Assessing field evidence for magmatic-hydrothermal porphyry-style mineralisation in the underexplored Huntoon Valley, Nevada

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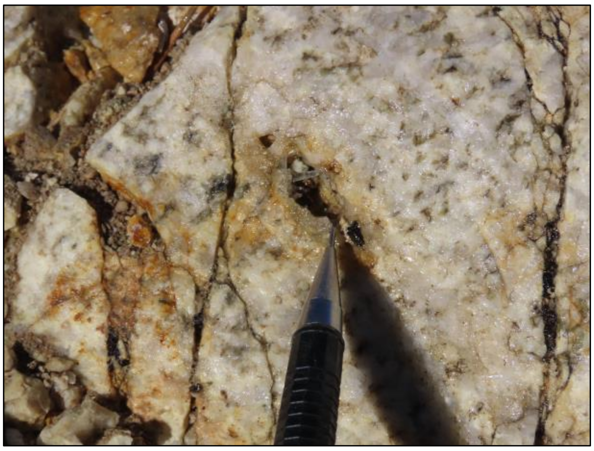

LC Geoscience

Mining & Exploration Services

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2. Executive Summary

The magmatic-hydrothermal transition and associated porphyry-style mineralisation displayed across a previously unmapped granitic cupola zone, in a historic skarn & epithermal mining district in South-West Nevada – Who said romance is dead?!

LC Geoscience Ltd was contracted by Great Western Mining (GWM) to perform a reconnaissance level field assessment for the evidence for porphyry-style mineralisation in the underexplored Huntoon Valley, Nevada, alongside providing GWM staff with field-based training on the features and architecture of magmatic-hydrothermal porphyry mineralising systems. Highlights from field studies performed in Yerington and the Huntoon Valley, Nevada, between 3rd-8th October 2023 include:

- A 'bottom-to-top' walkthrough of the classic Yerington District, Nevada, with Dr James Blight and GWM field staff. Discussing porphyry-system genesis, this spanned from deep exposures of Na-Ca alteration, up through the potassic core and into the overlying phyllic to argillic and lateral propylitic alteration zones of the porphyry system. GWM staff were exposed to a variety of alteration and vein types, key to the understanding of porphyry system architecture, along with evidence for the magmatic-hydrothermal transition in the form of miarolitic cavities, unidirectional solidification textures and A-type quartz veins.

- Walking the western side of Huntoon Valley (i.e. GWM's Huntoon property and surrounding land) unveiled first-order evidence for a magmatic-hydrothermal system with strong indications of associated porphyry-style mineralisation. Upwards through the system, in various apparently juxtaposing fault blocks, observed components include: 1) a large pluton of coarse grained porphyritic biotite granite (Whisky Flat granite); 2) finer grained phases of likely the same granite, cut by aplitic porphyry; 3) wall rocks exhibiting locally intense Na-Ca to propylitic alteration; 4) an aplitic cupola zone containing abundant pegmatitic pods, quartz eyes and miarolitic cavities; 5) a fine to medium grained quartz eye bearing porphyritic granite cut by aplitic porphyry dykes (with rare quartz Unidirectional Solidification Textures [USTs] at their margins) locally intense stock work of A-,AB-,B-type quartz veins and probable D-type veins containing relict sulphides, magnetite and tourmaline veins, abundant Fe-oxide staining, common Cu shows and various overprinting alteration assemblages including potassic, chlorite-sericite, and phyllic; 6) A shear zone hosting apparent remobilised Cu(-and other) mineralisation; 7) Host Mesozoic(?) sediments and volcanics with Cu shows; and 8) Overlying unmineralised and unaltered Tertiary cover.

- New field observations of exposed (but previously unmapped) altered and multiple type quartz vein bearing porphyry-granitic rocks on GWM's Huntoon property, seen with faulted contacts to be underlying Mesozoic(?) sediments and volcanics on the property, as well as having sharp intrusive contacts with intensely Na-Ca to propylitically altered mafic porphyry. Both host rocks host copper showings and copper and gold anomalism in soils. Significantly, this highlights potential for sub-cropping porphyry-style mineralisation on and surrounding GWM's current Huntoon property.

- Skarn-style mineralisation at GWM's 'M2' and 'M4' projects on the Eastern side of the Huntoon Valley is suggested to be associated with a much larger mineralising magmatic-hydrothermal system. Intensely Na-Ca/propylitically/skarn-style altered wall rocks were again apparent and new observations of proximal granitic magmatism to the skarn mineralisation were made (in the field at M2 and in core at M4). Analogues between the alteration and stratigraphy seen on both the West and East sides of Huntoon valley, along with the structural setting of the district, means that it is feasible for mineralisation on both sides of the valley to be co-genetic, and also highlights the potential for sub cropping mineralisation in the down thrown fault blocks now underlying the valley's sedimentary fill.

- Field evidence from across the Huntoon Valley, as summarised above, is suggestive towards a large subcropping porphyry-style magmatic-hydrothermal system. Current projects elsewhere in the county are continuously providing evidence for other such systems in the region. Exploration for the hypogene mineralised cores of such systems is complex, multi-faceted and expensive, but they remain the primary exploration target of mid-tier and major mining companies. Recommendations therefore focus on developing a robust observation-based framework from which larger scale exploration can be launched. In summary, recommendations are to:
  1. Use the new observations and understanding of outcropping altered and quartz vein bearing granitic rocks on and around GWM's Huntoon property to asses its likely sub-cropping geometry and immediately stake additional claims respectively. This has compelling field evidence for being a causative intrusion. It is highly recommended that this is done before publicising the field observations as the findings will likely prompt other parties to do so;
  2. Geochemically fingerprint the granitic rocks likely associated with mineralisation in the district using complete digestion ICP-MS methods (i.e. for full trace element and REE determination), so that their 'fertility' can be assessed using widely-accepted geochemical toolkits (e.g. Sr/Y, Eu/Eu*, REE curves);
  3. In the newly observed veined and altered granite phases, specifically map out quartz vein density, alteration assemblages and sulphide (including relict) density. These are known vectors towards porphyry-style mineralisation.
  4. Perform structural focused field work, to better delineate faults and grasp sense of shear, to give better constraints on the juxtaposing fault blocks, and likely juxtaposing and mineralisation, in the district;
  5. Utilise zircon geochronological and geochemical studies to provide regional and district scale constraints of magmatism and likely associated mineralisation in space and time;
  6. Use of geophysical surveys on and around GWM's Huntoon project to identify potential zones of sub cropping disseminated sulphide mineralisation.

Contents

3. Introduction

This report summarises the observations and initial interpretations made from a field tour made around Great Western Mining's (GWM's) properties around the Huntoon Valley, Nevada, between the 3rd-9th October 2023. Dr James Blight and his GWM field team accompanied Dr Lawrence Carter (LC Geoscience Ltd) for this tour. This report first introduces fundamental aspects of porphyry Cu systems alongside key nomenclature for mineralisation and alteration styles before detailing field observations and interpretations made from the Huntoon Valley. Findings are then summarised along with recommendations for further work. All co-ordinates referenced in this report are WGS 84. Accompanying this report are full collections of geo-referenced field photographs.

4. Porphyry Cu Systems

Porphyry copper systems have been defined as large volumes (10 - >100 km^3) of hydrothermally-altered rock centred on porphyry stocks, which may also contain associated skarn, carbonate replacement, sediment-hosted and high and intermediate sulphidation epithermal mineralisation (Sillitoe, 2010). These large systems, often comprising multiple plutons, have magmatic-hydrothermal histories spanning millions of years, but ore formation typically occurred during multiple short-lived events with durations of a few hundred thousand years (Seedorff et al., 2005; Sillitoe, 2010). They are typically associated with calc-alkaline magmatic systems above active subduction zones, although some can be found in post-collisional settings (Richards, 2003). In subduction zone environments, as the oceanic plate and overlying sediments subduct, increasing pressures and temperatures causes them to dehydrate. This releases fluids into the overlying mantle wedge causing it to melt and produce water-rich arc-type magmas (with distinctive trace element geochemistry) that rise to high levels in the crust (Wilkinson, 2013).

Porphyry Cu ± Mo ± Au deposits, of sizes ranging from <10 Mt to >10 Gt, are mostly found at depths of several km within porphyry systems (Sillitoe, 2010; Wilkinson, 2013). These may be associated with Cu, Au and/or Zn skarns at their margins and high and intermediate sulphidation epithermal Au ± Ag ± Cu mineralisation at higher levels (Sillitoe, 2010). In porphyry Cu deposits, ore minerals typically occur in veins and as disseminations with relatively low grades; commonly less than 1% Cu in a copper porphyry, about 0.1% Mo in a molybdenum porphyry and about 1 g/t Au where this is economically important. Ore and surrounding rock is characterised by numerous generations of closely spaced veins and veinlets (stockwork), which mark the pathways of hydrothermal fluids, between which the rock is pervasively altered. Key hypogene ore minerals are chalcopyrite, bornite, chalcocite, molybdenite and native Au (Sillitoe, 2010). Supergene oxidation and enrichment, occurring in the weathering environment to depths of several hundred metres, has a major impact on the economic viability of porphyry Cu deposits, transforming Cu grade locally to two to three times the hypogene tenor (Sillitoe, 2005).

Some key schematic models for porphyry models along with schema for alteration and vein nomenclature and magmatic-hydrothermal textures associated with porphyry Cu systems are included within the appendices of this report.

5. Huntoon Project

This section combines field observations made from on and around GWM's Huntoon project, i.e. on the West side of Huntoon Valley in the Excelsior mountains. Significantly, through a series of fault blocks, multiple levels of a magmatic-hydrothermal system are exposed here (**Fig. 1**). These are described in order of palaeo-depth. The overlying Tertiary succession is not discussed.

5.1 'Deep' Whisky Flat granite and Granite Spring creek

Part of a large granitoid is exposed in the prominent rounded hill due W from 'Cow Camp', previously described and mapped as the Whisky Flat biotite granite (**Fig. 1**) (Stewart et al. 1981). This is a medium-coarse grained porphyritic granite with notable pink K-feldspar phenocrysts (average 2 cm across) set in a matrix (average 5 mm) of K-feldspar, plagioclase and quartz, with common biotite and lesser hornblende (**Fig. 2a**). Here, the granite appears mostly unaffected by hydrothermal alteration apart from cross cutting sporadic ~5-10 cm sheeted zones of apparent K-feldspar alteration and Fe-oxide staining along cryptic veins (**Fig. 2b**). Looking up to the exposures high in the hill side, shearing and much more abundant Fe-oxide staining is apparent. This is interpreted to represent a relatively deep exposure of the Whisky Flat granite, perhaps at ~6-8 km palaeo-depth, which shows some evidence for deep hydrothermal fluid flow.

