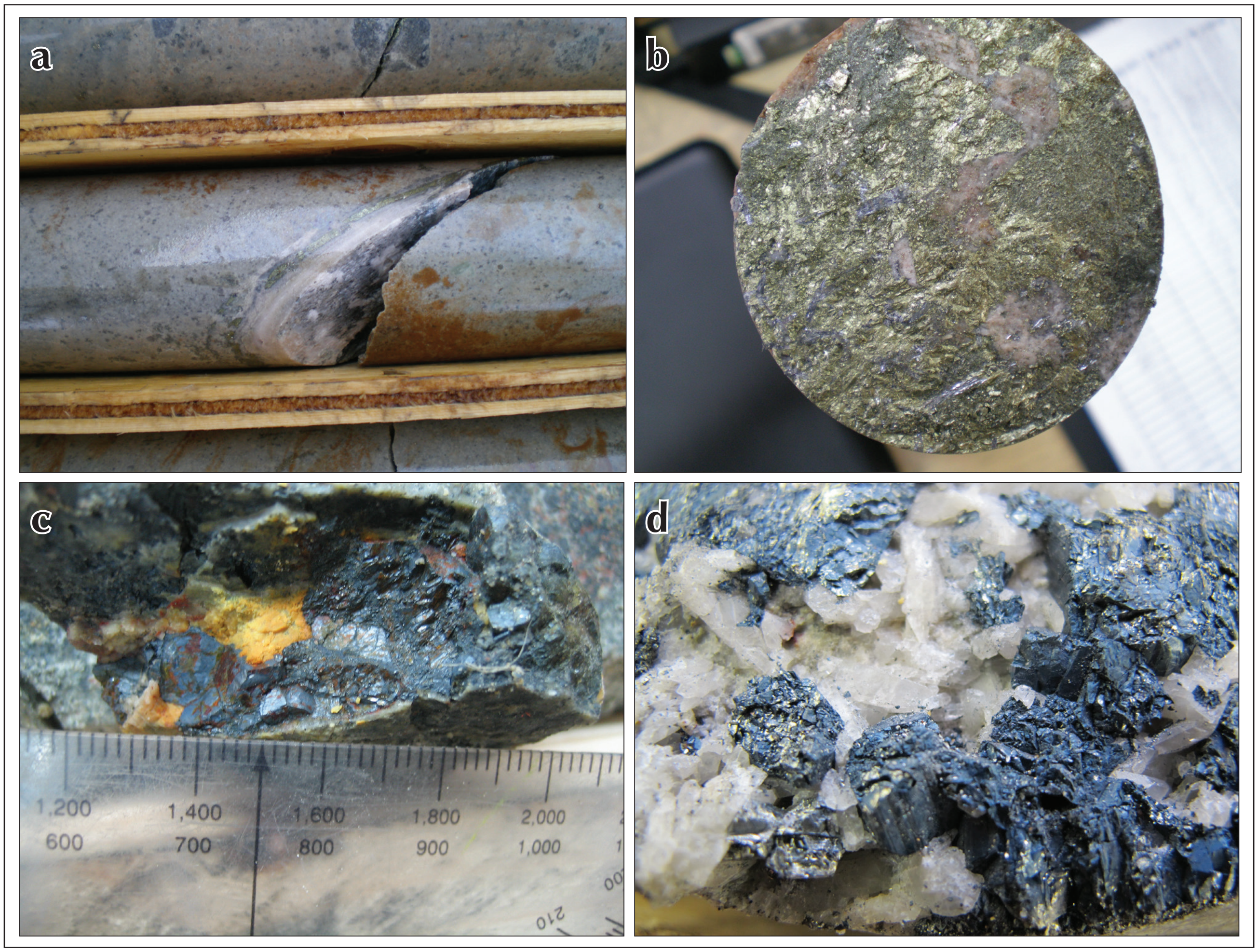


Figure 8. *Representative mineralization types from the Casino deposit.* ***(a)*** *Pyrite-chalcopyrite-quartz stockwork vein in Intrusion Breccia,* ***(b)*** *pyrite-molybdenite mineralization,* ***(c)*** *chalcocite coating pyrite in supergene zone,* ***(d)*** *chalcocite coating pyrite in supergene zone.*

The supergene oxide zone is discontinuous and varies from non-existent to tens of metres thick. It is also found as perched lenses, likely due to a periodic drop in the water table (Godwin, 1975). This zone is thought to be related to present day topography, and is best developed where oxidation of earlier secondary copper sulphide occurs above the water table on well drained slopes (Bower *et al*., 1995).

