Intrusive-breccia-hosted gold mineralization associated with ca. 92 Ma Tombstone Plutonic Suite magmatism: An example from the Bear Paw breccia zone, Clear Creek, Tintina gold belt, Yukon

***J. R. Stephens*[1]**
James Cook University, Queensland, Australia

***S. Weekes*[2]**
Redstar Resources Corporation

Stephens, J.R. and Weekes, S., 2001. Intrusive-breccia-hosted gold mineralization associated with ca. 92 Ma Tombstone Plutonic Suite magmatism: An example from the Bear Paw breccia zone, Clear Creek, Tintina gold belt, Yukon. *In:* Yukon Exploration and Geology 2000, D.S. Emond and L.H. Weston (eds.), Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 347-353.

ABSTRACT

The Bear Paw breccia zone is located at the Clear Creek property in the Tintina gold belt, central Yukon Territory. Gold mineralization occurs in hydrothermal breccias with stockwork quartz + potassium-feldspar + sulphide veins that overprint earlier intrusive and tectonic breccias. Grades of up to 2.3 g/t gold over 31.8 m have been intersected in recent drilling. The Bear Paw breccia zone is 1.5 km from any significant-sized granitoid stock and thus is indicative of the high potential for gold mineralization outboard of Tombstone Plutonic Suite stocks.

RÉSUMÉ

La zone bréchique de Bear Paw se trouve sur la propriété de Clear Creek, dans la ceinture aurifère de Tintina, dans le territoire du Yukon. La minéralisation aurifère dans la zone est associée aux brèches hydrothermales composées de filons de quartz + feldspath potassique + sulfures qui se surimposent sur des brèches intrusives et tectoniques plus anciennes. Les sondages ont rencontré des teneurs d'or allant jusqu'à 2,3 g/t d'or sur 31,8 m. La zone bréchique de Bear Paw se trouve à 1,5 km de tout stock granitique de taille significative et indique le potentiel élevé de minéralisation aurifère à l'extérieur des stocks du cortège plutonique de Tombstone.

[1]*julian.stephens@jcu.edu.au*

[2]*611-675 West Hastings Street, Vancouver, British Columbia, Canada V6B 1N2, sweekes@abacusminerals.com*

INTRODUCTION

The Bear Paw breccia zone is located at the Clear Creek property, in the Tintina gold belt, central Yukon Territory (Fig. 1). Recent drilling has defined significant gold grades hosted predominantly by intrusive and tectonic breccias associated with ca. 92 Ma Tombstone Plutonic Suite (TPS) magmatism.

LOCAL GEOLOGY

Highly deformed, dominantly clastic metasedimentary rocks of the Neoproterozoic to Early Cambrian Hyland Group underlie the Clear Creek area. Numerous TPS stocks, dykes and sills with compositions varying from quartz monzonite to granite, granodiorite and diorite were emplaced into Hyland Group country rocks at ca. 92 Ma (Murphy, 1997; Fig. 2). Temporally associated auriferous quartz-sulphide veins occur within, and surrounding, most of the larger stocks (Marsh et al., 1999, 2000).

Three dominant structural trends have been identified in the area (Stephens et al., 2000; Stephens and Mair, 2000):

1. South- to south-southeast-striking, steeply dipping, mostly sinistral faults, shear veins and granitoid dykes.
2. East- to east-southeast-striking, steep fracture zones, granitoid and lamprophyre dykes and a dominant set of auriferous quartz-sulphide veins (Marsh et al., 1999, 2000).