The southern edge of 'Granite spring' (38.183012, -118.540956; marking the south of the prominent granite hill) is marked by a ~5-10 m wide ESE trending zone of intense kaolinisation(?) running parallel to the creek, which is interpreted to represent a fault zone. Walking along creeks southwards through and beyond this zone of kaolinisation, the porphyritic granite becomes notably finer grained whilst aplitic dykes and textures, notably without the K-feldspar phenocrysts, also become common (**Fig. 2c**). Aplitic and pegmatitic granitic dykes are also seen cutting the overlying Na-Ca/propylitically altered mafic porphyry (with notable epidote clots) (**Fig. 2d**; see next section). This kaolinsed fault zone is interpreted to juxtapose the deep portion the Whisky Flat granite with either its own shallower border phase, or another shallower granitoid.

5.2 Mafic porphyry canyon

Mafic porphyry (after Stewart et al., 1981), characterised by abundant coarse plagioclase phenocrysts set in a fine grained matrix, was observed along 'mafic porphyry canyon' (38.176850, -118.550058). Igneous breccias containing clasts of the mafic porphyry were also observed. The mafic porphyry is notably Na-Ca and/or propylitically altered, with common blotchy epidote clots and with primary plagioclase seen replaced by albite as well as epidote. This appears focused along cryptic fractures, away from which alteration fades, and is extreme around albite-epidote veins. The white albite bleaching, or selvages, around the veinlets (**Fig. 3**) suggest that this is a Na-Ca alteration assemblage rather than propylitic alone, and is interpreted to be due to circulation of hot Na-rich acid fluids, and is likely deep and/or lateral to potential centres of porphyry mineralisation. Secondary Cu shows are observed locally associated with the intensely altered zones around the albite-epidote veins (**Fig. 3e**), which is not dissimilar to 'Na-flushes' seen in the Na-Ca altered zones deep in the Yerington batholith where high Cu grade is locally observed in intensely Na-Ca altered rocks amongst otherwise barren rocks.

Whilst these mafic porphyry units are seen to pre-date granitic emplacement, and whilst these alteration features are typically relatively large scale across districts, the alteration is cogenetic with operation of the magmatic-hydrothermal system. They therefore should be considered when seen elsewhere in the district to aid placing yourself within the relative stratigraphy.

Float samples along the canyon bed show sharp contacts between the mafic porphyry units and the coarse grained Whisky Flat granite (previous section) (**Fig. 4a**). The contact between the mafic porphyry and the fine grained to aplitic granite also outcrops in the bottom of the Canyon wall (**Fig. 4b**), which significantly offers tie points for mapping this granite in the subsurface.

5.3 Aplitic cupola zone

Walking further up mafic porphyry canyon leads to a fine grained quartz-eye bearing granite with an aplitic groundmass which hosts abundant cupola and magmatic-hydrothermal related textures. These include; aplitic zones and dykes, occasionally with quartz-feldspar unidirectional solidification textures (USTs) at their margins (**Fig. 5a & b**); abundant quartz-feldspar (and occasionally -biotite-tourmaline) pegmatite pods and lenses (**Fig. c & d**); and abundant quartz lined miarolitic cavities (**Fig. 5 d & e**). The aplite-pegmatite textures are likely due to intense undercooling (i.e. rapid, shallow, emplacement) whilst the UST textures also indicate first-type boiling (i.e. hydrofracturing of the wall rock, triggering rapid pressure fluctuations) syn-emplacement (see summary explanations in Carter & Williamson, 2022, and references therein). Miarolitic cavities are undoubted evidence for magmatic fluid exsolution (Candela, 1997) (i.e. the magmatic-hydrothermal transition), and their abundance here is significant. Their abundance in places (**Fig. 5f**) highlights their potential to be connected to one another in 3D via networks of quartz in the aplitic groundmass (i.e. palaeo-permeability which could have been exploited by magmatic-hydrothermal fluids – see Carter et al., 2021 for explanations).

These textures are indicative to cupola zone of the granite, from and through which mineralising magmatic-hydrothermal fluids were most likely focussed (i.e. a causative intrusion). Whilst mineralisation is not apparent at these outcrops, palaeo-vertical exposures above this zone should therefore targeted in order to find potential zones of hypogene mineralisation. Whilst the exposure of this likely cupola zone is lost beneath the ridge (of mafic porphyry?) to the south-west, from satellite imagery it appears directly along strike of the 'Crown Point' granite discussed in the next section.

5.4 Crown Point mineralised granite

The 'Crown Point granite' outcrops on Crown Point's and GWM's current claim blocks. Whilst described separately here, it is most likely related to the granite outcrops discussed in the above sections and may well be connected in the subsurface, indeed being along strike from the cupola textured outcrop discussed above. Sharp intrusive contacts are seen with fine-grained andesitic/metasedimentary(?) wall rocks to the west, whilst the east-most extent appears to disappear under Tertiary volcanic cover (**Fig. 6**).

The Crown Point granite is quartz rich and fine-medium grained with an aplitic ground mass, local graphic quartz-feldspar texture (**Fig. 7**), quartz eyes (rounded quartz phenocrysts) (**Fig. 8a**). Quartz-feldspar pegmatitic pods are abundant in places, some with quartz lined miarolitic cavities (**Fig. 8b**), Finer grained aplitic zones/pods/dykes with lobate contacts with the granite are numerous, with rare quartz 'atoll' UST texture at their margin (**Fig. 8c**) (see Muller et al., 2023), and sporadic miarolitic cavities (**Fig. 8d**). All of these phases are cut by locally abundant stock works of A-, AB- and B-type mm to 2 cm wide quartz veins (**Fig. 9**) and probable later D-type veins (**Fig. 9d**), as well as magnetite and tourmaline veins (**Fig. 10**). The quartz veins have varying orientations although often seen sub-vertical and vein density appears greatest to the north of the exposure, with dozens of quartz vein per metre. Various overprinting alteration assemblages are apparent, including potassic, chlorite-sericite and phyllic in places. Fe oxide staining is abundant and Cu shows appear associated with areas on intense quartz veining. Pyrite and relict pyrite is common within the quartz veins across the exposures. GWM's recently collected soil samples over this granite, as well over the surrounding wall rocks are reportedly anomalous for both Cu and Au. The alteration, intense quartz veining and magmatic-hydrothermal textures exposed here suggest proximity to the core of the magmatic-hydrothermal system.

5.5 Crown Point shear zone

The Crown Point property and historic Huntoon underground mine workings appear focused around a roughly E-W trending shear zone, which appears to truncate the granite described above against meta-volcanic and meta-sedimentary units (south side of the shear zone) which appear intensely hornfelsed in places and gossanous locally, perhaps relating to skarn-style mineralisation. Strong foliation in the metasediments is seen in places (measured 050/60W locally) but this likely fluctuates around large boudinage structures along the shear. These units are cut by rare black sericite veinlets, magnetite veinlets, ~1 cm wide calcite veins, as well as likely structurally late stage ~east-west trending (040/60W and 090/40N measured) 5-30 cm wide massive chalcedonic quartz veins, one of which appearing Cu-mineralised and historically worked.

This shear zone appears to be late and post-dates the exposed magmatic-hydrothermal features described above, and has likely remobilised Cu (and others) into the now structurally controlled and historically worked lode structures (Chalcopyrite-malachite-chrysocolla).

5.6 Overlying sedimentary succession

A transect up a ridge line (38.155669, -118.565799) to the south of the Crown Point property and historic Huntoon Mine covered a sequence of continental shelf clastic and overlying volcanics. These include a sequence of interbedded sand and limestones (bedding striking ~060, dipping sub vertical) which grade into purple foliated slates with locally abundant calcite veins. Further up the ridge these are overlain by chert rich conglomerates and then volcanic sequences, including some volcanic breccias. Striking red Fe oxide rich horizons cut these volcanics, with calcite-pyrite-specularite ankerite veins (**Fig. 12**).

It is interpreted that this sedimentary-volcanic sequence was represents an unrelated distal facies which has since been thrust ontop of the potential magmatic-hydrothermal system of interest. However, before overlooking these sequences, it is suggested that the subsurface geology is considered, as to where the thrust sub-crops and what may lie beneath it.

5.7 Tun

Neither the Tun project nor surrounding geology was visited on this tour. However, it is understood that the Tun project may entail high-sulphidation epithermal veins. It is therefore suggested that the geology of the Tun project is considered in comparison with the age, geometry, host rocks and structural setting of the magmatic-hydrothermal system described through the rest of this report, particularly with regards to faulting possibly juxtaposing shallow and deeper parts of the system by down throwing and/or tilting, in case of a possible genetic association. This is because high-sulphidation systems are well understood to represent the near surface extents of porphyry systems (e.g. Sillitoe, 2010).

6. Fletcher's Camp

The granite at Flecther's Camp was briefly visited, to compare it with the granites exposed elsewhere in the valley. Outcropping here is a coarse grained porphyritic granite, with ~2 cm average phenocrysts of K-feldspar. Similar to the granite described in section 5.1, this likely represents a deep level in the system. A whole rock sample of the granite was taken to potentially investigate its geochemistry in relation to the rest of the district.

7. Mineral Jackpot

The Mineral Jackpot site was visited to compare the nature of granite with elsewhere in the district and to appreciate the style of mineralisation (high grade Ag-Au bearing quartz veins). Here an equigranular coarse grained granite is well exposed, which is intensely altered around the veins. The quartz veins observed in the historic mine's waste tips appear sheeted, varying from 1cm to massive, and the variety of vein textures observed in the tips suggest that the veins hosted multiple generations of fluid flow. A whole rock sample of the granite was taken to potentially investigate its geochemistry in relation to the rest of the district. The granite textured exposed here are indicative of relatively deep levels of emplacement.

8. 'M2' Project

Exposures around 'M2' project drillpads were observed. Here, Dunlap sediments (after Stewart et al., 1981) are seen intensely hornfelsed, Na-Ca or skarn-style altered (with clots of epidote and white ablite bleaching) with skarn style mineralisation (chalcopyrite, secondary malachite ± azurite, pyrite, magnetite) and cut by several generations of quartz and calcite veins (**Fig. 13a**).

In search for the possible magmatic causes of the skarn style mineralisation, exposed diorite was investigated directly downhill from the M2 drill pads. This diorite is altered with abundant Fe-oxide staining, epidote clots and magnetite veinlets, along with secondary Cu shows, and appears too to be hornfelsed. The diorite is cut by multiple sheets of relatively unaltered medium to coarse granite porphyritic to locally aplitic granite dykes (**Fig. 13b**). Both the diorite and granite here are candidates for the magmatic cause for the skarn-style mineralisation. The alteration of the diorite however suggests it may have been passive. The granite dykes appear questionably fresh, although this is perhaps expected if it were causative – i.e. no chemical gradients in which to cause alteration with itself. Regardless, whole rock samples were taken from both to investigate their geochemistry in relation to the rest on the district.

