Willow Cu-Mo Project, Buckskin Range, Douglas County, Nevada: On the Trail of the Fifth Yerington Porphyry Deposit

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EXTENDED ABSTRACT

A common thread linking the four Jurassic porphyry Cu deposits in the Yerington district is their relationship with granite porphyry (JGP) dike swarms sourced from cupolas of the Luhr Hill granite (JPG). The Abacus/Almadex Willow property in the Buckskin Range to the west covers two zones of high-level alteration in Jurassic volcanic rocks overlying the west-tilted Yerington batholith. The more extensive southern zone is marked by JGP dikes, quartz-veined zones, and chargeability highs, with Cu and Mo increasing towards the east. Restoration of a long section compiled from 1967-81 drilling showed the dikes are the projection of the JGP dike swarm along the southern edge of the batholith, where no porphyry center had yet been discovered. A source cupola of JPG was inferred beneath the southeastern Buckskin Range. An initial three-hole test in 2018 confirmed the concept, intercepting 0.05–0.24% Cu, with two holes cutting JPG in the subsurface. Highest Cu grades are associated with early-halo veins similar to those controlling better Cu at the nearby Ann Mason deposit. Due to complications drilling through the low-angle faults, two of three holes failed to reach targeted depths. The target could reach within 100–300 m of the surface, and will be definitively tested in the near future.

Key Words: Yerington, Porphyry, Granite, Copper, Lithocap

INTRODUCTION

The four known porphyry Cu deposits in the mid-Jurassic Yerington batholith (Yerington, Ann Mason, Bear, and MacArthur; Figure 1) share a common relationship with dike swarms of granite porphyry sourced from cupolas of the Luhr Hill porphyritic granite. A fifth porphyry deposit related to the Ludwig granite porphyry dike swarm along the southern edge of the batholith has long been hypothesized. Initial drilling of a geologic-geochemical-geophysical target by Abacus Mining and Exploration Corporation suggests a sizable portion of the hypothesized porphyry center could be preserved in the southeastern part of the Buckskin Range, west of the known porphyry deposits.

The 15.7 km^2 Willow property covers the central and southern Buckskin Range on the western edge of the Yerington district (Figure 1). Much of the current property was staked by Almaden Minerals (now Almadex) between 2007–2016. Abacus entered into an option agreement to earn a 75% interest in the Almadex property in February 2017. Abacus expanded this land position in February 2018 with a lease agreement covering the adjacent Nev-Lorraine claims.

The southern and central Buckskin Mountains were explored and drilled by Bear Creek, Phelps Dodge, Conoco, and Anaconda between 1967–1981. Many logs and some skeleton core from these drill holes are preserved at the Nevada Bureau of Mines and Geology. Abacus' work has included property-scale mapping, surface rock and grid soil geochemistry, ground magnetic and induced polarization surveys, re-logging and re-assaying of historic drill core, and collection of short-wave infrared (SWIR) spectral data from outcrops and drill core. An initial test with three core holes was conducted in April-July 2018.

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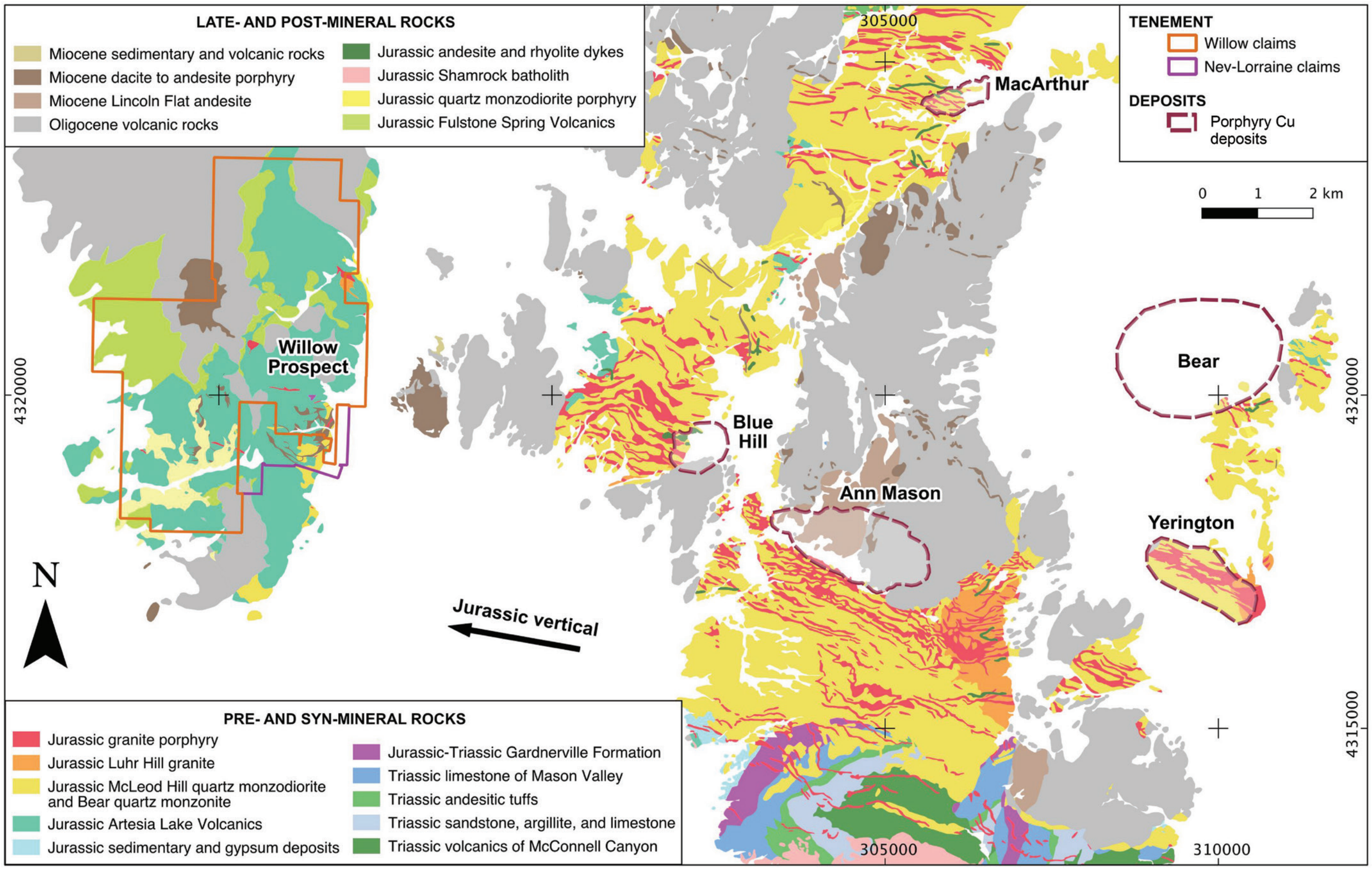