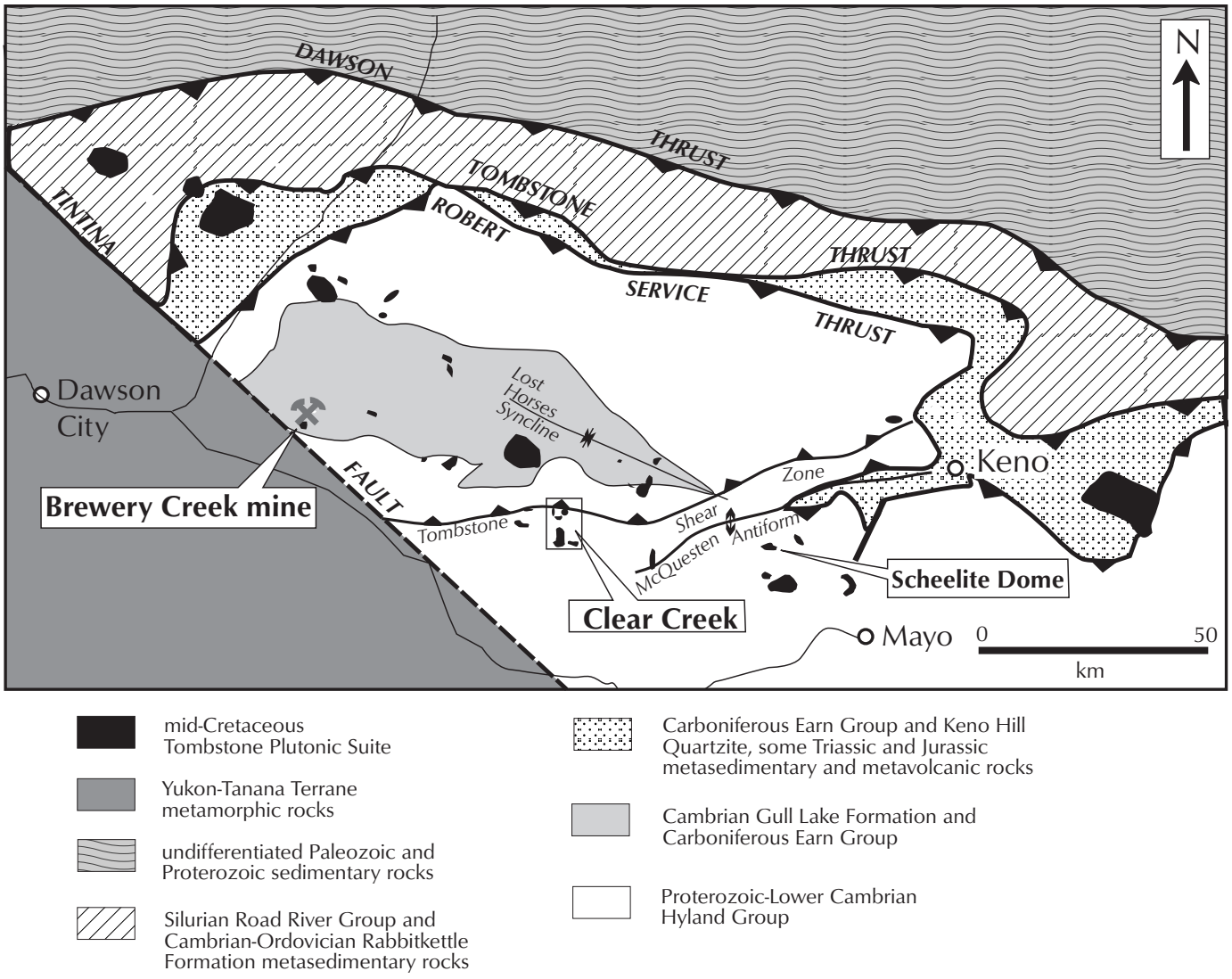

Figure 1. *Location of the Clear Creek property and geology of the western Selwyn Basin.*

3. Northeast- to north-northeast-striking, steep fracture zones with a lack of dykes and veins.

The following four main styles of gold mineralization are recognized at Clear Creek, two of which occur in the Bear Paw breccia zone:

1. East- to east-southeast-striking, sheeted, auriferous quartz sulphide veins occurring mostly within larger TPS stocks, (e.g., Rhosgobel, Pukelman, Eiger stocks).
2. Silicified fault zones in both south to southeast and east to east-southeast orientations (e.g., Contact zone).
3. Intrusive breccias with stockwork, auriferous quartz-sulphide veins (e.g., Bear Paw breccia, Saddle Stock).
4. Calc-silicate rocks with replacement/skarn-style mineralization (e.g., Bear Paw breccia).