9. 'M4' Project

The only observations of the 'M4' skarn project was made from the limited intervals of drill core stored at GWM's warehouse in Hawthorne (hole M4-005). In this core hydrothermally altered either Dunlap or Mina Formation sediments (after Stewart et al., 1981) are seen cut by calcite cemented hydrothermal breccia. Besides multiple generations of hydrothermal calcite, this breccia contains clasts of metasediments which are cut by Cu mineralised calcite-quartz veins, whilst the breccia cement itself contains secondary Cu mineralisation (after primary chalcopyrite?). This brecciation event therefore post-dates at least one episode of mineralisation, whilst also representing a separate episode of mineralisation itself.

A narrow, ~2 cm wide possible granite porphyry dykelet was also seen cutting the metasediments, and in turn being cut by a calcite dyke. Significantly, this also suggests potential causative magmatism proximal to the skarn mineralisation. However, these observations should be checked (to confirm a dykelet and not a micro-breccia) along with any other possible evidence for magmatic activity proximal to the mineralisation. It is suggested that stratigraphic and alteration comparisons between the two (east and west) sides of Huntoon valley should be made, in case of potential correlation between them, as within the larger system scale it is feasible for them to be co-genetic. This in turn would highlight the potential for sub cropping mineralisation in the down thrown fault blocks now underlying the valley's sedimentary fill.

10. Summary

The Huntoon Valley, SW Nevada, hosts historically worked skarn and epithermal style mineralisation. These mineralisation styles are well understood to be genetically related to much larger scale magmatic-hydrothermal systems (e.g. Sillitoe, 2010), which remain the primary exploration targets for mid-tier and major-mining companies.

Various juxtaposing fault blocks on the western side of Huntoon Valley (i.e. GWM's Huntoon property and surroundings) expose multiple levels of a likely large porphyry-style magmatic-hydrothermal system. Moving upwards through the system (through the various fault blocks) this includes: 1) a large pluton of coarse grained porphyritic biotite granite (Whisky Flat granite); 2) finer grained phases of likely the same granite, cut by aplitic porphyry dykes and zones(?); 3) wall rocks exhibiting locally intense Na-Ca and/or propylitic alteration; 4) an aplitic cupola zone containing quartz-feldspar USTs, abundant pegmatitic pods, quartz eyes and miarolitic cavities; 5) a fine to medium grained quartz eye bearing porphyritic granite cut by aplitic porphyry dykes and zones (with rare quartz USTs at their margins) locally intense stock work of A-,AB-,B-type quartz veins and probable D-type veins containing relict sulphides, magnetite and tourmaline veins, abundant Fe-oxide staining, common Cu shows and various overprinting alteration assemblages including potassic, chlorite-sericite, and phyllic; 6) A shear zone hosting apparent remobilised Cu(-and other) mineralisation; 7) Host Mesozoic(?) sediments and volcanics with Cu shows; and 8) Overlying unmineralised and unaltered Tertiary cover.

Skarn-style mineralisation at GWM's 'M2' and 'M4' projects are hypothesised to be associated with a larger causative magmatic-hydrothermal system, and new observations indeed suggest proximal magmatic activity to these skarns. Notable analogues in the stratigraphy, alteration and structures between the West and East sides of Huntoon valley means that it is feasible for mineralisation on both sides of the valley to be co-genetic, whilst also highlighting the potential for subcropping mineralisation in down thrown fault blocks under the valley's sedimentary fill.

The field observations from across the Huntoon Valley is suggestive towards a large dismembered, likely mostly subcropping, porphyry-style magmatic-hydrothermal system. Current projects elsewhere in the county are continuously providing evidence for other such systems in the region (e.g. VR Resources' 'New Boston' project; Sierra Nevada Gold's 'Blackhawk project'; Golden Metal Resources'

'Pilot Peak project'). These observations highlight the potential for sub-cropping porphyry-style and related mineralisation in the Huntoon Valley property. Unravelling the valley's complex and little mapped structural framework will likely play a key part in finding potential zones of economic mineralisation, which likely lies across numerous dismembered, probably rotated and tilted, fault blocks.

11. Recommendations

Exploration for the potentially hypogene Cu-Mo-Au mineralised zones of large porphyry-style magmatic-hydrothermal systems is complex, multi-faceted and expensive, but they remain the primary exploration target of mid-tier and major mining companies. Recommendations therefore focus on developing a robust observation-based framework from which larger scale exploration can be launched. To achieve this, key recommendations are to:

1) Use the new observations and understanding of outcropping altered and quartz vein bearing granitic rocks on and around GWM's Huntoon property to asses its likely sub-cropping geometry, its immediate wall- and (palaeo) roof-rocks, and immediately stake additional claims respectively. This granite should also be mapped out in full when possible, as it has compelling field evidence for being a causative intrusion. Its (palaeo) uppermost parts and overlying rocks should be deemed highly prospective. **It is highly recommended that this is done before publicising the field observations as the findings will likely prompt other parties to do so.**

2) Geochemically fingerprint the granitic rocks likely associated with mineralisation in the district using complete digestion ICP-MS methods (i.e. for full trace element and REE determination), so that their 'fertility' can be assessed using widely-accepted geochemical toolkits (e.g. Sr/Y, Eu/Eu*, REE curves; e.g. Loucks, 2014). Please see appendices for details of the recommended initial sample suite. Whist developing a framework for the magmatic systems evolution, this will also allow for the igneous suite to compared with well-characterised mineralised (i.e. fertile) granitic systems elsewhere. LC Geoscience is happy to offer geochemistry interpretations fully integrated with field observations – recommendations and quotes available upon request.

3) In the newly observed veined and altered granite phases, specifically map out quartz vein density, alteration assemblages and sulphide (including relict) density. From studies based on numerous systems worldwide, these are known vectors towards hypogene mineralised zones in porphyry-style magmatic-hydrothermal systems, and quartz vein density is known to be a direct proxy for Cu grade in many systems (e.g. Seedorff et al., 2005; Sillitoe, 2010).

4) Perform structural focused field work, to better delineate faults and grasp sense of shear, to give better constraints on the juxtaposing fault blocks and likely juxtaposition of mineralisation in the district. This is because the magmatic-hydrothermal system and likely associated mineralisation has most likely been dismembered and now lies across different fault blocks which are probably invariably rotated and tilted. A robust structural framework will therefore likely play a key role in unveiling potential zones of economic mineralisation.

5) Utilise zircon geochronological and trace element geochemical studies to provide regional and district scale constraints of magmatism and likely associated mineralisation in space and time. Zircon is particularly useful because it is resistant to re-equilibrium during hydrothermal alteration. Age

constraints can be integrated with the above recommended structural framework development. Further, similar to whole-rock trace element geochemistry (see above), zircon trace elements can also unveil the system's evolution through time and can also be used to assess the magmatic system's 'fertility' against specific geochemical plots (e.g. Lu et al., 2016; Cooke et al., 2017). LC Geoscience is happy to offer an 'all-inclusive' zircon geochronology and geochemistry package including zircon separation, grain preparation, cathodoluminescence (CL) imaging, LA-ICP-MS analysis, data interpretation and synthesis – study recommendations and quotes available on request.

6) Use of geophysical surveys on and around GWM's Huntoon project to identify potential zones of sub cropping disseminated sulphide mineralisation, which can in turn be used to develop drill targets.

7) Consider the planning and application timelines for drilling and related permits on Forestry Land, to prevent potential backlogs if drill targets are to be generated and tested in future.

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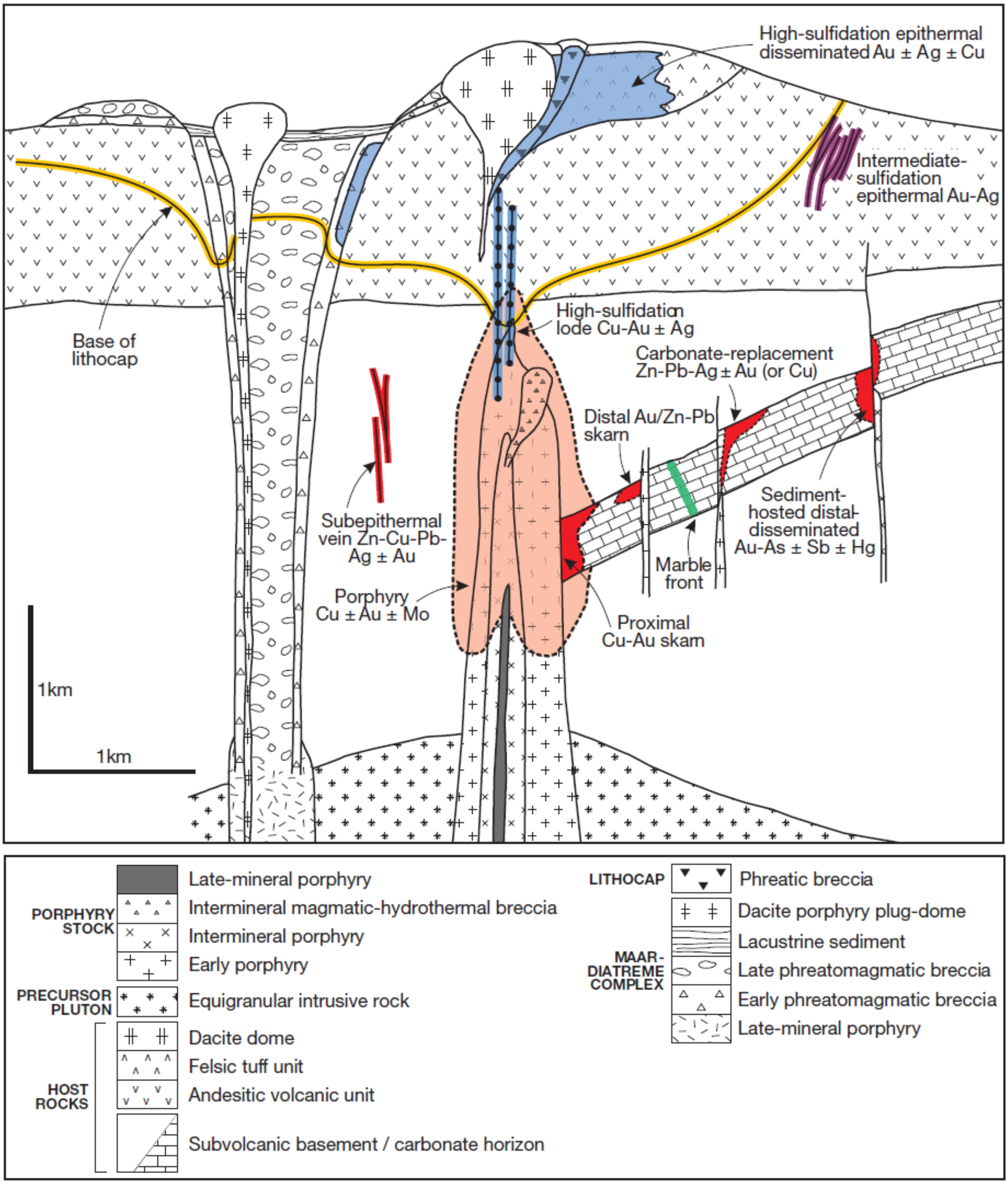
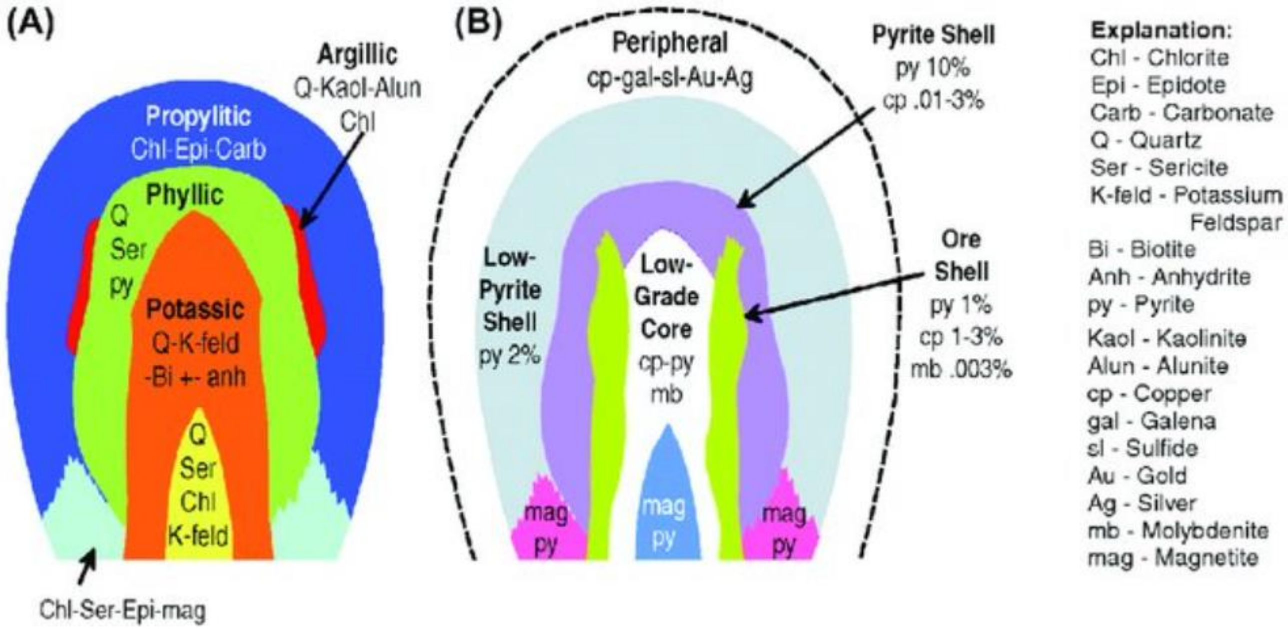
13. Appendices