Figure 1. Generalized geologic map of the Yerington district and southern Buckskin Range. Due to the steep westward tilting, the map patterns essentially represent Jurassic cross sections when viewed from the east-southeast. The known porphyry Cu deposits at Yerington, Ann Mason, MacArthur, and Bear are all associated with dike swarms of granite porphyry grading into cupolas of Luhr Hill porphyritic granite. (The Blue Hill resource is believed to represent a fault offset of the Ann Mason deposit.) Geology from Proffett and Dilles (1984), Proffett (2007), and Abacus mapping. Resource outlines from Kulla *et al.* (2017) and https://quaterra.com/. Coordinates in this and subsequent figures are UTM zone 11, NAD 1983 datum.

GENERAL GEOLOGY

Rock units

The Willow property is underlain by mid-Jurassic intermediate intrusive and related volcanic and epiclastic rocks, Oligocene silicic ignimbrites, and Miocene hypabyssal rocks (Figures 2 and 3). The most extensive unit is the Artesia Lake Volcanics, a ~1-km thick sequence of mostly intermediate lavas that represents the early extrusive phase of the Yerington batholith. Overlying these are intermediate to silicic Fulstone Spring Volcanics, which are slightly younger than the batholith, but may in part correlate with its later phases (Dilles *et al.*, 2000; Proffett, 2007).

Mapping by Proffett (2007) and Abacus correlated many of the intrusive bodies with phases of the Yerington batholith based on similar compositions and textures. Stocks along the east side of the Buckskin Range are equivalent to the early McLeod Hill quartz monzodiorite phase (169.4 Ma; Dilles and Wright, 1988). Luhr Hill porphyritic granite is present in the subsurface in the east side of the range. Dikes of granite porphyry are common in the southern Buckskin Range, and are correlated with the mineral-related 168.5 Ma granite porphyry dikes of the main Yerington district.

Jurassic rocks are unconformably overlain by Oligocene (27.0–26.5 Ma) quartz latite to rhyolite ignimbrites and tuffaceous sedimentary rocks of the Mickey Pass Tuff and Singatse Tuff (Proffett and Proffett, 1976; Hudson and Oriel, 1979; Dilles and Gans, 1995; Garside *et al.*, 2002). Miocene diorite to granodiorite porphyry dikes and stocks (~13 Ma; Ghobadi, 2017) are exposed in the central and southeastern portions of the range. These porphyries are cogenetic with the ~13 Ma Lincoln Flat andesite to the east (Dilles and Gans, 1995; John Dilles, Oregon State University, oral communication, October 2017).

Structure

Minor faults of probable Jurassic age trend west-east to northwest-southeast with moderate to steep dips. These are mineralized with quartz-magnetite-hematite-chlorite-pyrite-chalcopyrite ± Au at the Buckskin mine (Gibson, 1987) and west of Alunite Hill (Lipske and Dilles, 2000).

Both Jurassic and Oligocene rocks dip moderately to steeply west due to rotation along mostly east-dipping Tertiary extensional faults (Proffett, 1977, 2007). Domino-style rotation of originally high-angle normal faults by younger faults produced shallow eastward dips, commonly 10–25 degrees. Low-angle normal faults include the No. 13, BC-3, and BSW-7 faults (Figure 3). Offsets of a tuff/epiclastic marker unit in the upper Artesia Lake Volcanics indicate that these faults accommodated up to 800 m of normal displacement. The youngest generation of the Basin and Range faults dip moderately to steeply east and include the 65–70º-dipping eastern Buckskin range-front fault.

Most of the extension and tilting in the Yerington district occurred between 14.0–12.5 Ma (Dilles and Gans, 1995). Miocene porphyries both intrude and are cut by faults, and are interpreted to be rotated westward but by a lesser amount than the Jurassic and Oligocene rocks.

ALTERATION AND MINERALIZATION

Hydrothermally altered rocks are exposed over approximately 16 km^2 in the central and southern Buckskin Range (Figure 4), and probably exceed 25 km^2 including covered areas. The most intense alteration and the majority of mineral prospects and Cu occurrences are in Artesia Lake Volcanics and Jurassic intrusive rocks, i.e., rocks $\geq$ 168 Ma in age. Fulstone Springs Volcanics and Oligocene tuffs are less altered and generally lack biotitic alteration, quartz veins, and significant Cu or Mo mineralization. Porphyries of known or suspected Miocene age appear to include one group that is biotitized, weakly veined, and Cu-Mo mineralized (quartz diorite to tonalite por-

GEOLOGIC UNITS (Fig. 3)