EXPLORATION HISTORY

The Clear Creek area has produced about 130,000 ounces (4 million grams) of placer gold since the turn of the century (Allen et al., 1999), with hardrock claims dating back to almost as far as the placer records. Modern day exploration work began in the late 1970s and early 1980s with companies investigating the area for tungsten and tin. In the mid 1980s, exploration work shifted to the hardrock gold potential and concentrated on mineralization mostly hosted within the numerous TPS intrusive bodies on the property. Exploration focused on low-grade, high-tonnage, granitoid-hosted, sheeted-vein-style mineralization similar to that currently being mined at Fort Knox, Alaska. Work conducted on the property since the mid 1980s included geological mapping, soil sampling, trenching, ground and airborne magnetic and radiometric surveys and drilling.

DISCOVERY OF THE BEAR PAW BRECCIA

In the mid 1990s, Kennecott Canada Ltd. collected soil samples along the road that they constructed on the ridge separating Clear Creek and Left Clear Creek. Anomalous gold results encouraged Newmont Exploration Limited to undertake a contour-soil geochemical survey to further define the gold-bismuth anomaly.

Follow-up prospecting by geologists Mike Stammers and Richard Gorton (Newmont) found float of mineralized breccia that they considered the source of the gold. Geophysical surveys showed that the gold-bismuth soil anomaly is associated with a magnetic low and potassium high, and a south- to southeast-trending VLF (very low frequency) anomaly.

In 1998, Newmont Exploration Limited completed a contour soil geochemical survey on the ridge that separates Clear Creek and Left Clear Creek (Fig. 3). A gold and bismuth anomaly that is associated with a magnetic low and potassium high was identified. A south- to southeast-trending VLF anomaly was subsequently identified just east of the soil geochemical anomaly. This area was to become the Bear Paw breccia zone.