13.1 Porphyry-system anatomy

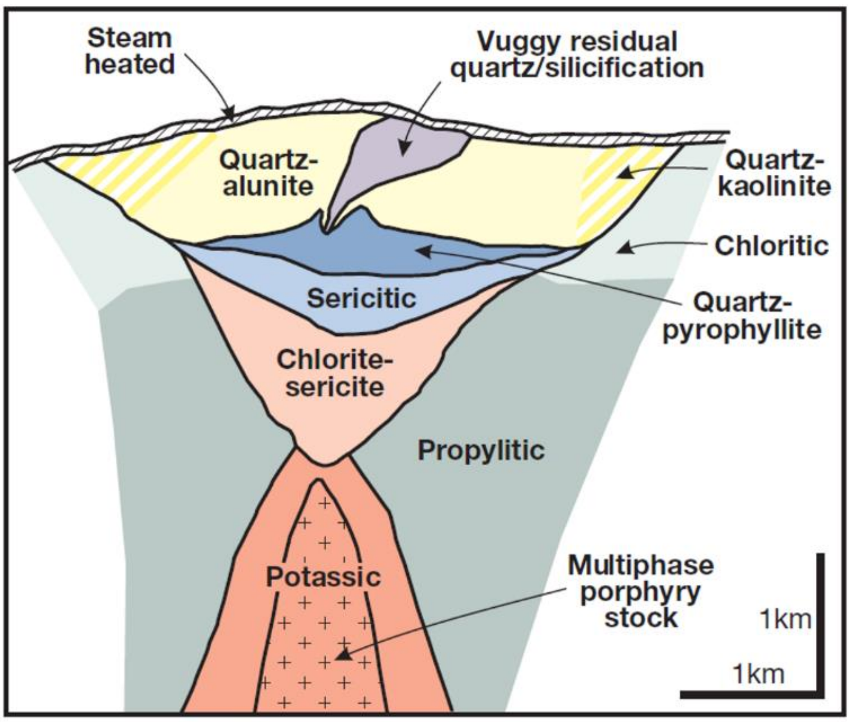
Anatomy of a porphyry Cu system, showing spatial interrelationships of a centrally located porphyry Cu ± Au ± Mo deposit. From Sillitoe (2010).



Modified version of Lowell and Guilbert's (1970) classic schematic model for the distribution of (a) alteration and (b) ore minerals within a porphyry system, based on the San Manuel-Kalamazoo deposit, Arizona.

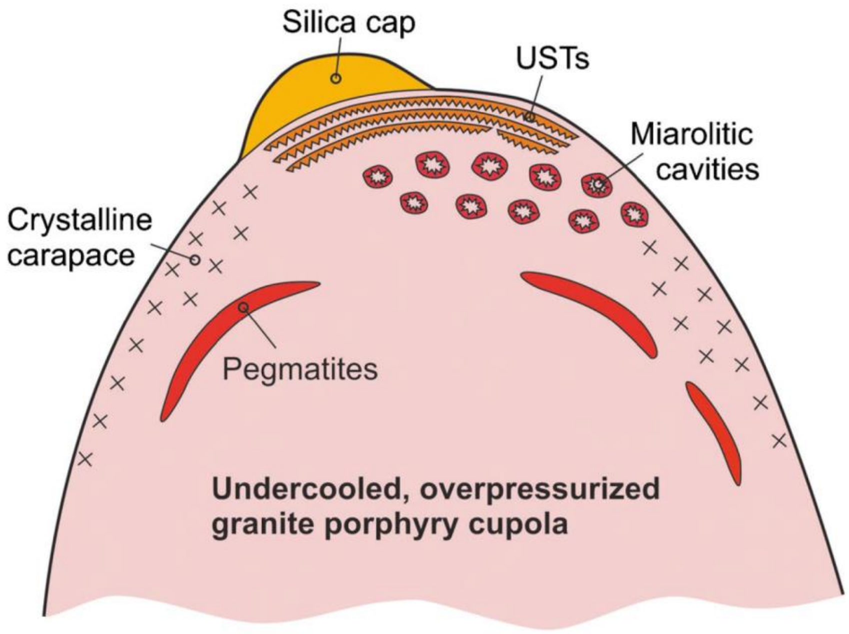


Generalised alteration-mineralisation zonation for a non-telescoped porphyry Cu system. This emphasises the commonly barren gap between the lithocap and porphyry stock. The sodic-calcic zone is not labelled as is often poorly preserved. From Sillitoe (2010).

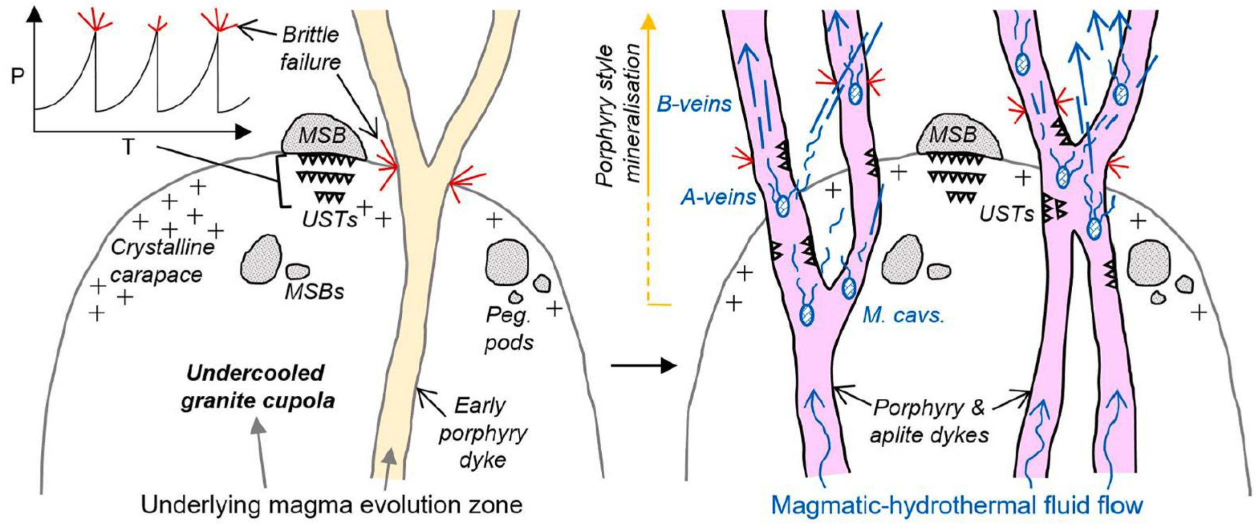


13.2 Schematic of cupola textures

Schematic diagram showing distribution of various early-stage magmatic textures in the apical zone of stock-like porphyry intrusions. From Muller et al. (2023).



Summary schematic section showing the spatial and temporal distribution of magmatic-hydrothermal textures within an undercooled granitic cupola associated with porphyry-style mineralisation. Inset graph is schematic showing pressure (P) versus time (T) during the formation of rhythmically banded USTs. Peg. pods = pegmatitic pods. MSBs = massive silica bodies. USTs = unidirectional solidification textures. M. cavs. = miarolitic cavities. A-veins represented by sinuous blue lines which transition to B-veins represented by straight blue lines. Vein nomenclature after Gustafson and Hunt (1975). Not to scale. From Carter & Williamson (2022).



13.3 Alteration assemblages

Summary of the principal alteration-mineralisation types in porphyry systems. Collated from Seedorff et al. (2005) and Sillitoe (2010).

