

Home of Bullion project – mapping

Michael Green
Remote Area Geoscience

1.0 Introduction

The Home of Bullion Cu-Pb-Zn-Ag prospect is located 27 km east of Barrow Creek on EL 23186 and the Neutral Junction PPL. The deposit was sporadically mined between 1923 and 1951, with peak production in 1949 when 5,500 tons of ore were removed. Since then, the deposit has been deemed uneconomic, despite a lack of systematic exploration. Some regional exploration was completed in the greater area by CRA Exploration (1980-82) and Aberfoyle (1992-98) with no success. Second edition geological mapping of the 1:250,000-scale Barrow Creek sheet was undertaken between 1981-1988 (Haines et al., 1991) and the area is covered by regional gravity (11 km cell spacing) and airborne magnetics and radiometrics (500 m-spaced north-south lines) surveys.

Since grant of EL 23186 in 2002, work has focussed on determining whether the Home of Bullion deposit could support a low tonnage, high-grade mining operation. Various work programmes have been recommended to achieve this aim culminating in a 15 hole diamond drilling programme in mid-2006. One consistent recommendation has been for a geological map covering the greater area around Home of Bullion with the object of putting the prospect geology into greater perspective. Such mapping is reported here.

Field mapping was undertaken between 12-15 September, 2006. No airphotos were available at this time, although 1:25,000-scale colour photos covering the area have since been located and used to redraft the map. A 1.2 x 1.2 km area centred on the Home of Bullion prospect was mapped with geological information collected from 83 points (Appendix 1). There are further outcrops of metasedimentary schist immediately east and northeast of the mapped area that were not visited during this trip, but have been mapped using the airphotos. Mapping was done by traversing across strike and collecting point data with a handheld GPS. Mesoscopic folds identified by previous workers (Sullivan, 1953; Drown, 1993) were also visited. Points were downloaded and overlain on a LandSat 7 image to extrapolate the geology. Unfortunately, the LandSat image does not have sufficient resolution to confidently achieve this, and so, the 1:25,000-scale photos have since been used.

2.0 Geology

In general, the geology is quite straightforward; a package of bedded, fine- to medium-grained metasedimentary schist and subparallel dolerite sills folded into tight northwest-plunging upright folds. The main structural fabrics, including bedding, dip uniformly north-northeast. Tabular bodies of Cu-Pb-Zn-Ag mineralisation are hosted within the metasedimentary schist, and dip north-northeast, grossly subparallel to bedding. Outcrop in the immediate area is good, though the schists are quite weathered. Nevertheless, detailed mapping is difficult as the schists are quite uniform with no good marker horizons and the main schistosity has destroyed most small-scale primary features. No granite or pegmatite intrusions were mapped, though regionally they are very common (Haines et al., 1991). Neoproterozoic sediments of the Georgina Basin drape the schists, outcropping as isolated outliers north of Home of Bullion and extensive hills to the south. Palaeotopography has been partly preserved.

2.1 Rocktypes

Bullion Schist: The majority of exposed rock at Home of Bullion comprises quartz-muscovite schist with varying abundances of andalusite and chloritoid porphyroblasts (Photo 019a). A black fibrous mineral, probably tourmaline, is common with the andalusite porphyroblasts. The schists represent a metamorphosed package of bedded, fine-grained clastic sediments, predominantly silty sandstone with minor muddy siltstone. Fine-scale sedimentary structures are poorly preserved, but in places there are cm-scale planar beds (Photo 005) and rare instances of possible normal grading represented by increasing andalusite content toward the top of the bed (Photo 020). Such grading indicates that the package is upward facing. Thick beds are traceable over hundreds of metres as tram-track stratigraphy, where certain beds (typically more sandy) form ridges and other beds are recessive (Photo 006, 018). Andalusite-rich beds, such as beneath the cairn (Site 002), also form more resistant units.

Mafic rocks: Two recessive areas north of the Home of Bullion prospect and subparallel to bedding within the Bullion Schist have formed by weathering of mafic rocks (Photo 018). These mafic units are massive, medium- to fine-grained and composed of chlorite, actinolite, quartz and albite. In places, subophitic textures are preserved. At least one of these units was folded during the main deformation event, suggesting they represent early dolerite sills. Some minor secondary copper mineralisation (malachite, siderite) is associated with these sills (Site 011).

To the southeast of the prospect (Sites 033, 034, 036), there is a pyroxene-bearing dolerite. The lack of metamorphism here suggests that this mafic unit intruded later than the sills and so all the mafic units are probably not part of one coeval suite.