Rock Unit	Age	Description	Distinguishing Characteristics	Equivalent Unit in Proffett and Dilles (1984)
POST-MINERAL UNITS				
Alluvium and colluvium	Holocene to Pliocene	Unconsolidated alluvial fan and fluvial gravel to sand; includes some white shaley to silty lake sediments that may in part be Pliocene in age		
Older alluvium	Pleistocene to Pliocene(?)	Coarse unsorted cobble to boulder gravels; clasts of Shamrock batholith	Rounded cobbles to boulders of Shamrock batholith, commonly with sodic-altered fracture halos	
Ferruginous conglomerate	Quaternary?	Gravels cemented by goethite, hematite, and jarosite; commonly forming benches along modern drainages		
Andesite to dacite porphyry	Miocene (13 Ma; Ghobadi, 2017). Can be altered, pyritized, and carry Zn-Pb mineralization	~40% phenocrysts of Pl > Hbl, stacked Bt, rare Qz; aphanitic groundmass of Qz, Pl and/or Kfs	Nearly fresh; sparse joints	
LATE-MINERAL UNITS				
Quartz diorite to tonalite porphyry	Miocene (13 Ma?). Weakly veined and Cu-Mo mineralized	~15-45% phenocrysts of Pl > Hbl > stacked Bt in microcrystalline groundmass of Pl, Qz ± Bt	Poor in Kfs; weakly veined and Cu-Mo mineralized	
Tertiary volcanic rocks (mostly Singatse and Mickey Pass Tuffs	Oligocene; 27.0-26.5 Ma (Proffett and Proffett, 1976; Hudson and Oriel, 1979; Dilles and Gans, 1985; Garside et al., 2002)	White, red-brown, lavender, pink, and buff crystal-lithic ash-flow tuffs of quartz latite to rhyolite composition, nonwelded to strongly welded; phenocrysts of Pl, Qz, Sa, Bt, Hbl	Abundant coarse white pumice	
Fulstone Spring Volcanics	167.8-166.5 Ma (Proffett, 2007, Dilles and Wright, 1988)	Latite to quartz latite flows, domes, minor ignimbrites, and epiclastic siltstone to conglomerate. Typically green-grey porphyry with 20-40% phenocrysts of lineated Pl > Hbl > stacked Bt, Qz, Kfs (megacrysts 5-20 mm) in an aphanitic, Qz-bearing groundmass	Coarse tabular Kfs (Artesia Lake lavas normally lack Kfs phenocrysts). Supports less vegetation than Artesia Lake Volcanics	
SYN-MINERAL UNITS				
Granite porphyry	168.5 Ma (Dilles and Wright, 1988)	25-45% phenocrysts of Pl > Hbl, stacked Bt > Qz, Kfs (megacrysts 5-15 mm); aphanitic to microcrystalline groundmass of Qz, Kfs, Pl	Less crowded and fewer mafic minerals than Miocene porphyries; minor Kfs megacrysts. Contacts commonly silicified	Quartz monzonite porphyry (Jqmp)
Porphyritic granite, or Luhr Hill granite	~168.5 Ma (grades into granite porphyry at Ann-Mason; Proffett and Dilles, 1984)	Seriate to crowded porphyritic, fine- to medium-grained, 3-4 mm crystals of Pl > Hbl, Bt, Kfs; sparse (<10%) fine-grained Qz-Kfs-Pl groundmass. Rare Kfs megacrysts 4-10 mm	Equigranular to very crowded porphyry; 10-15% mafics	Porphyritic quartz monzonite (Jpqm)
PRE-MINERAL UNITS				
Bear porphyritic aplite	~169 Ma	≤10% phenocrysts of fine Pl and/or Kfs and pinhead-sized Qz; groundmass of 0.1-0.2 mm Pl > Qz	Poor in phenocrysts; aplitic texture; virtually no mafic minerals	Quartz monzonite (Jqm, Jbqm)
McLeod Hilll quartz monzodiorite	169.4 Ma (Dillies and Wright, 1988)	Seriate, fine- to medium-grained; Pl > Hbl, interstitial Qz and Kfs, nil to minor Bt	Seriate to near-equigranular texture; Hbl with sparse to nil Bt	Granodiorite (Jgd)
Artesia Lake Volcanics	~169-168.5 Ma (Dillies and Wright, 1988)	Andesite to dacite flows, flow breccias, Dark green andesite flows most common; these contain 10-35% phenocrysts of Pl (≤2 mm) > Hbl, Cpx in an aphanitic groundmass. Patterned areas indicate marker unit of welded tuffs and epiclastic siltstone, sandstone, and conglomerate near top of sequence	Sparsely porphyritic (commonly ≤15% phenocrysts); no Bt or Kfs phenocrysts; generally no Qz in groundmass	
Gardnerville Formation	Latest Triassic and Early Jurassic (Stewart et al., 1997)	Grey to green-grey, thin- to medium-bedded tuffaceous argillite, siltstone, and limestone		

STRUCTURE (Figs. 3 and 4)

Contacts
- mapped
- approximate
- inferred
- concealed

Faults
- mapped
- approximate
- inferred
- concealed

GENERALIZED ALTERATION (Fig. 4)
- Propylitic
- Intermediate argillic
- Sericitic
- Silicic +/- advanced argillic
- Quartz-veined zones

Figure 2. Description of rock units of the Willow property and vicinity. Rocks of the Yerington batholith are classified as in Dilles *et al.* (2000). The last column shows equivalent historic units based on pre-IUGS rock names, as used in Proffett and Dilles (1984) and other older publications. This figure also serves as a legend for Figures 3, 4, and 6. Mineral abbreviations (from Whitney and Evans, 2010): Bt, biotite; Cpx, clinopyroxene; Hbl, hornblende; Kfs, K-feldspar; Pl, plagioclase; Qz, quartz; Sa, sanidine. "Stacked" refers to biotite that is elongate in the C-axis direction.