Alteration type[1]	Environments	Key minerals	Ancillary minerals	Sulphide assemblages	Contemporaneous veinlets[2]	Veinlet selvages	Economics
Sodic-calcic	Deep, beneath deposits, and inner zones of magmatic intrusions, generated by hot Na-rich acid fluids	Albite/oligoclase, actinolite, magnetite	Diopside, epidote, garnet	Typically absent	Magnetite ± actinolite (M-type)	Albite/oligoclase	Usually barren, ore bearing locally
Potassic (K-silicate)	Inner zone of magmatic intrusions, generated by hot (>500°C), K-rich acid fluids	Biotite, K-feldspar	Actinolite, epidote, sericite, andalusite, albite, carbonate, tourmaline, magnetite	Pyrite-chalcopyrite, chalcopyrite ± bornite, bornite ± digenite ± chalcopyrite	Biotite (EB-type), K-feldspar, quartz-biotite-sericite-K-feldspar-andalusite-sulphides (EDM/T4-type), quartz-sulphides ± magnetite (A-type), quartz-molybdenite ± pyrite ± chalcopyrite (B-type)	EDM-type with sericite ± biotite ± K-feldspar ± andalusite ± disseminated chalcopyrite ± bornite, locally K-feldspar around A- and B-types	Main ore contributor
Propylitic (~greenschist facies)	Outer zone of magmatic intrusions, intemediate to deep levels	Chlorite, epidote, albite, carbonate	Actinolite, hematite, magnetite	Pyrite (± sphalerite, galena)	Pyrite, epidote		Barren, other than subepithermal veins
Chlorite-sericite (Intermediate argillic)	Upper parts of porphyry core zone. Usually a widespread overprint on previous alteration. Can lie between advanced argillic and propylitic (100-300°C)	Chlorite, sericite/illite, hematite (martite, specularite)	Carbonate, epidote, smectite	Pyrite-chalcopyrite	Chlorite ± sericite ± sulphides	Chlorite, sericite/illite	Common ore contributor
Sericitic (phyllic)	Upper parts of porphyry systems. Forms a (often late) peripheral halo around previous zones, moderate temperature (200-450°C)	Quartz, sericite	Pyrophyllite, carbonate, tourmaline, specularite	Pyrite ± chalcopyrite (pyrite-enargite ± tennantite, pyrite-bornite ± chalcocite, pyrite-sphalerite)	Quartz-pyrite ± other sulphides (D-type)	Quartz-sericite	Commonly barren, but may constitute ore
Advanced argillic (acid sulphate, secondary quartzite)	Intense alteration, often the roof of intrusions/porphyry deposits, and constitute lithocaps	Quartz (partly residual, vuggy), alunite, pyrophyllite, dickite. kaolinite	Diaspore, andalusite, zunyite, corundum, dumortierite, topaz, specularite	Pyrite-enargite, pyrite-chalcocite, pyrite-covellite	Pyrite-enargite ± Cu sulphides	Quartz-alunite, quartz-pyrophyllite/dickite, quartz-kaolinite	Can constitute ore in lithocaps and their roots

[1] Arranged from believed oldest (top) to youngest (bottom), other than propylitic which is the lateral equivalent of potassic. Advanced argillic can also form above potassic early in system genesis

[2] Many veinlets in potassic, chlorite-sericite, and sericitic alteration contain anhydrite, which also occurs as late monomineralic veinlets

13.4 Vein types

Nomenclature and general paragenesis of veins from a typical porphyry deposit, compiled by Vry (2010). The EB- and C-type classification is from Gustafson and Quiroga (1995), and the A-, B- and D-type from Gustafson and Hunt (1975). Associated alteration styles are after Seedorff et al. (2005).

Vein Type	Vein Mineralogy	Vein Texture	Alteration	Morphology
EB	Biotite±sulphides-quartz-albite-anhydrite-actinolite	Perthitic K-feldspar; fine grained, equigranular; no symmetry.	Albite-K-feldspar-biotite-sericite-anhydrite.	Randomly orientated; discontinuous; segmented; thin alteration halos.
A	Quartz-K-feldspar-anhydrite-bornite-chalcopyrite±biotite	Perthitic K-feldspar; fine grained; equigranular; no symmetry.	K-feldspar.	Randomly orientated; discontinuous; segmented; thin alteration halos.
B	Quartz-anhydrite-sulphide	Coarse grained, approaching cockscomb texture; symmetrical with sulphides±quartz in the centre.	None.	Regular; continuous; internal banding present
C	Sulphide-sericite-biotite-anhydrite±quartz	Coarse grained.	Sericite-alkali feldspar-biotite-chlorite.	Regular; continuous.
D	Pyrite-anhydrite±quartz-carbonate	Quartz shows good crystal form; anhydrite-sulphides show banding.	Feldspar destructive; sericite-chlorite.	Continuous; locally irregular; systematically orientated.

13.5 Recommended initial sample set for whole-rock geochemical fingerprinting

	Co-ordinates, WGS 84		
Sample	N	W	**Description**
GWLC000	-	-	Coarse blank
GWLC006	38°10’20.02”	118°33’46.82”	Crown Point granite
GWLC007	38°10’58.14”	118°33’49.02”	Aplitic cupola granite, with pegmatites and miarolitic cavities
GWLC010	38°11’01.88”	118°33’49.96”	Fine-medium grained granite, hosting 007 aplites
GWLC011	38°11’04.30”	118°33’45.59”	Medium grained granite, downhill from 007 & 010.
GWLC012	38°10’15.09”	118°33’51.41”	Aplite in Crown Point granite, with USTs at margin and hosts miarolitic cavities
GWLC013	38°10’14.97”	118°33’51.34”	Crown Point granite, a few metres below 011
GWLC014	38°12’19.57”	118°27’12.70”	Coarse grained porphyritic granite dyke cutting diorite beneath M2 drill pads
GWLC015	38°12’21.84”	118°27’11.62”	Diorite beneath M2 drill pads
GWLC016	38°12’38.81”	118°26’58.04”	Coarse grained porphyritic granite from Fletcher’s Camp
GWLC017	38°12’08.63”	118°25’55.16”	Equigranular granite from Mineral Jackpot
GWLC018	38°11’07.61”	118°32’35.04”	Coarse grained porphyritic granite, pink K-Fsp phenocrysts – Whisky Flat granite

14. Figures

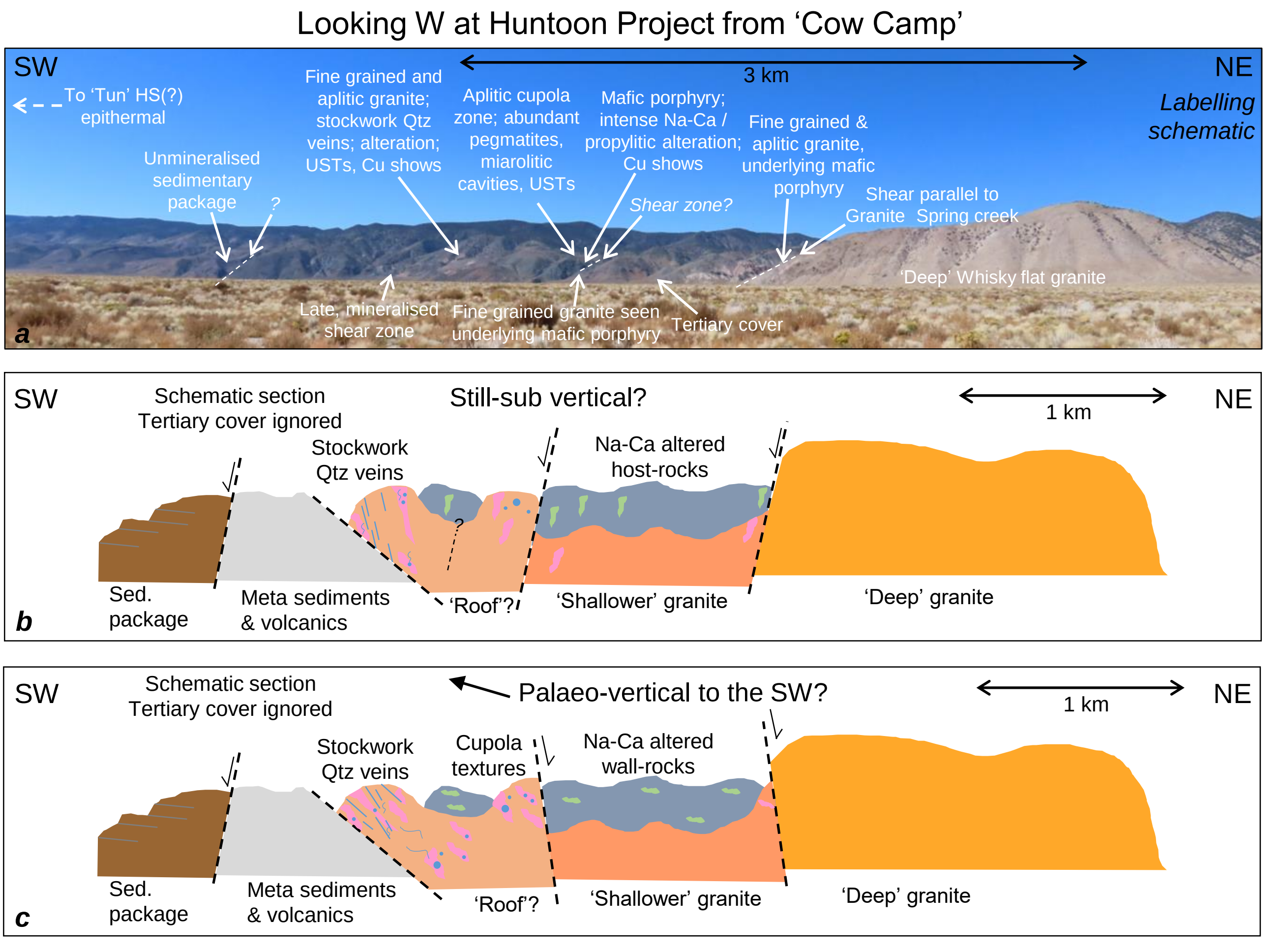


Fig. 1 a) Photograph of GWM's Huntoon project and surroundings, with key features annotated; b & c), schematic SW-NE x-sections through the project, showing subtle but significant differences between a vertical and a moderately tilted system.