The supergene sulphide zone is relatively flat lying and pancake shaped with an average thickness of 60 m; along the rim of the deposit it is less than 30 m thick to a maximum depth of 80 m, and in the centre of the deposit it is up to 110 m thick to a maximum depth of 280 m. Supergene alteration and mineralization is thickest and richest within the phyllic alteration zone, due to the permeability of the breccia and concentrations of pyrite, which act as a localizing catalyst for the precipitation of the secondary copper sulphide minerals, particularly chalcocite. The supergene sulphide zone is particularly important for the economics of the deposit due to the upgrading of copper concentration to nearly double the concentration in the hypogene zone; 0.43% Cu vs. 0.23% Cu.

RESOURCES

The resource estimate for the Casino deposit was updated in 2013 (Huss *et. al.*, 2013). Table 1 shows the mineral resource estimate for the various zones of the deposit.

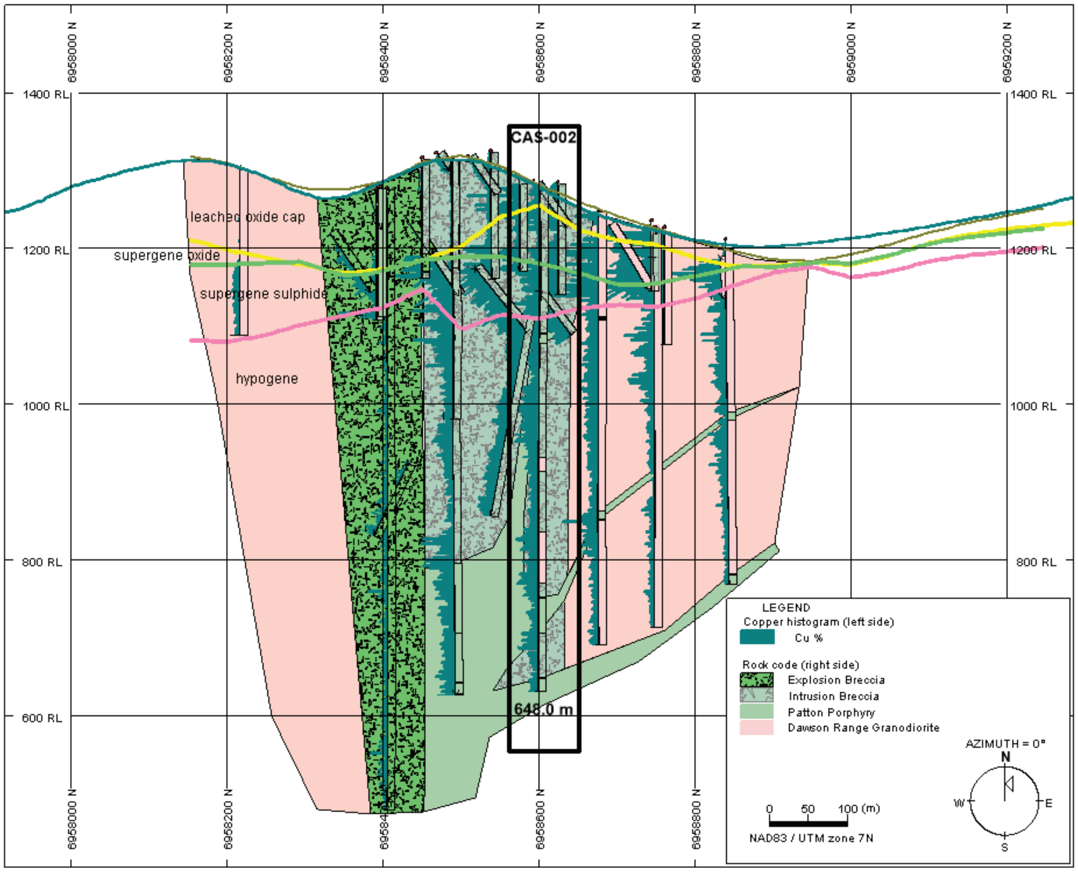


Figure 9. *Cross section A-A′; north-south cross section through the core of the Casino deposit including diamond drill hole CAS-002.*