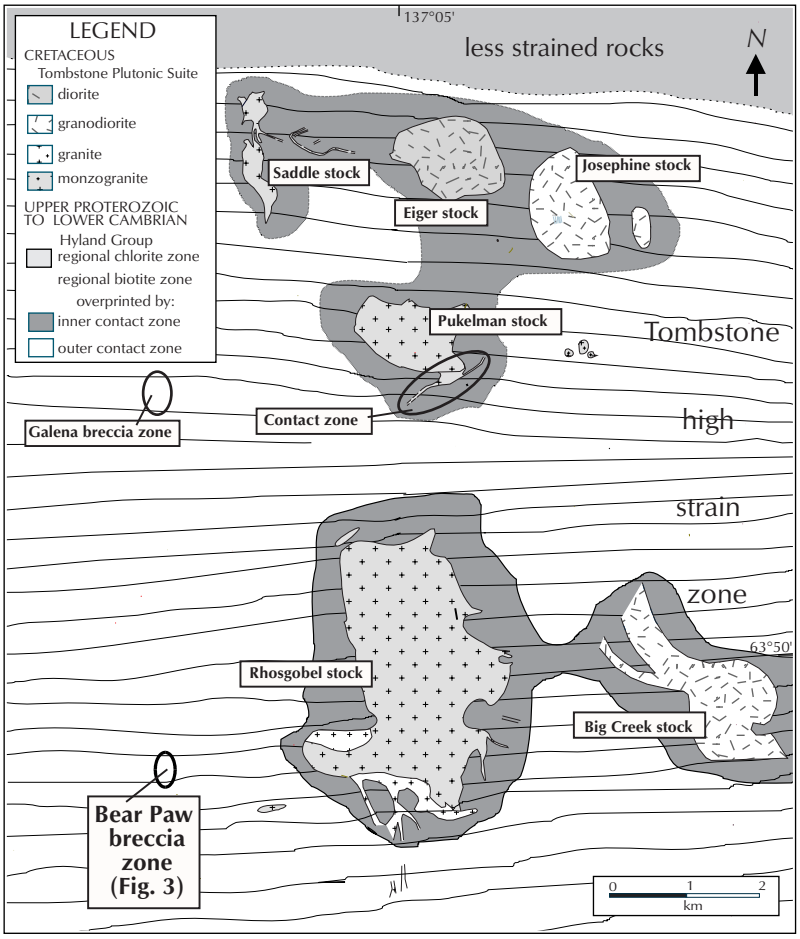

Figure 2. *Simplified geology of the Clear Creek area displaying the location of Tombstone Plutonic Suite (TPS) stocks. The Bear Paw breccia zone (Fig. 3) is 1.5 km from the nearest significant exposed TPS stock in an area covered by soil and colluvium.*

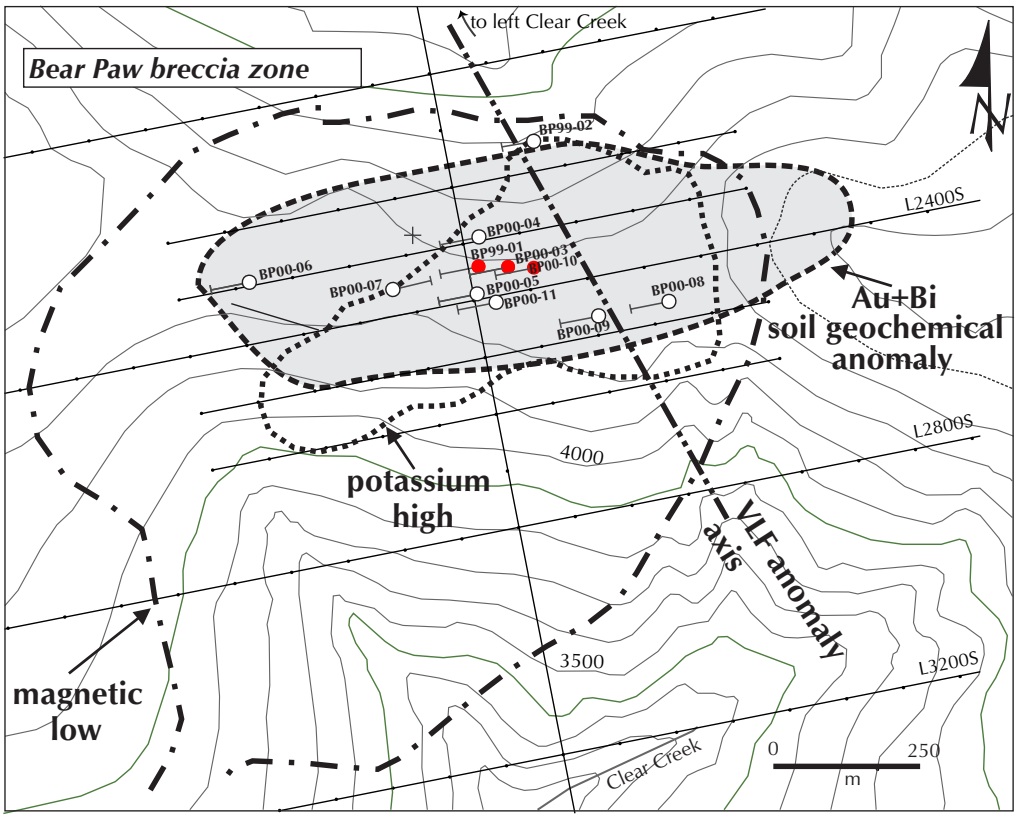

Figure 3. *Summary map of drilling, geophysical and geochemical surveys conducted on the Bear Paw breccia zone. The two most prominent mineralized structural trends on the property are consistent with the south- to southeast-trending VLF anomaly and the east to east-southeast trend of the geophysical and geochemical anomalies. Contour spacing is 100 ft.*

In 1999, Redstar Resources Corporation completed a detailed soil-sampling program over the Bear Paw breccia zone in addition to two short diamond drill holes. Soil sampling defined a broad, east-trending gold and bismuth anomaly 900 x 400 m. The two drill holes intersected wide zones of hydrothermal breccia with gold mineralization. The discovery hole, BP99-01, returned 2.0 g/t over 26.7 m and was the first indication of the economic potential of the zone.