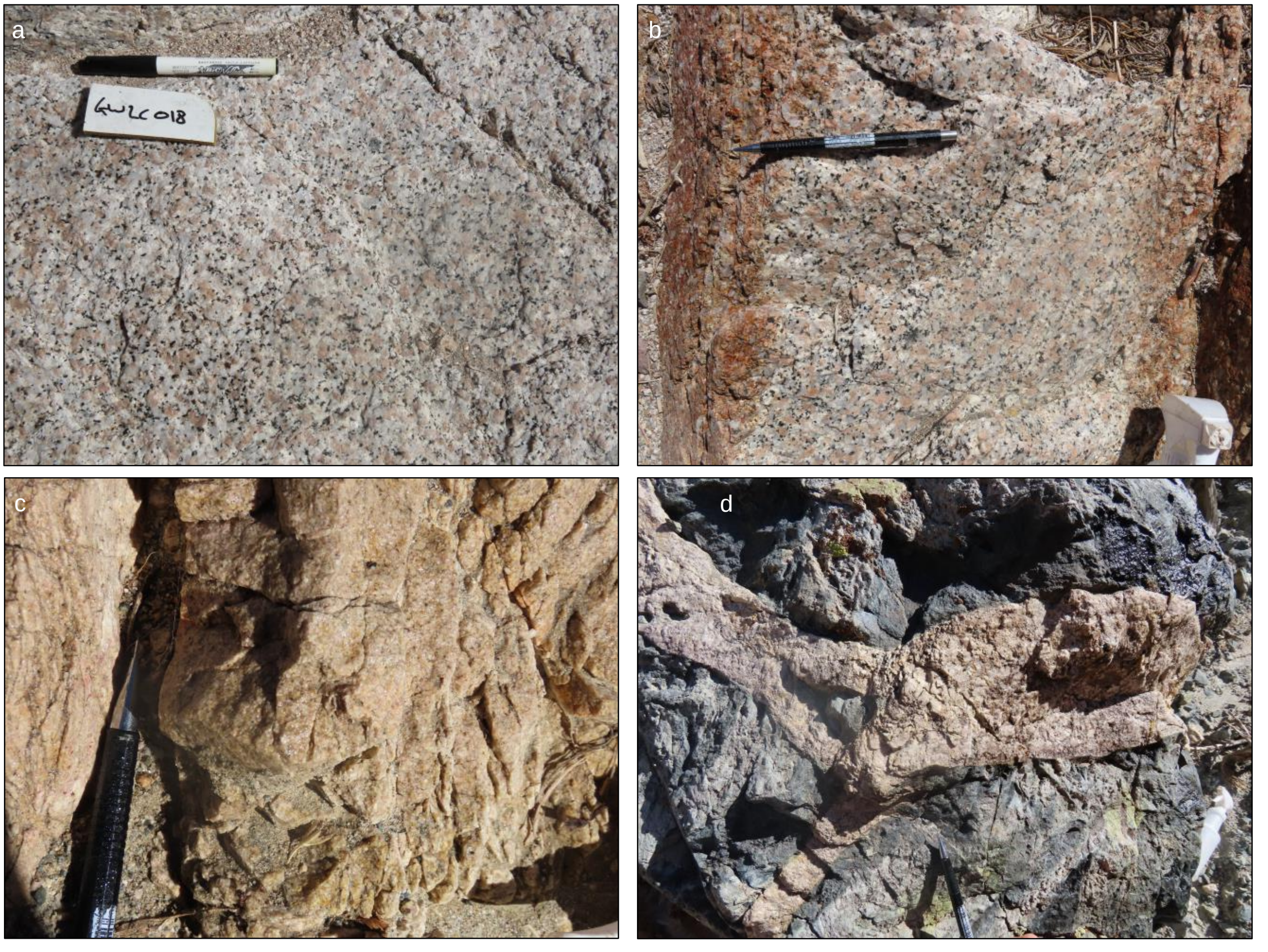


Fig. 2 a) Porphyritic Whiskey Flat biotite granite; b) Sheeted zones of K-feldspar alteration along cryptic veins in the granite; c) Fine grained to aplitic granitic on south side of granite spring; d) Andesite and mafic porphyry on south side of granite spring altered with blotchy epidote clots and cut by aplitic and pegmatitic granitic dykes.

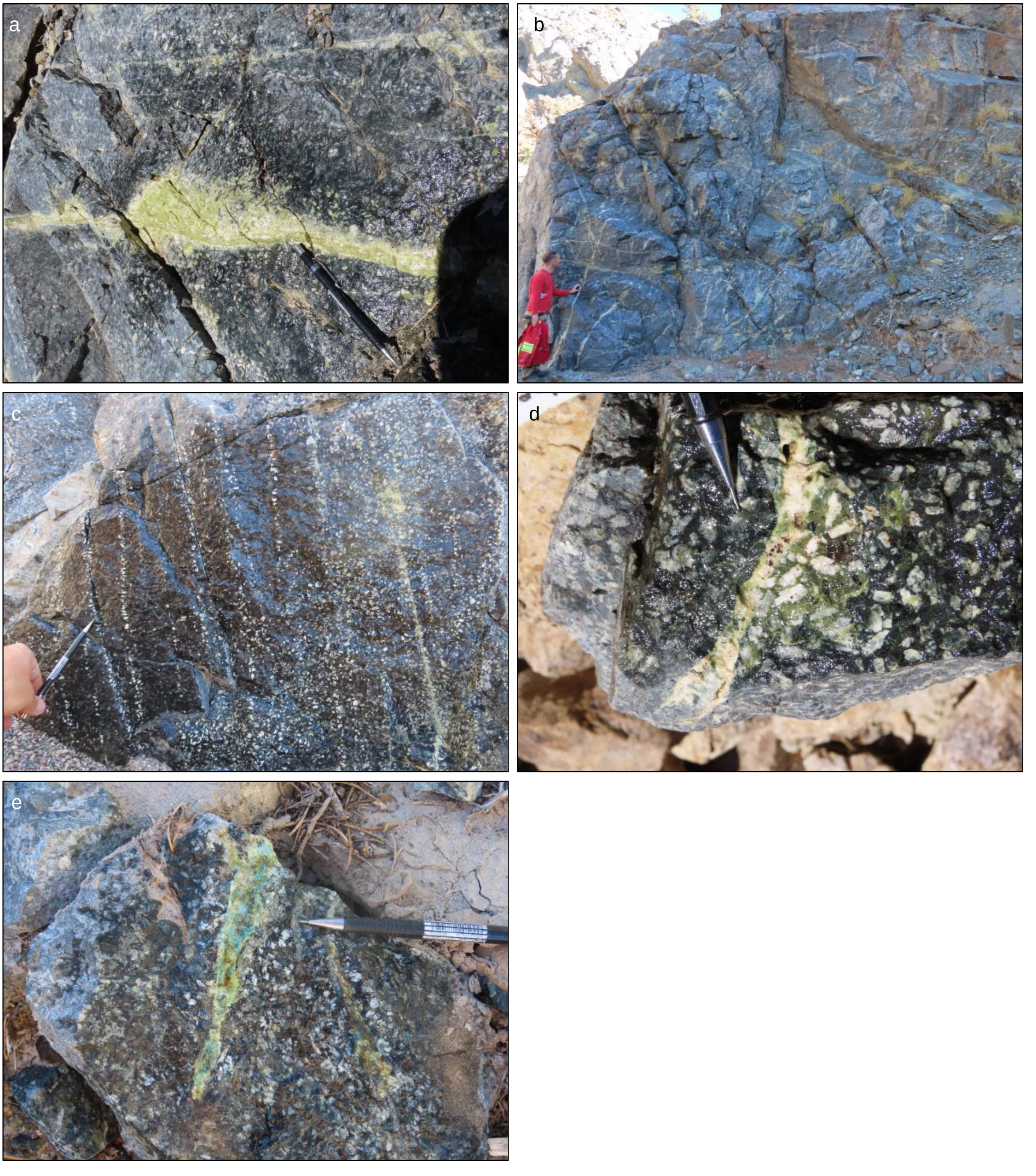


Fig. 3 a-d) Na-Ca and/or propylitically altered mafic porphyry wall rocks. Primary plagioclase is seen replaced by albite and epidote, focused around cryptic fractures. Epidote clots, from 1cm to > 10 cm across are seen locally abundant. Alteration is most intense around albite veins. The white albite bleaching suggests this is a Na-Ca assemblage; e) Malachite locally associated with the albite veinlets.

Fig. 4 a) Float sample in ‘mafic porphyry canyon’ creek bed showing sharp contact between coarse grained porphyritic granite (‘deep’ Whisky Flat granite) and an andesitic unit; b) Sharp contact between the fine grained granite (perhaps upper phase of Whisky Flat granite, or another intrusive) and mafic porphyry seen in the bottom of ‘mafic porphyry canyon’.

Fig. 5 a & b) Aplitic granite cupola zone with pegmatitic pods and quartz-feldspar USTs growing off internal contacts; c) pegmatitic pod with rare tourmaline in aplitic granite; d-f) quartz lined miarolitic cavities (undoubted evidence for magmatic fluid exsolution; Candela, 1997) in aplitic granite; f) abundant miarolitic cavities, likely interconnected through quartz in the aplitic groundmass - see Candela & Blevin (1995) and Carter et al. (2021) for significance for palaeo-permeability.

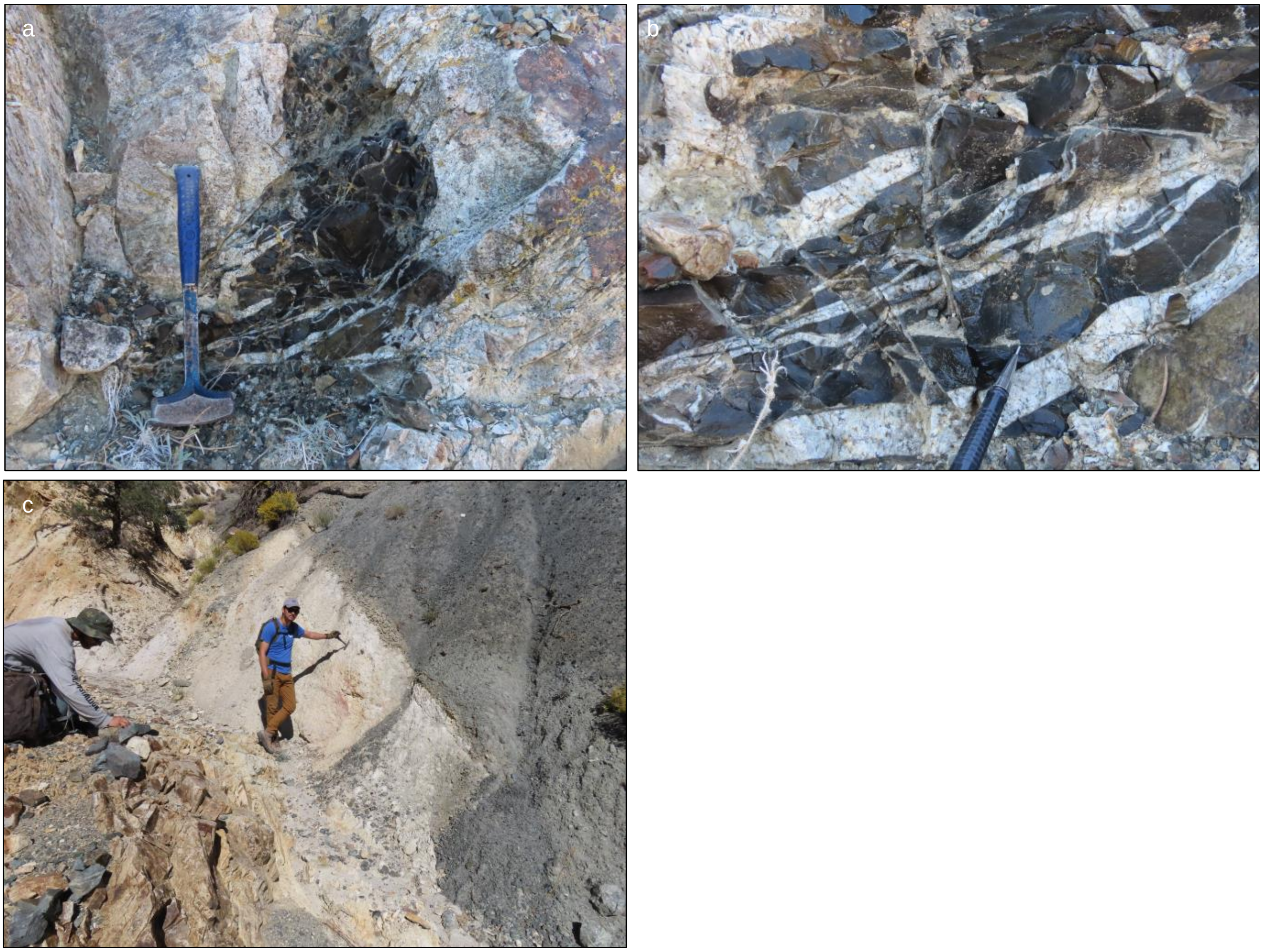


Fig. 6 a & b) Sharp intrusive contacts between the exposed western extent of the 'Crown Point granite' and host andesite or metasediments. c) Eastern exposed extent of the Crown point granite disappearing under Tertiary volcanic cover.