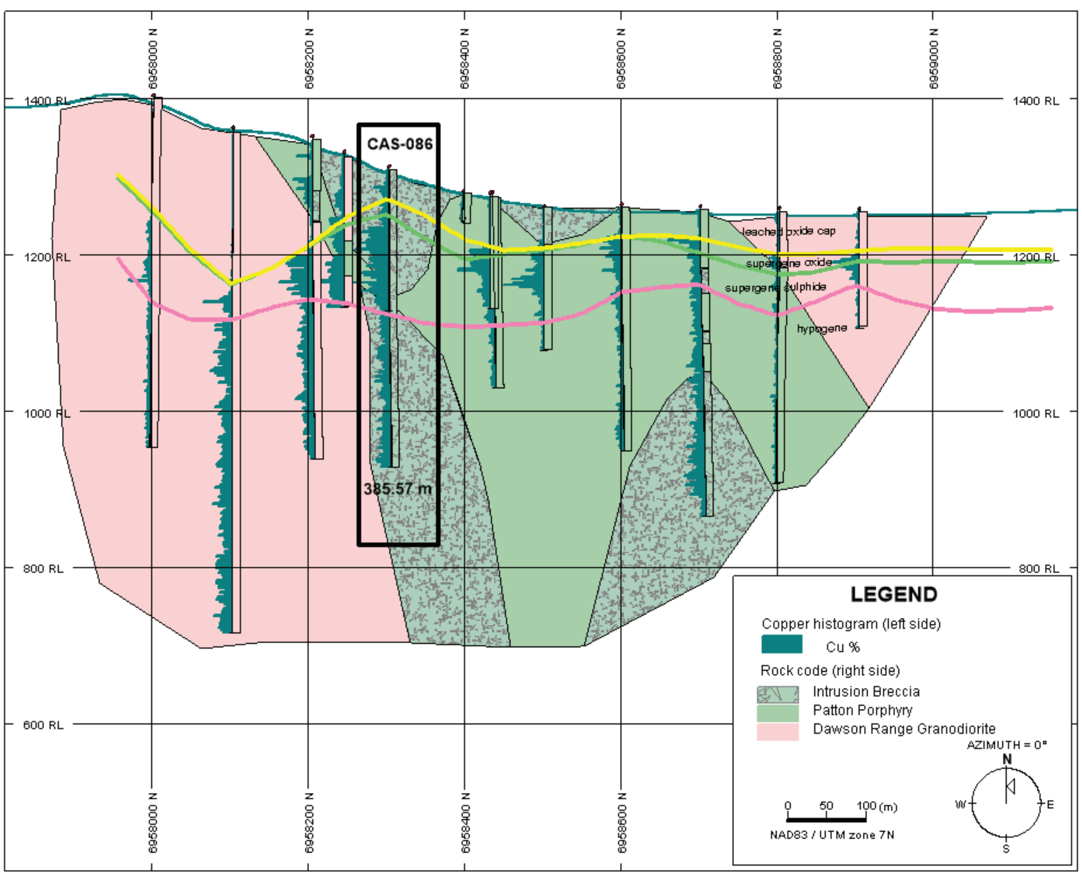


Figure 10. *Cross section B-B′; north-south cross section through the western portion of the Casino deposit including diamond drill hole CAS-086.*

Table 1. *Casino deposit mineral resource summary. The cut-off grade for the Leached Cap/Oxide Gold zone was 0.25 g/t gold and that for the supergene oxide, supergene sulphide and hypogene zone was 0.25% copper equivalent using the following metal prices to calculate the copper equivalent (prices in CDN $): $2.00/lb Cu, $875.00/oz Au, $11.25/lb Mo, and $11.25/oz Ag. M, I & I=measured, indicated and inferred.*

						Contained metals			
	Tonnage (000)	Cu (%)	Au (g/t)	Mo (%)	Ag (g/t)	Cu (lbs)	Au (oz)	Mo (lbs)	Ag (oz)
Leached Cap									
Measured and Indicated	84000	0.04	0.400	0.020	2.57	74,075,299	1,080,274	37,027,200	6,940,758
Inferred	17000	0.01	0.310	0.008	1.93	3,747,857	169,436	2,997,440	1,054,874
Total M, I & I	101000	0.03	0.385	0.018	2.46	77,823,157	1,249,709	40,024,640	7,995,632
Supergene Oxide									
Measured and Indicated	61000	0.25	0.340	0.022	1.83	336,204,855	666,812	29,577,680	3,589,016
Inferred	26000	0.26	0.170	0.010	1.43	149,032,447	142,107	5,730,400	1,195,374
Total M, I & I	87000	0.25	0.289	0.018	1.71	485,237,302	808,919	35,308,080	4,784,390
Supergene Sulphide									
Measured and Indicated	252000	0.26	0.250	0.021	1.81	1,444,468,334	2,025,513	116,635,680	14,664,714
Inferred	102000	0.20	0.190	0.010	1.49	449,742,888	623,086	22,480,800	4,886,309
Hypogene									
Measured and Indicated	743000	0.17	0.220	0.023	1.66	2,784,658,048	5,255,402	376,641,560	39,654,400
Inferred	1568000	0.14	0.160	0.020	1.36	4,839,586,214	8,066,043	691,174,400	68,561,364
Supergene Sulphide & Hypogene									
Total M, I & I	2665000	0.16	0.186	0.021	1.49	9,518,455,485	15,970,045	1,206,932,440	127,766,788