Quartz veins: Thin quartz veins, generally subparallel to bedding, are common throughout the area, but not abundant. These veins are typically red, massive and contain significant Fe-oxide. Minor massive quartz veining is associated with mineralisation, but not in any greater abundance than regionally. Small massive quartz pods cut the main schistosity and are clearly very late (Site 048).

Central Mount Stuart Formation: North of the Home of Bullion prospect, there are two outliers of basal Georgina Basin sediments, which comprise coarse, poorly sorted quartz sandstone with trough cross-beds and pebble-filled channels. The pebbles are predominantly subangular white massive vein quartz and have dispersed downslope forming a false lag anomaly.

To the south of the prospect, there are large hills of flat-lying Georgina Basin sediments. Furthermore, the valley between these hills and the Bullion Schist is also filled with Georgina Basin sediment suggesting that deposition of the Georgina Basin was onto a topographically complex platform that has been partly preserved.

2.2 Deformation

In the mapping area, the Bullion Schist is intensely folded and foliated, preserving structures formed during four deformation events (see Stereoplot). In contrast, the mafic units are massive, although one unit has been clearly folded. The interpretation here is based on observations of the Bullion Schist.

Bedding-parallel mineral cleavages (D_1 , S_1) are well developed throughout the mapping area (Photo 005), but do not appear to be related to folding. Such cleavages are interpreted to have formed during sediment burial and, as such, are not considered to be tectonic.

The first tectonic event (mapped as D_2 , S_2 , F_2) is expressed widely as a strong moderately northeast-dipping quartz-mica foliation (modal $S_2 = 59^\circ/041^\circ$), which is axial planar to regional, upright, northwest-plunging folds (modal $F_2 = 55^\circ \rightarrow 326^\circ$, β -axis of $S_0 = 52^\circ \rightarrow 344^\circ$). Outcrop-scale folds are difficult to recognise due to intense cleavage development, but two instances of folds have been recorded. The only decimetre F_2 recorded is best expressed by a 20 m wide mafic unit 400 m northwest of the main shaft. The schists around this fold closure also preserve the fold, probably because they have been protected by the competency of the mafic unit. At the western end of the minesite, a metre-scale parasitic F_2 is preserved in the western wall of the adit (Site 065). Importantly, the folds are asymmetric with long north-dipping limbs forming tram track stratigraphy and short overturned limbs subparallel to S_2 . The short limbs are difficult to map due to the intense subparallel S_2 cleavage, and are probably sheared out in places.

The second tectonic event (D_3 , F_3 , L_3) is represented by small-scale folds and crenulations of S_1 and S_2 (Photos 002b, 019b) and stretching lineations plunging steeply to the northeast (modal L_3 , $F_3 = 52^\circ \rightarrow 052^\circ$, β -axis of $S_2 = 58^\circ \rightarrow 032^\circ$). S_3 axial planar mineral cleavage are poorly developed, and hence D_3 was at a lower temperature than D_2 . Sullivan (1953) reported that the ore pitches 65° E, most consistent with these structures.

The third tectonic event (S_4) is represented by a steep north-south-trending, 10 cm to metre-spaced disjunctive cleavage. No displacement was recorded with this cleavage, but comments by Roy Cox suggest that similarly oriented structures may dextrally displace the ore lodes. The role of these structures in modifying mineralisation needs to be further investigated.

2.3 Metamorphism

The regional metamorphic grade at Home of Bullion is constrained by a peak assemblage of quartz, muscovite, andalusite and chloritoid in the most aluminous rocks, indicating upper greenschist to lowermost amphibolite-facies. This is consistent with the lack of grain size increase in the silty sandstone units and the presence of chlorite, albite and actinolite in the northern mafic units.

Peak metamorphism must have postdated the main folding event because the andalusite and chloritoid porphyroblasts are randomly oriented within bedding planes (Photo 002a, 063). Moreover, these porphyroblasts have not been deformed by S_2 (ie shear rotations). In contrast, some of the andalusite porphyroblasts are crenulated by F_3 , (Photo 002a, 019b) suggesting peak metamorphism was between D_2 and D_3 .

2.4 Mineralisation

Although not the focus of this mapping project, some observations around the Home of Bullion lodes were made to put the mineralisation into a regional context. Detailed constraints of the depth and distribution of mineralisation have been obtained from recent diamond drilling, but are unavailable here. Importantly, near-surface mineralisation and adjacent rocks are intensely weathered and so some observations here may be near-surface artifacts. For instance, the weathered mineralisation is massive, but this does not imply that the primary mineralisation is also massive.