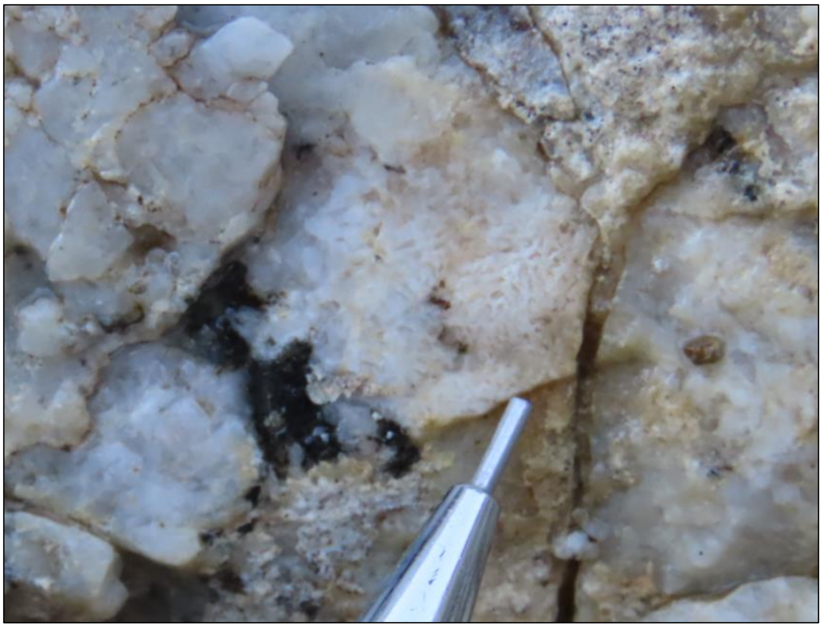


Fig. 7 Quartz-feldspar graphic texture within the Crown Point granite, likely indicating intense undercooling upon emplacement.

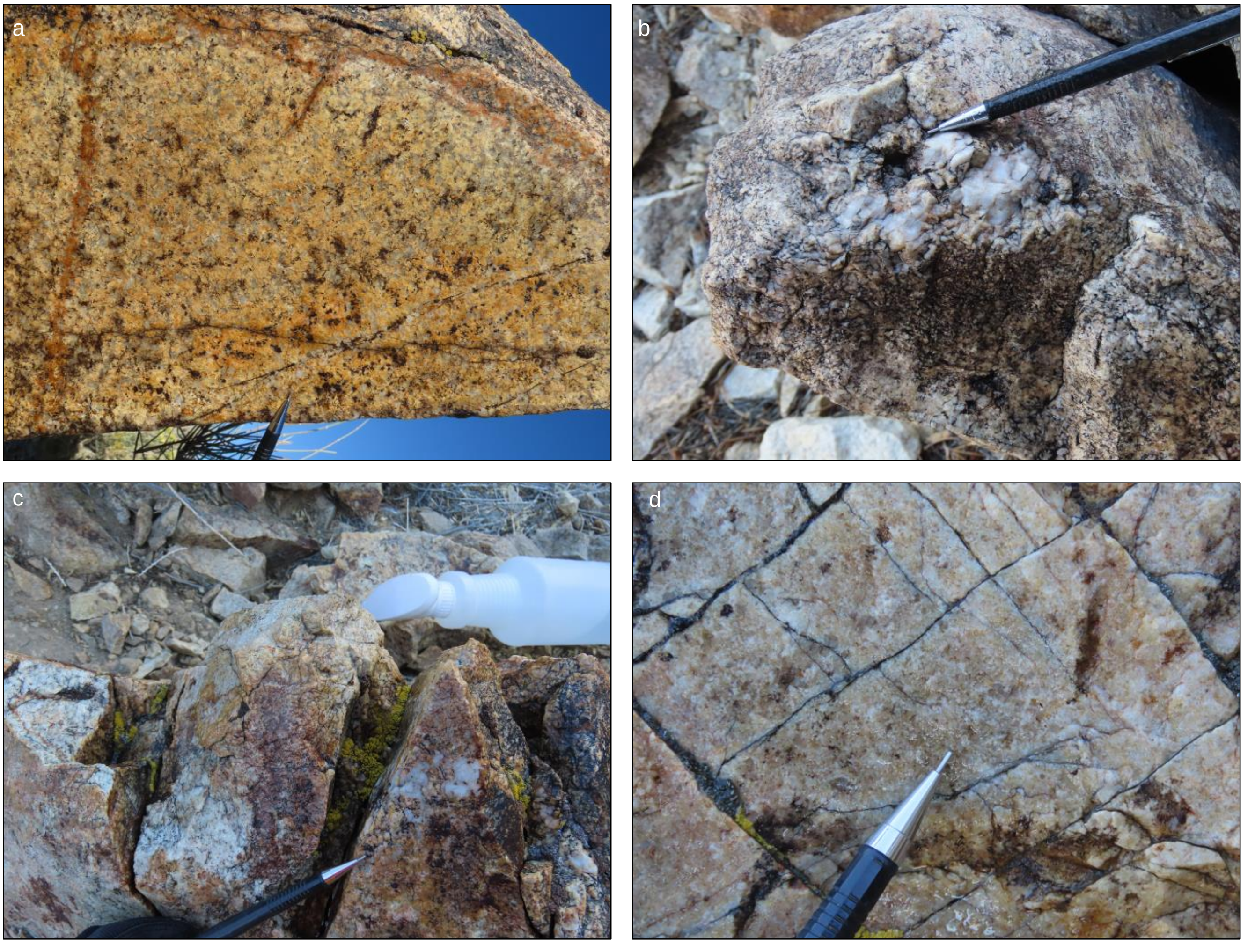


Fig. 8 a) Crown point granite with quartz phenocryst and quartz eyes set in an aplitic groundmass; b) pegmatitic pods with miarolitic cavities in Crown point granite; c & d) aplitic dyke(?) containing miarolitic cavities and common quartz eyes and quartz 'atoll UST' texture (see Muller et al., 2023) growing in from its margin, within Crown Point granite.

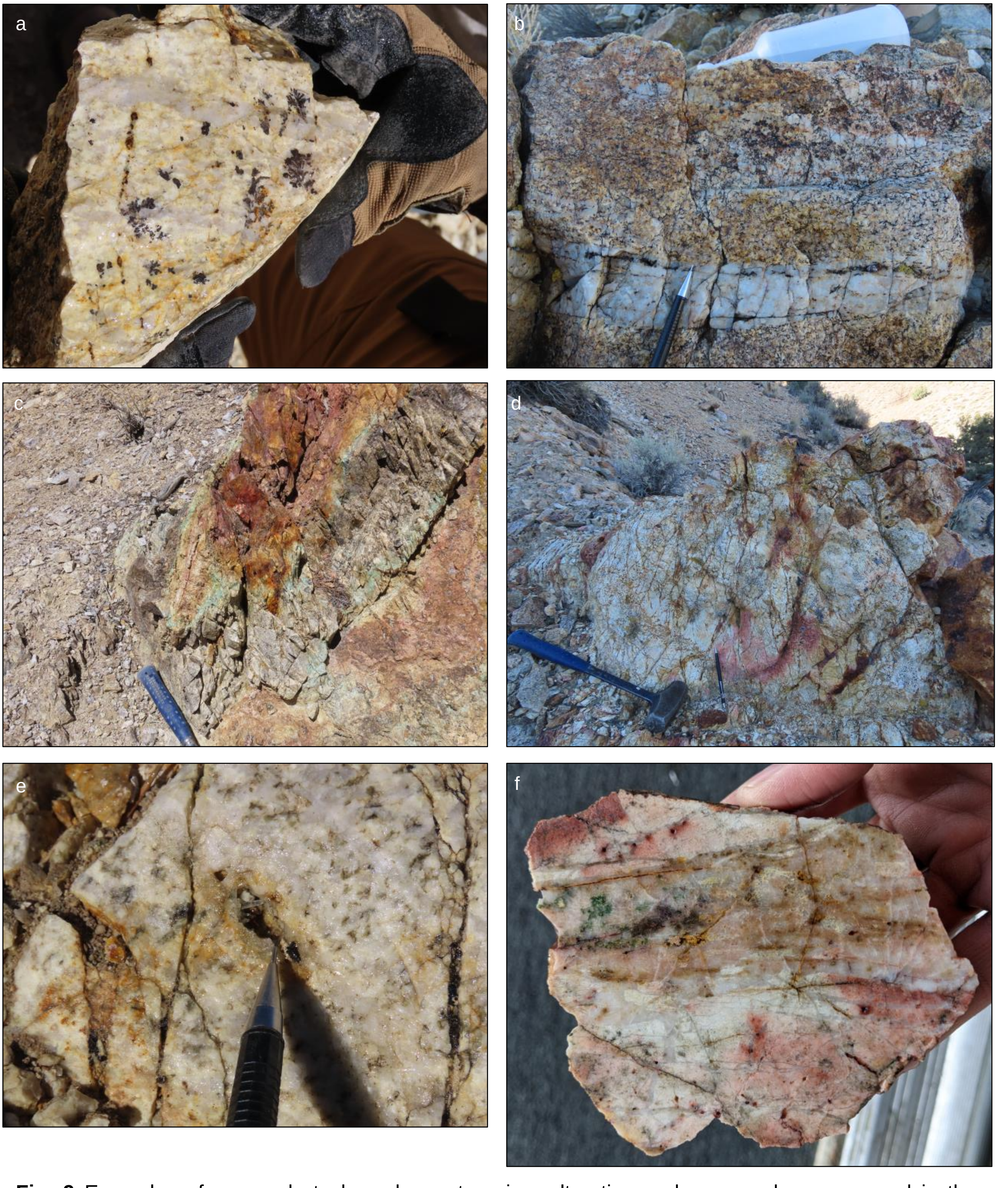


Fig. 9 Examples of exposed stock work quartz veins, alteration and copper shows exposed in the Crown Point granite; f) cut slab of example stock work veining within quartz eye bearing aplitic zone/dyke(?) within Crown Point granite, showing A-,AB- & B-(with characteristic central suture)type quartz veins with relict sulphides.