DIAMOND DRILL CORE IN YGS CORE COLLECTION

Core from two complete holes within the deposit and one hole from outside the deposit have been donated by Western Copper and Gold Corporation to the YGS core collection (Table 2, Fig. 3). Drill hole CAS-002 is from the eastern part of the deposit near the central part of the *Patton Porphyry* intrusion and shows the relationship between the *Patton Porphyry* intrusion and *Intrusion Breccia* with Dawson Range phase country rocks, as well as the hydrothermal alteration, secondary weathering and supergene enrichment. Drill hole CAS-086 is located on the western portion of the deposit, where the *Patton Porphyry* flattens out into a sill-like intrusion. It is mostly in the *Intrusion Breccia* along the margins of the *Patton Porphyry* and has good representation of each of the ore zones: the leached cap, the supergene oxide zone, supergene sulphide zone and hypogene zone. Drill hole CAS-031 is from 450 m south of the deposit and shows lesser altered Dawson Range phase granodiorite with examples of the distal sphalerite-galena veins associated with the mineralizing system.

Available data for each diamond drill hole includes digital data in the form of Excel files, pdfs of original logs, and core photographs. The Excel files include collar, survey, lithology, assay and geochemistry data.

Table 2. *Drill core donated to YGS library.*

Hole No.	Easting (m)*	Northing (m)*	Year drilled	Length (m)	Entire hole at YGS	Area	Mineralization style
CAS-002	611110.11	6958601.29	2008	648.00	Yes	Central core of deposit	Leached Cap, Supergene Oxide, Supergene Sulphide, Hypogene
CAS-031	610717.3	6957322.78	2009	638.56	No (only 596.1 - 638.56 m)	500 m south of deposit	distal Pb-Zn veins
CAS-086	610462.64	6958303.34	2010	385.57	Yes	Western part of deposit	Leached Cap, Supergene Oxide, Supergene Sulphide, Hypogene

*UTM NAD 83, Zone 7

ACKNOWLEDGEMENTS

The authors would like to thank Western Copper and Gold Corporation for the permission to publish this paper and for the donation of core from three diamond drill holes and accompanying data and photographs to the Yukon Geological Survey H.S. Bostock core library.

REFERENCES

Bower, B., Case, T., DeLong, C. and Rebagliati, C.M., 1995. Casino Project, 1994 Exploration and Geotechnical Drilling Program on the Casino Porphyry Copper-Gold- Molybdenum Deposit. Unpublished Company Report, Pacific Sentinel Gold Corp.

Casselman, S.G., 2013. 2012 Assessment Report for the Casino Property. Yukon Energy, Mines and Resources Assessment Report 096384.

Colpron, M., Isreal, S., Murphy, D. C., Pigace, L.C. and Moynihan, D., 2016. Yukon Bedrock Geology Map, Yukon Geological Survey, Open File 2016-1.

Godwin, C.I., 1975. Geology of the Casino porphyry copper-molybdenum deposit, Dawson Range, Yukon Territory. Unpublished PhD Thesis, University of British Columbia.

Huss, C., Drielick, T., Austin, J., Giroux, G., Casselman, S., Greenaway, G., Hester, M. and Duke, J., 2013. Casino Project: Form 43-101F1 Technical Report, Feasibility Study, Yukon, Canada. Internal report, M3 Engineering & Technology Corp., 248 p.

Johnston, S.T., 1995. Geological compilation with interpretation from geophysical surveys of the northern Dawson Range, central Yukon (115J/9, 10, 115I/12) . Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Open File 1995-2 (G), scale 1:100 000.

Ryan, J.J., Zagorevski, A., Williams, S.P., Roots, C., Ciolkiewicz, W., Hayward, N. and Chapman, J.B., 2013. Geology, Stevenson Ridge (northeast part), Yukon. Geological Survey of Canada, Canadian Geoscience Map 116 (preliminary), scale 1:100 000.

Selby, D. and Creaser, R.A., 2000. Late and Mid-Cretaceous mineralization in the Northern Canadian Cordillera: constraints from Re-Os molybdenite dates. Economic Geology and the Bulletin of the Society of Economic Geologists, vol. 96, p. 1461-1467.

Selby, D. and Nesbitt, B.E., 1998. Biotite chemistry of the Casino porphyry Cu-Mo-Au occurrence, Dawson Range, Yukon. *In:* Yukon Exploration and Geology 1997, Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 83-88.

DIGITAL APPENDIX

The digital appendix to this paper includes two summary pages for each drill hole. Each summary is designed to be printed as a double-sided sheet. The first page has a plan map, a table summarizing collar information, and strip logs showing downhole lithology and assay data. The second page has a section with the drill hole highlighted and a table of the key assay data for the hole.