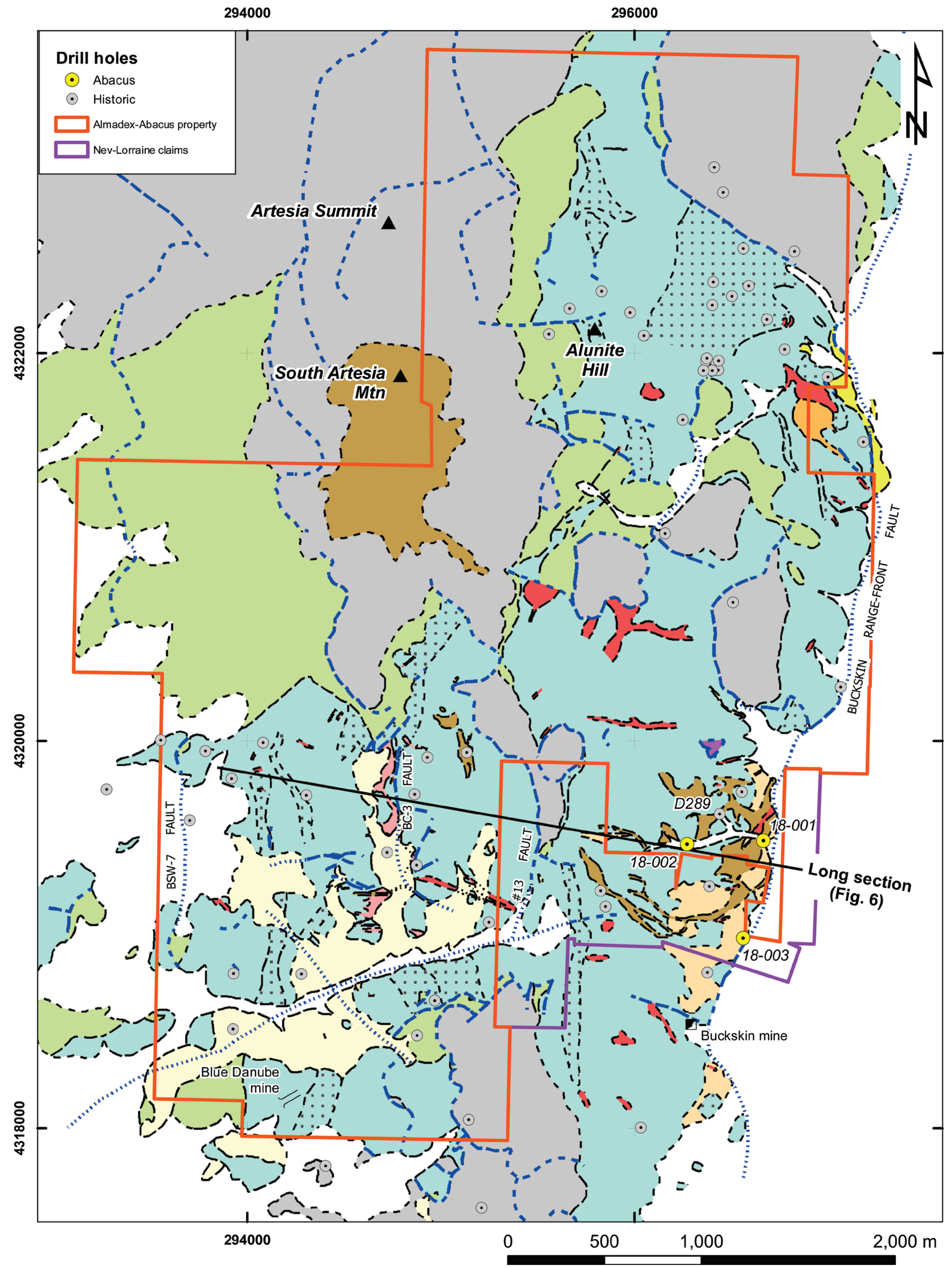

Figure 3. Geologic map of the Willow property. Rock units, contacts, and faults as in Figure 2. The geographic names "Alunite Hill" and "South Artesia Mountain" are informal, and not accepted by the U.S. Board of Geographic Names (https://geonames.usgs.gov).