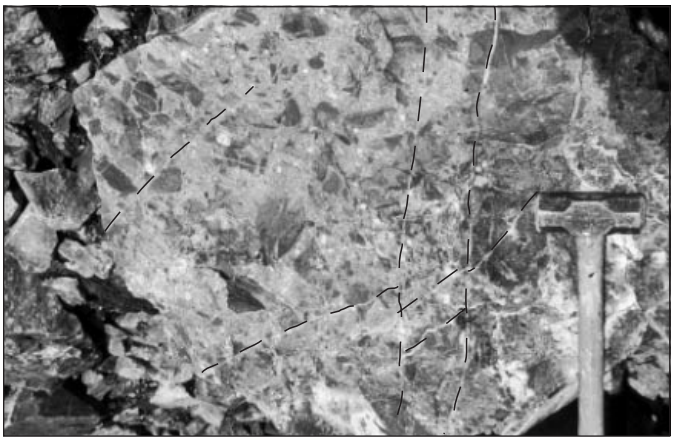

Figure 4. *Veined intrusive breccia from the Saddle stock. The dark fragments are mostly phyllite and the matrix is porphyritic quartz monzonite. The intrusive breccia is cut by mineralized quartz + potassium feldspar veins in two distinct orientations highlighted by dashed lines.*

BEAR PAW GEOLOGY

Drilling during the 1999 and 2000 exploration programs confirmed the presence of a large area of gold mineralization centred on an area of shallowly dipping, irregularly shaped, granitic sills and/or dykes, and associated intrusive breccia. These intrusive bodies and surrounding Hyland Group rocks formed a favourable zone for further fracturing and the introduction of mineralizing fluids to create a stockwork of quartz + potassium-feldspar + sulphide + gold veins.

Breccia types within the Bear Paw zone are divided into the following four categories on the basis of genesis:

1. Intrusive breccia: angular phyllitic and psammitic clasts in a matrix of medium-grained granite *(sensu lato)* (Fig. 4).
2. Tectonic breccia: angular clast-supported breccia dominated by phyllite and psammite with rare granitic clasts.

3. Hydrothermal breccia (Au): stockwork of quartz + potassium-feldspar + sulphide + gold veins that overprints both the intrusive (1) and tectonic (2) breccias. Higher vein densities generally occur in zones where intrusive breccia and granodiorite sills or dykes are dominant. Many of the veins are 'breccia veins' and contain clasts of Hyland Group rocks.
4. Late hydrothermal breccia: irregular, thin, quartz–carbonate-pyrite veins with associated strong, pervasive, sericite/clay alteration of wallrocks. This phase overprints breccia types (1), (2) and (3) and is concentrated around fault zones.

The south- to southeast-trending Bear Paw fault zone has the strongest structural control on the Bear Paw breccia zone. A number of the faults intersected in drilling contain clay gouge, and cut granitic sills and/or dykes and intrusive breccia. There also appears to be some east-trending controls on the mineralization expressed in magnetic, geochemical and potassium anomalies (Fig. 3). In drill-core, the orientation of quartz + potassium-feldspar + sulphide + gold veins is consistent with the property-wide, roughly south- to southeast- and east-trending vein sets.

There is a continuous spatial zoning from sparse quartz + potassium-feldspar veining, to stockwork, to silica-flooded breccia zones (Figs. 5 and 6). Sulphide content in quartz veins is typically less than 2% and includes pyrite, pyrrhotite and chalcopyrite, with minor arsenopyrite, bismuthinite and gold. The best gold grades are associated with zones of granitic and intrusive-breccia-dominant hydrothermal breccias with visible bismuthinite. Zones of phyllite-dominant hydrothermal breccia with significant pyrrhotite, pyrite and chalcopyrite, however, returned only slightly elevated gold grades. A number of semi-massive quartz-sulphide veins up to 1 m wide were intersected and returned grades of 8-22 g/t gold (Fig. 7).