Four Cu-Pb-Zn-Ag \pm Au lodes have been identified at Home of Bullion hosted in chlorite-altered Bullion Schist. Alteration aside, the Bullion Schist around the lodes is no different from that elsewhere and there are no major lithological changes across the lode horizons. No mafic or felsic units were mapped around the lodes, though the drillcore will provide better detail. The lodes are tabular and dip steeply northeast,

grossly concordant with bedding. At South Lode 2, however, mineralisation is subparallel to the footwall, which is much steeper than the hangingwall (Photo 026a, b), suggesting some form of structural discordance. McBride (2006) suggests that the main-east and southern lodes are on opposite limbs of a large fold (F_2), but bedding-cleavage relationships show such a configuration to be incongruent. Instead, it is likely that the main and east lodes were once continuous, but have now been displaced by F_3 and S_4 structures. Likewise, the southern lodes were probably also continuous. It is unlikely, however, that all the lodes were once connected.

Primary alteration around mineralisation is dominated by chlorite with lesser coarse-grained muscovite. At the main and eastern lodes, chlorite alteration overprints schists with andalusite and chloritoid porphyroblasts (Photo 044a, 063) indicating that alteration, and thus mineralisation, was post-peak metamorphism. This relationship and the structural discordance at South Lode 2 suggests that mineralisation was emplaced along structures grossly parallel to bedding after D_2 and peak metamorphism, but before, or even during, D_3 . A further clue to the timing of mineralisation is given by Sullivan (1953) who states that the ore pitches 65° E, grossly coaxial to L_3 , and thus may have been emplaced during D_3 .

3.0 Recommendations

Discussions with Roy Cox and Wilson Gewardis have highlighted the need for an accurate survey of the Home of Bullion prospect, including recent drill collars. Upon completing this survey, existing costeans need to be deepened and extended to provide reasonable geological information along strike of the lodes. New costeans may also need to be dug. Using these costeans and other outcrop, the geology around each lode needs to be mapped in greater detail than presented in this report. Some of the diamond core should also be relogged to better integrate with the geological mapping. These data then need to be modelled in 3D to identify the best drill targets, in particular the possible whereabouts of reported plunging shoots.

Beyond the immediate Home of Bullion prospect, there is good scope to identify additional base metal mineralisation under shallow cover. Initial work should aim to produce prospectivity maps, starting with evaluation of previous exploration and then integrating regional outcrop, regolith and geophysical data. Orientation surveys (soil, lag, stream sediment, vegetation) should then be undertaken to identify the most effective sampling methods in the area. A targeted, cost-effective exploration programme can then be proposed to best evaluate all of EL 23186.