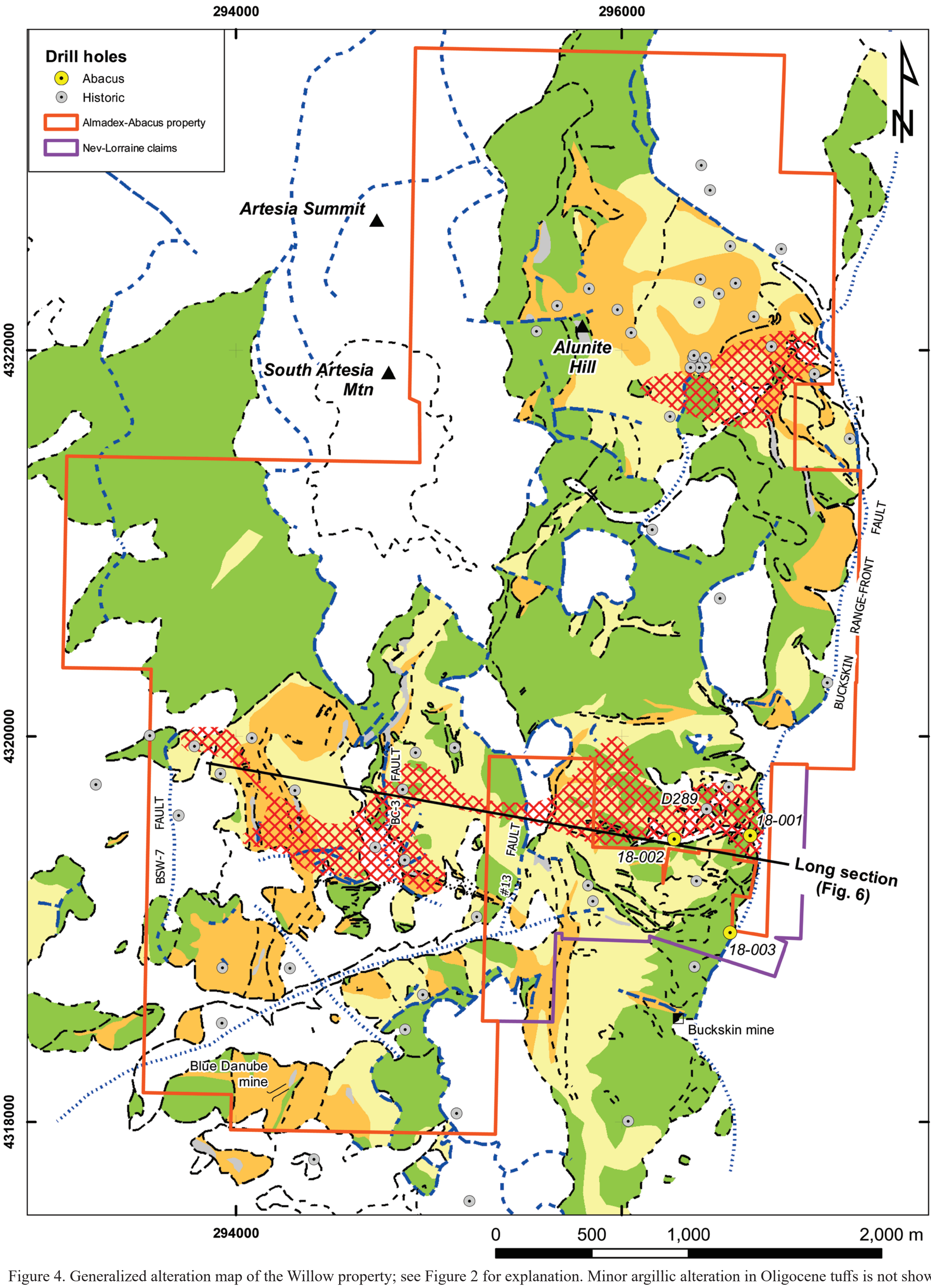

Figure 4. Generalized alteration map of the Willow property; see Figure 2 for explanation. Minor argillic alteration in Oligocene tuffs is not shown.

phyry on Figure 2); with a second group that is barren of Cu-Mo but contains sphalerite and local galena (andesite to dacite porphyry).

Propylitic (chlorite + epidote ± sericite-clay-carbonate) alteration is widespread and especially well developed in Artesia Lake and Fulstone Spring Volcanics. Sulfide content is typically < 1%. Intermediate argillic alteration is dominated by illite, other clays, and chlorite, with 1–3% pyrite. Sericitic alteration is marked by the occurrence of pale gray to buff to green sericite, local quartz veining (2–10%), and 3–10% sulfides (mostly pyrite). Silicic and related advanced argillic alteration are mostly limited to sediments and tuffs of the Artesia Lake Volcanics, within or adjacent to sericitic zones. Replacement by fine-grained quartz and pyrite (2–5%) commonly obliterates rock textures. Advanced argillic assemblages are characterized by pyrophyllite + alunite ± dickite ± zunyite ± diaspore ± topaz. Corundum and andalusite occur locally, most importantly at the Blue Danube mine near the south end of the range (Moore, 1969; Hudson, 1983).

Potassic alteration is rarely exposed but is widespread in the subsurface. It is marked by shreddy biotite replacement of primary hornblende. Secondary K-feldspar is less common. Quartz veins comprise 1–5 percent of most potassic-altered rock, and locally exceed 10 percent. Cu and Mo in the subsurface are strongly concentrated within areas of potassic alteration and quartz veining.

Vein styles are broadly typical of porphyry copper deposits worldwide (cf. Gustafson and Hunt, 1975; Gustafson and Quiroga, 1995; Seedorff *et al.*, 2005; Sillitoe, 2010). Early, sulfide-poor chlorite-biotite seams with halos of chlorite ± biotite ± magnetite are similar to EB veins elsewhere. Early halo (EH) veins are thin fractures fringed by much thicker envelopes of sericite, K-feldspar, and/or biotite with common sulfides. These occur in the subsurface in the southeastern part of the property.