Several horizons of calc-silicate rocks with replacement pyrrhotite-pyrite-chalcopyrite mineralization were identified within the zone. All of these horizons are associated with elevated gold grades. Intercalated calc-silicate rocks and phyllite sections up to 10 m wide, grading 1.0 g/t gold were intersected in the drilling.

Redstar Resources Corporation completed nine diamond drill holes during the 2000 exploration season. All holes were drilled in the area of the Bear Paw breccia zone and all intersected varying amounts of breccia and gold mineralization. The best results were obtained from section 2350 m S, where hole BP00-03 returned

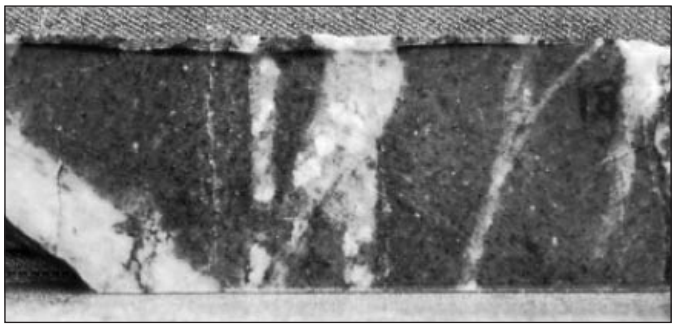

Figure 5. *Granitic-dominant stockwork/hydrothermal breccia displaying two distinct vein orientations. This style of breccia hosts most of the gold mineralization in the Bear Paw breccia zone.*

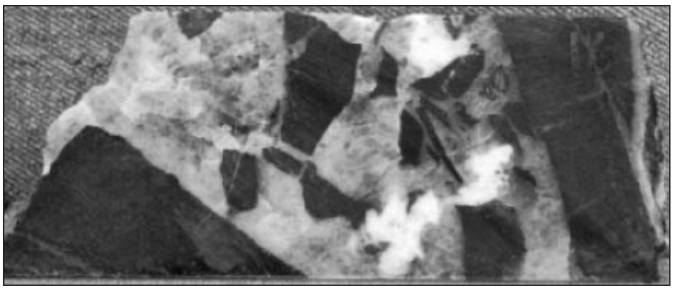

Figure 6. *Hydrothermal breccia vein in phyllite. Vein mineralogy is similar to that in Figure 5, but typically contains much lower gold grades than the granitic-dominant and heterolithic zones. The white mineral is potassium feldspar.*

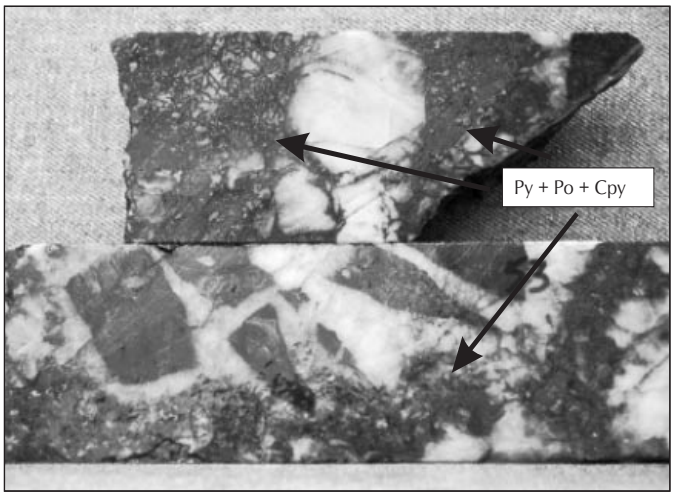

Figure 7. *Semi-massive sulphides in heterolithic hydrothermal breccia. The sulphides are pyrrhotite (Po), pyrite (Py) and chalcopyrite (Cpy), with minor arsenopyrite and bismuthinite. Gold grades within these veins range from 8-22 g/t gold.*

2.0 g/t Au over 34.8 m and hole BP00-10 returned 2.3 g/t Au over 31.8 m (Fig. 8).