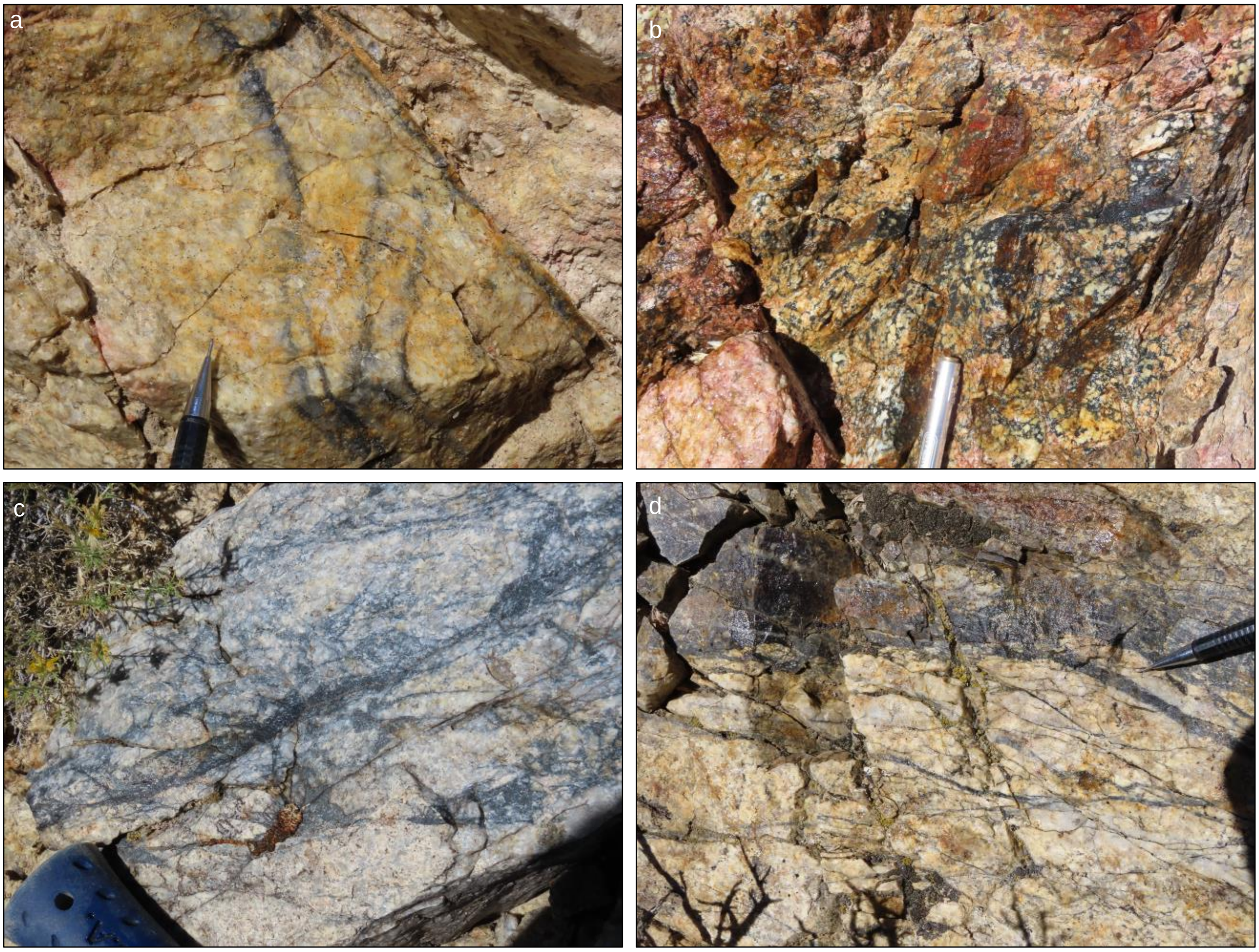


Fig. 10 Examples of magnetite and tourmaline veins, and possible breccias, in Crown point granite, cross-cutting earlier quartz veins.

Fig. 11 Sheared aplitic Crown Point granite/porphyry with quartz veins in Crown point shear zone.

Fig. 12 Striking red Fe oxide rich horizon in volcanic package, cut by calcite-pyrite-specularite-ankerite veins.

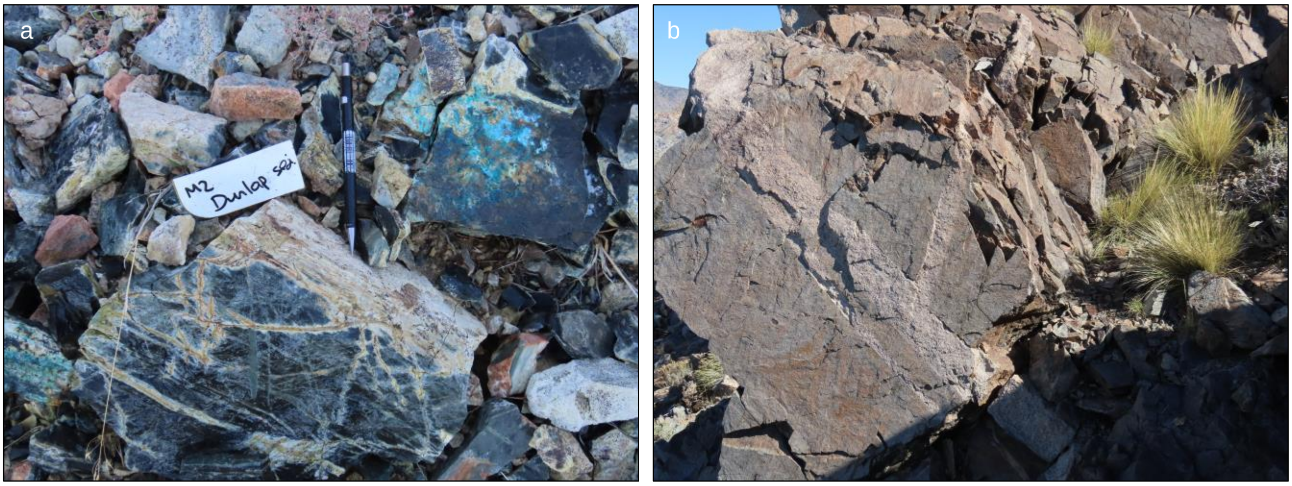


Fig. 13 a) Skarn-style mineralised and altered Dunlap sediments at M2 drill pads; b) Altered diorite cut by sheets of relatively fresh medium to coarse grained porphyritic to locally aplitic granite dykes outcropping downhill from the M2 drill pads.

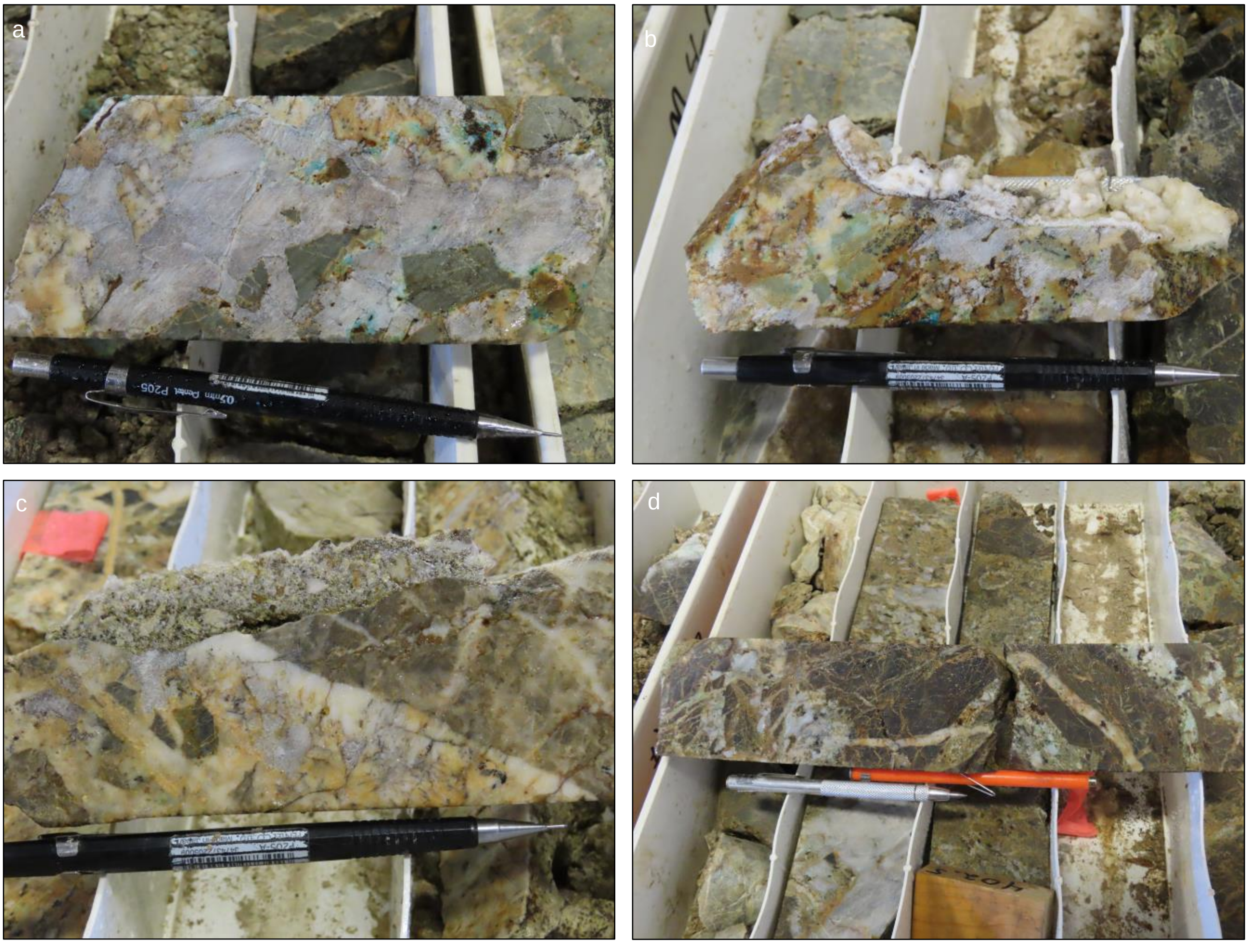


Fig. 14 M4 drill core showing Cu mineralised hydrothermal breccia, with multiple generations of calcite. Whilst the breccia cement itself is mineralised, the breccia clasts contain mineralised veins, indicating multiple episodes of mineralisation; d) narrow possible granite porphyry dykelet(?) seen cutting the host sediments above magnet, in turn cut by calcite veins. This may be evidence for magmatic activity proximal to mineralisation at M4.