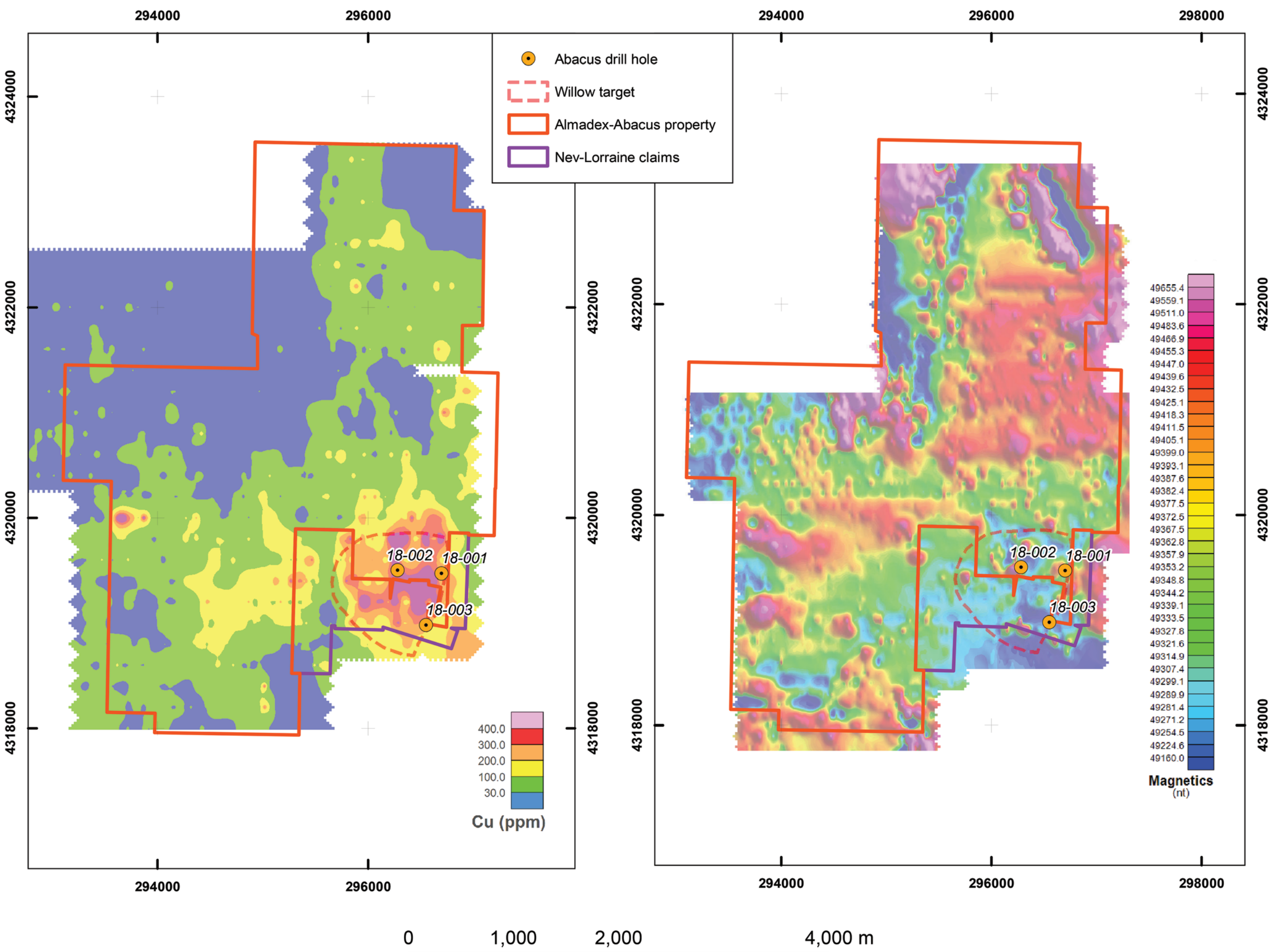

Figure 5. Cu in soils (contoured from a grid with spacing 200 m south-north and 50 m west-east) and total field ground magnetics (grid spacing 100 m north-south, 15 m west-east).

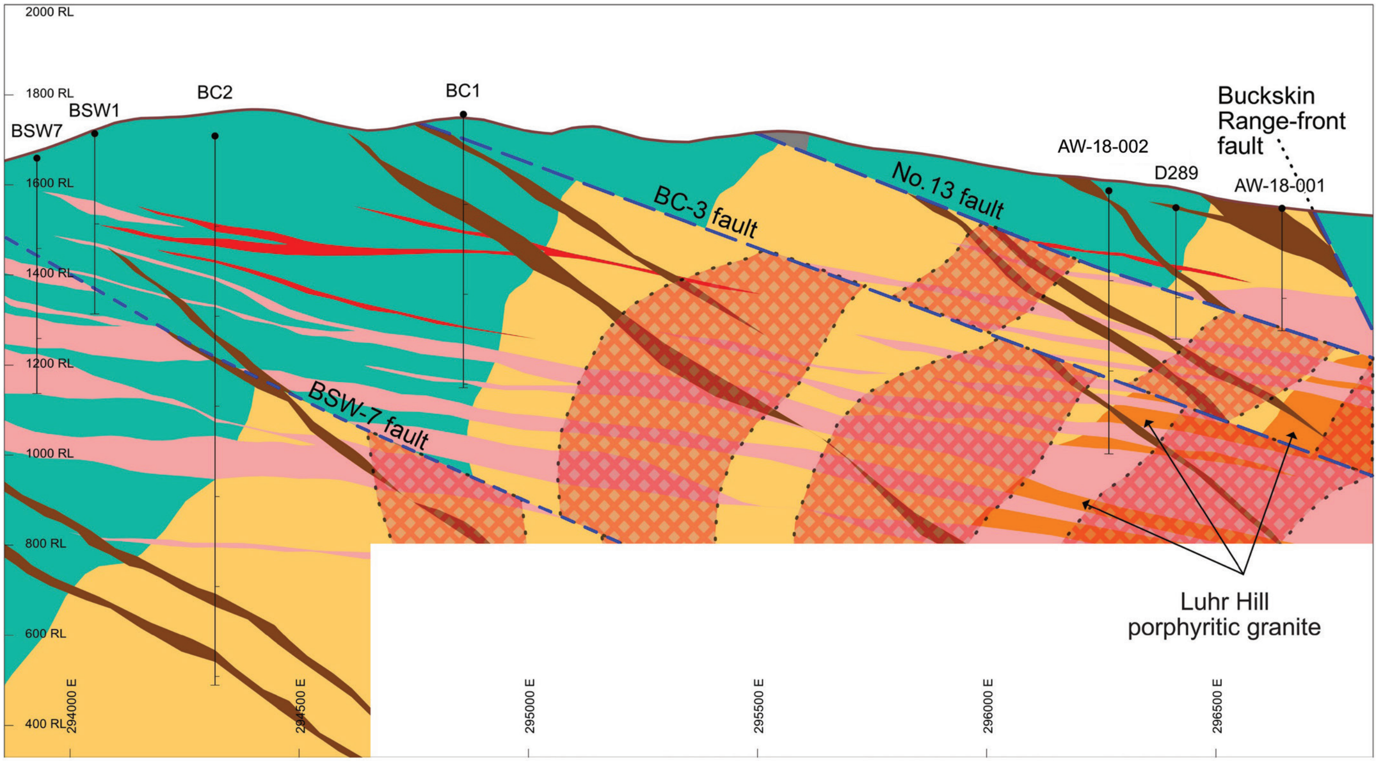

Figure 6. WNW-ESE cross-section through the Willow target. Red cross-hatching indicates possible outlines of Cu shells that are consistent with data from the surface as well as 2018 and prior drill holes; see text for discussion. Location shown on Figures 3 and 4; rock units as in Figure 2.

Similar veins control higher Cu grades at Ann Mason, Chuquicamata, Los Pelambres, and Butte (Proffett, 2009). Thin "AB" veinlets contain granular or elongate quartz, local K-feldspar, and sulfides. They commonly exhibit pyrite centerlines or molybdenite walls, and lack alteration halos. Thus, they appear transitional between the A and B veins of Gustafson and Hunt (1975). D veins are sulfide-dominant veins with sericite ± pyrite halos. Most are pyritic, but some contain sphalerite and/or galena. Gypsum veins cut or re-open all other veins. They probably formed from supergene hydration of anhydrite in earlier veins.

Abacus' mapping and samping outlined two alteration systems, each flaring to the west-northwest (Jurassic-up) with increasing sericitic, silicic and advanced argillic alteration (Figure 4). The northern or Alunite Hill alteration zone is 1.5 by 2 km and extends under cover to the northeast and east. Quartz veining is weak, mostly ≤ 3%, and only minor Cu showings are present. This zone represents the lithocap of the Ann Mason system, and was drilled extensively for Cu skarn and Au vein targets by Anaconda in the 1970s. The South Buckskin alteration zone is more extensive, measuring at least 3.0 km west-east by 2.5 km south-north (Figure 4). It is marked by a WNW-ESE axis of granite porphyry dikes approximately coincident with areas of 3–20 percent quartz veins. Turquoise occurrences are common, especially in the eastern part of this zone, where rocks contain up to 1.62% Cu.