CONCLUDING COMMENTS

The Bear Paw breccia zone is covered entirely by overburden and was discovered primarily by geochemical and geophysical surveys. Gold mineralization occurs in hydrothermal breccia that overprints earlier intrusive and tectonic breccias. The best zones of mineralization occur in areas dominated by granitic sills and/or dykes and intrusive breccia of the Tombstone Plutonic Suite (TPS). These areas have provided the best competency contrasts for fracturing resulting in enhanced rock permeability conducive to high fluid fluxes and consequently gold mineralization. Furthermore, high fluid pressures are indicated by the presence of mineralized breccia veins containing phyllite clasts hosted wholly within granite.

The Bear Paw breccia zone is situated 1.5 km from the nearest significant-sized stock and therefore indicates the high potential for structurally controlled gold mineralization significantly outboard from granitoid stocks throughout the entire TPS belt.

Soil geochemical sampling in 1999 and 2000 defined an area 1300 by 400 m that is anomalous in gold and bismuth. Drilling to date has tested only a portion of this anomaly. The wide zones of breccia-hosted gold mineralization intersected in 1999 and 2000 drilling programs indicate the area has the potential to host a large tonnage, near-surface gold resource.

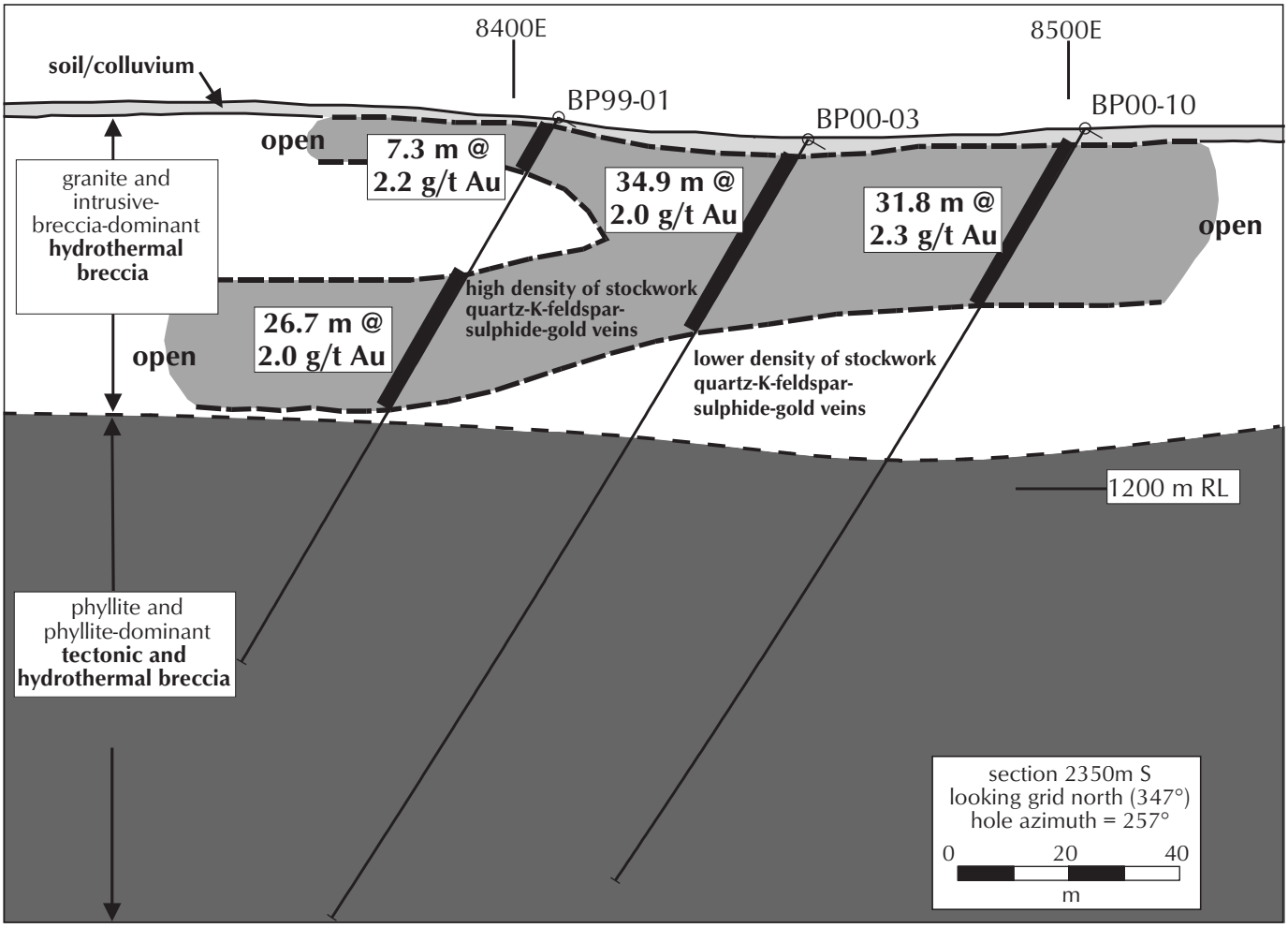

Figure 8. *Simplified 2350 m S cross-section showing the economic gold grades within an apparently flat zone (on section) dominated by granite and intrusive breccia. Location of drill holes is shown in Figure 3.*

ACKNOWLEDGEMENTS

The authors are grateful for support from the Yukon Geology Program. Redstar Resources and Pamicon staff Bob and Maryanne Darney, Kevin Millage, John Anderson, Rob Falls, Steve Toduruk and Doug Fulcher are acknowledged for logististical support and helpful discussions in the field. The Harper family is kindly thanked for once again providing excellent accommodation and messing facilities at their camp in Left Clear Creek. Reviews by Craig Hart and editing by Leyla Weston improved the manuscript.