4.0 Bibliography

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Appendix 1

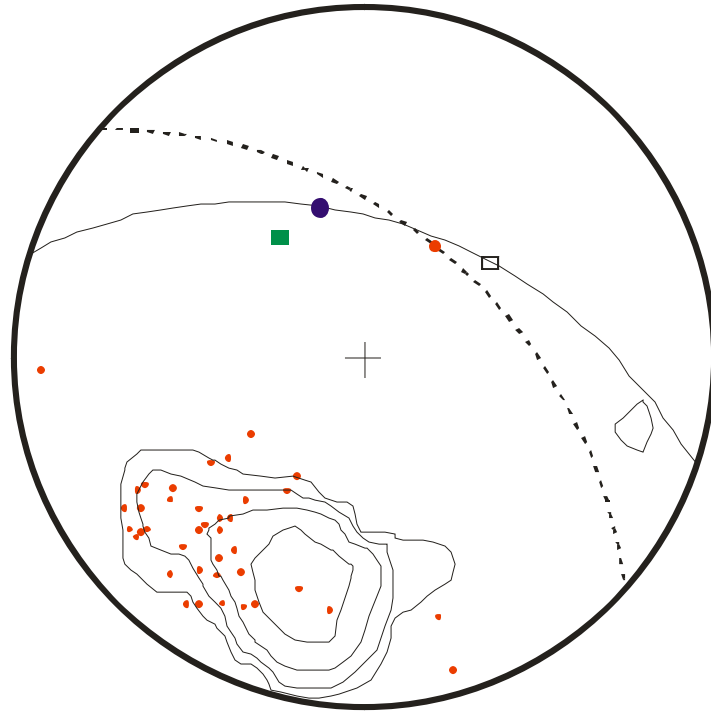
Sites, structural data

point_id	east	north	S0	S1	S2	L2	L3	S3	S4	GB-S0
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06GSK002	412601	7620879			54,014		44,048		58,256	
06GSK003	412642	7620888		52,036	82,344		52,060			
06GSK004	412680	7620920		50,102	66,344		50,054			
06GSK005	412759	7620945	50,016	50,012	40,054		40,046			
06GSK006	412828	7621012	72,014	72,014	50,040					
06GSK007	412831	7621054								
06GSK008	412843	7621094	76,012		76,036					
06GSK009	412813	7621184								
06GSK010	412813	7621233	62,016		64,034		56,032			
06GSK011	412821	7621246								
06GSK012	412820	7621270	64,026		54,040					
06GSK013	412827	7621470	50,016		44,056				74,084	
06GSK014	412722	7621373								
06GSK015	412559	7621326								
06GSK016	412527	7621262	60,006		56,044		54,034			
06GSK017	412468	7621158								
06GSK018	412554	7621093	66,020		54,048					
06GSK019	412453	7620913	40,020				50,060	86,328		
06GSK020	412378	7620931	48,014		56,034					
06GSK021	412177	7621079	56,020	56,020	66,056					
06GSK022	412168	7621107	72,014	72,014	58,044					
06GSK023	412148	7621384	60,360		32,030					
06GSK024	412176	7621505								
06GSK025	411834	7621144	62,014		60,036		54,052			
06GSK026	412366	7620746	56,012		70,058					
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06GSK032	412763	7620590	64,066		82,088					
06GSK033	412806	7620592								
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06GSK035	412871	7620545	46,020	46,020	66,038					
06GSK036	412896	7620588								
06GSK037	412880	7620667	68,026		72,054					
06GSK038	412863	7620783	68,006		70,030					
06GSK039	412959	7620986	54,008	54,008	56,044					
06GSK040	412775	7620904	78,050	78,050	68,026					
06GSK041	412762	7620857	54,356	74,020						
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06GSK043	412733	7620800			66,024	78,152	50,062			
06GSK044	412655	7620836								
06GSK045	412646	7620804	64,014	64,014						
06GSK046	412636	7620842			32,056		38,066			
06GSK047	412481	7620925								
06GSK048	412576	7621130								
06GSK049	412691	7621100								
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06GSK051	412327	7621209	60,336							
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06GSK060	412518	7620993	60,046	60,046	58,016		66,034			
06GSK061	412592	7620873	52,028	52,028	56,056					

Appendix 2

List of photos

- 06GSK001E: From cairn looking east.
- 06GSK001N: From cairn looking north (main shaft).
- 06GSK001S: From cairn looking south (hills of Georgina Basin sediments).
- 06GSK001W: From cairn looking west (lone of lode)
- 06GSK002a: Randomly oriented very coarse-grained andalusite porphyroblasts.
- 06GSK002b: F₃ crenulations around porphyroblasts.
- 06GSK005: Thin sandy bed with less developed cleavage.
- 06GSK006: Tram-track stratigraphy of thick beds.
- 06GSK018: Tram-track stratigraphy with recessive mafic unit to left (north).
- 06GSK019a: Bed defined by great abundance of andalusite.
- 06GSK019b: F₃ crenulations.
- 06GSK020: Putative top of bed defined by increased abundance of andalusite.
- 06GSK026a: South Lode 2 – hangingwall and ore zone discordance.
- 06GSK026b: South Lode 2 – footwall and ore zone concordance.
- 06GSK028: South Lode 2 – rootless sheath folds in footwall.
- 06GSK038: Georgina Basin sediments – flat lying quite low in valley.
- 06GSK044a: Eastern Lode – chlorite alteration in hangingwall schist.
- 06GSK044b: Eastern Lode – bleaching and chlorite alteration either side of weathered mineralisation.
- 06GSK047a, b: Main lode looking east.
- 06GSK062: Main Lode – discordant mineralisation and schistosity. Main body of mineralisation subparallel to flagged stones.
- 06GSK063: Main Lode – immediate footwall, chlorite-altered andalusite-chloritoid schist.
- 06GSK065: Main Lode – F₂ in hangingwall.
- 06GSK066: Large-scale bedding preserved as ridges.



Lower hemisphere, equal area stereoplot of structural data collected from Home of Bullion. Contours calculated from poles of S_0 and red dots are poles of S_2 . Solid green square is average F_2 and solid blue circle is β -axis defined from S_0 poles (solid line is average S_0 great circle). Open black square is average F_3 and solid red circle is β -axis defined from S_2 poles (dashed line is average S_2 great circle).