TARGETING

Abacus developed the Willow target in the eastern part of the South Buckskin alteration zone from mapping complemented by geochemistry, geophysics, and SWIR studies, compilation of prior drill data, and logging of skeleton core. I.P. surveys yielded chargeability values > 30 mV/V along the central axis of the South Buckskin zone (as defined by granite porphyry dikes and quartz veining). Advanced argillic phases are concentrated along the same axis, and flare to the south along tuff and sediment beds of the Artesia Lake Volcanics. Soils over a 1.3 km by 1.0 km area in the eastern South Buckskin zone contain 200–2,330 ppm Cu and 5–69 ppm Mo. The Cu-Mo anomalies overlap the eastern half of a pronounced ground magnetic low (Figure 5).

Re-logging of skeleton core from twelve holes along a 3-km transect across the South Buckskin zone showed a systematic eastward increase in intersected quartz monzodiorite and granite porphyry. Zones of 0.08–0.16% Cu associated with potassic alteration were outlined on the west and east sides of this transect. Restoration of faulting in this section showed that the granite porphyry dikes represent the projection of the Ludwig dike swarm; and that a Cu-Mo-mineralized source cupola of Luhr Hill porphyritic granite should exist beneath the southeastern part of the Buckskin Range, coincident with the Cu-Mo anomalies and magnetic low. The target was inferred beneath

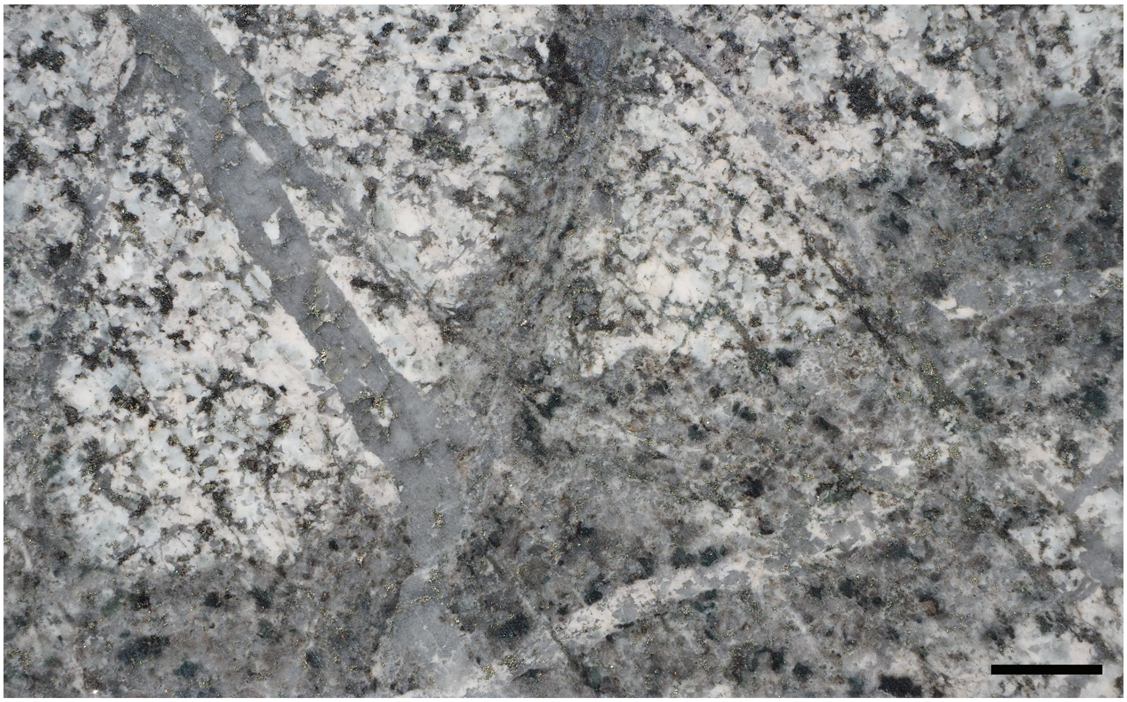

Figure 7. Luhr Hill porphyritic granite cut by early fracture halo with biotite-muscovite-K feldspar-pyrite-chalcopyrite (shades of gray), which is in turn reopened and cut by several stages of AB quartz-pyrite ± K-feldspar veinlets. This 2.7 m interval averaged 0.136% Cu and 61 ppm Mo. Hole AW18-002, 569.4 m. Scale bar is 1.0 cm long.

the No. 13 fault, in rock volumes largely untested by earlier holes in this area, which ranged in depths from 13–292 m.

DRILLING

Three core holes were planned to 600-800 m depths, in order to test the blocks beneath the No. 13 and BC-3 faults (Figure 6). Due to drilling complications, however, only AW18-002 reached targeted depth. AW18-001 was lost in the No. 13 fault zone, and AW18-003 was terminated in what is probably the BC-3 fault. Nonetheless, the holes confirmed the target concept, as both AW18-002 and -003 intersected significant intervals of chalcopyrite- and molybdenite-mineralized Luhr Hill granite. Cu and Mo also occur in McLeod Hill quartz monzodiorite, Artesia Lake Volcanics, and some Miocene(?) porphyries. Partial analyses indicate the holes intercepted 0.05–0.24% Cu and ≤ 0.015% Mo.

Consistently highest Cu grades (0.10–0.17%) were intercepted in AW18-002 between the BC-3 fault at ~405 m and the total depth of 584 m (Figure 6). Luhr Hill granite, some of the Miocene(?) porphyries, and minor McLeod Hill quartz monzodiorite are cut by early-halo sericite-K feldspar-biotite-andalusite-chalcopyrite-pyrite veins (Figure 7). Lower grade Cu (0.06–0.10%) occurs in McLeod Hill and Miocene(?) porphyries higher in the hole, but are related to AB and EB veins and not early halos.