REFERENCES

Allen, T.L., Hart, C.J.R and Marsh, E.E., 1999. Placer gold and associated heavy minerals of the Clear Creek drainage, central Yukon: Past to present. *In:* Yukon Exploration and Geology 1998, C.F. Roots and D.S. Emond (eds.), Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 197-214.

Marsh, E.E., Hart, C.J.R, Goldfarb, R.J. and Allen, T.L., 1999. Geology and geochemistry of the Clear Creek gold occurrences, Tombstone gold belt, central Yukon Territory. *In:* Yukon Exploration and Geology 1998, C.F. Roots and D.S. Emond (eds.), Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, p. 185-196.

Marsh, E.E., Goldfarb, R.J., Hart, C.J.R. and Johnson, C., 2000. Auriferous sheeted quartz veins of the Clear Creek intrusion-related gold deposit, Tintina Mineral Belt, Yukon, Canada. *In:* Gold in 2000, L.A. Bucci and J.L. Mair (eds.), poster session and extended abstracts, Lake Tahoe, Nevada, November 10-11, 2000, p. 53-56.

Murphy, D.C., 1997. Geology of the McQuesten River region, northern McQuesten and Mayo map areas, Yukon Territory (115P/14, 15, 16; 105M/13, 14). Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada, Bulletin 6, 122 p.

Stephens, J.R. and Mair, J.L., 2000. Structural controls on intrusion-related gold mineralization at Clear Creek, Tintina Gold Belt, Yukon Territory, Canada. *In:* Gold in 2000, L.A. Bucci and J.L. Mair (eds.), poster session and extended abstracts, Lake Tahoe, Nevada, November 10-11, 2000, p. 57-61.

Stephens, J.R., Oliver N.H.S., Baker, T. and Hart, C.J.R., 2000. Structural evolution and controls on gold mineralization at Clear Creek, Yukon Territory, Canada. *In:* Yukon Exploration and Geology 1999, D.S. Emond and L.H. Weston (eds.), Exploration and Geological Services Division, Yukon, Indian and Northern Affairs Canada.