Hole AW18-003 cut mostly Luhr Hill granite below the No. 13 fault at ~250–290 m. Weak Cu mineralization in this hole is related to AB and EB veins; early-halo veins are absent.

DISCUSSION

Due to drilling challenges in the 2018 program, the target remains largely untested. The relatively high pyrite/chalcopyrite ratios and lack of K-feldspathic alteration in rock drilled to date indicate that a potassic core with higher Cu grades remains undiscovered.

To predict the possible location of a higher grade zone, alteration, veining, and Cu and Mo values from recent and historic drill hole data have been compared, with emphasis on the block between the No. 13 and BC-3 faults. A northward vector is indicated by increased biotitic alteration, quartz veining, Cu and Mo in AW18-002 and D289 compared with AW18-003. This suggests that economic mineralization may occur below the No. 13 fault in the area of the prematurely lost hole AW18-001, or north of AW18-002. Offsetting AW18-002 to the west is supported by its relatively high Mo/Cu ratios. Since Mo typically occurs central to or below Cu in porphyry Cu systems, AW18-002 may lie east of (Jurassic below) economic Cu mineralization. Due to the eastward dip of the No. 13 fault, the westward vector increases the likelihood that higher grade Cu could reach within 100–300 m of the surface (Figure 6). A definitive drill test is planned in the near future.

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REFERENCES

Dilles, J.H., and Gans, P., 1995, The chronology of Cenozoic volcanism and deformation in the Yerington area, western Basin and Range and Walker Lane: Geological Society of America Bulletin, v. 107, p. 474–486.

Dilles, J.H., and Wright, J.E., 1988, The chronology of early Mesozoic arc magmatism in the Yerington district, Nevada, and its regional implications: Geological Society of America Bulletin, v. 100, p. 644–652.

Dilles, J.H., Einaudi, M.T., Proffett, J.M., and Barton, M.D., 2000, Overview of the Yerington porphyry copper district: Magmatic to nonmagmatic sources of hydrothermal fluids, their flow paths, alteration effects on rocks, and Cu-Mo-Fe-Au ores: Society of Economic Geologists Guidebook 32, p. 55–66.

Garside, L.J., Henry, C.D., and Boden, D.R., 2002, Far-flung ash-flow tuffs of Yerington, western Nevada erupted from calderas in the Toquima Range, central Nevada [abs.]: Geological Society of Americaa Annual Meeting, Denver, CO, October 2002. https://gsa.confex.com/gsa/2002AM/finalprogram/abstract_44937.htm.

Ghobadi, M., 2017, A17-09558 Modified Report: Report of U-Pb geochronological results to Abacus Mining and Exploration Corp., October 2017.

Gibson, P.C., 1987, Geology of the Buckskin Mine, Douglas County, Nevada: Reno, University of Nevada-Reno, M.S. thesis, 93 p.

Gustafson, L.B., and Hunt, J.P., 1975, The porphyry copper deposit at El Salvador, Chile: Economic Geology, v. 70, p. 857–912.

Gustafson, L.B., and Quiroga G., J., 1995, Patterns of mineralization and alteration below the porphyry copper orebody at El Salvador, Chile: Economic Geology v. 90, p. 2–16.

Hudson, D.M., 1983, Alteration and geochemical characteristics of the upper parts of selected porphyry systems, western Nevada: Reno, University of Nevada-Reno, Ph.D. thesis, 229 p.

Hudson, D.M., and Oriel, W.M, 1979, Geologic map of the Buckskin Range, Nevada: Nevada Bureau of Mines and Geology Map 64, scale 1:18,000.

Kulla, G., Oshust, P., Desautels, J.R.P., Melnyk, J., Zurowski, G., Jones, L., and Colantonio, M., 2017, 2017 updated preliminary economic assessment on the Ann Mason project, Nevada, U.S.A.: Technical report prepared for Entreé Gold, Inc., and Mason Resources Corp., 352 p.

Lipske, J.L., and Dilles, J.H., 2000, Advanced argillic and sericitic alteration in the subvolcanic environment of the Yerington porphyry copper system, Buckskin Range, Nevada: Society of Economic Geologists Guidebook 32, p. 91–99.

Moore, J.G., 1969, Geology and mineral deposits of Lyon, Douglas, and Ormsby Counties, Nevada: Nevada Bulletin of Mines and Geology Bulletin 75, 45 p.

Proffett, J.M., 1977, Cenozoic geology of the Yerington district, Nevada, and implications for the nature and origin of Basin and Range faulting: Geological Society of America Bulletin, v. 88, p. 247–266.

Proffett, J.M., 2007, Report on the geology and genesis of the Yerington porphyry copper district, Nevada, a four dimensional study: Final report, USGS Mineral Resource External Research Program grant 06HQGR0171, 16 p.

Proffett, J.M., 2009, High Cu grades in porphyry Cu deposits and their relationship to emplacement depths of magmatic sources: Geology, v. 37, p. 675–678.

Proffett, J.M., and Dilles, J.H., 1984, Geologic map of the Yerington district, Nevada: Nevada Bureau of Mines and Geology Map 77, 1:24,000.

Proffett, J.M., and Proffett, B.H., 1976, Stratigraphy of the Tertiary ash-flow tuffs in the Yerington district, Nevada: Nevada Bureau of Mines and Geology Report 27, 28 p.

Seedorff, E., Dilles, J.H., Proffett, J.M., Jr., Einaudi, M.T., Zurcher, L., Stavast, W.J.A., Johnson, D.A., and Barton, M.D., 2005, Porphyry deposits; characteristics and origin of hypogene features: Economic Geology 100th Anniversary Volume, p. 251–298.

Sillitoe, R.H., 2010, Porphyry copper systems: Economic Geology, v. 105, p. 3–41.

Stewart, J.H., Silberling, N.J., and Harwood, D.S.. 1997, Triassic and Jurassic stratigraphy and paleogeography of west-central Nevada and eastern California: U.S. Geological Survey Open-File Report 97-495, 57 p.

Whitney, D.L., and Evans, B.W., 2010, Abbreviations for names of rock-forming minerals: American Mineralogist, v. 95, p. 185–187.