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**COMMENTS ON
THE RECENT DRILL PROGRAM
AT THE
STAVELY PORPHYRY Cu PROJECT
VICTORIA**

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SUMMARY

Two as yet not identified porphyry intrusions are speculated to account for many of the features recognised in this review, while other magmatic sources no doubt account the variety of D veins as well as high and low sulphidation epithermal mineralisation recognised at in the Thursdays Gossan project to date.

An early blind porphyry is interpreted to be responsible for magnetite destructive phyllic-argillic alteration in the upper portion of many drill holes and also much of the D vein development. Although a wide variety of D veins have been identified at Stavely, there is a dominant pyrite greater than chalcopyrite style of D vein with prominent sericite selvages, which are interpreted to have been derived from this unseen porphyry. The strong development of these veins near the low angle structure suggests this is a long lived feature.

M veins, which must be derived from an unseen porphyry at depth, cut sericite wall rock alteration without magnetite destruction, and so two different porphyry events account for the early sericite and later magnetite. Apparent low temperature quartz and the actinolite selvages indicate these M veins have formed at a lower temperature than M veins might normally host significant Cu mineralisation in porphyry Cu deposits, but that they may vector towards an intrusion source.

The process leading to the identification of the magmatic source for the M veins would be aided by:

- Careful mapping of the transition within wall rocks from inner propylitic (actinolite-epidote) to potassic (K-feldspar-magnetite) fracture-vein alteration.
- Many of the M veins identified to date display actinolite selvages and therefore developed at the lower temperature range of formation. This actinolite must be carefully traced to higher temperature K-feldspar and/or secondary biotite.
- Estimation of the orientation for the sheeted M vein packages may also aid in identification of the source for these veins.
- A 3D model of Mo anomalism could be useful.
- The distribution of aplite dykes should also be carefully monitored as a possible vector towards their source.

This exploration program is provided with a priority A.

INTRODUCTON

In May 2018, 3 days were spent on site for Stavely Minerals in to review diamond drill core from the current drilling program. The assistance in this work of Chris Carins, Jennifer Murphy, Michael Agnew, Robert McConnell and Benton Linghof is greatly appreciated.

This review examined several diamond drill holes bored since the authors last visit, namely: DDH SMD013, 014, 015, 016, 017, 022, 023 and 024. This drill core displays many features typical of porphyry Cu systems (figure 1), which contribute towards the interpretation that multiple porphyry intrusions might be discernible. In particular the current exploration program seeks to identify the magmatic source for laminated quartz-magnetite veins identified in recent drill holes, although the presence of an earlier porphyry is also speculated from the data to hand.

Priority

Exploration projects are rated with priorities to proceed with the planned work program to take them to the next decision point. Any such a grading might include a number of projects at widely differing stages of evaluation, some with substantial data bases, while others might be unexplored, but may display considerable untested potential. Priorities are based upon the data to hand at the time of inspection, and are subject to change as increased exploration provides improved and additional data. Projects are categorised as:

A – Of highest interest such that the proposed exploration program should be carried out immediately. However, early stage projects with untested potential might be rapidly down graded from this stage by completion of the planned work program.

B – Of some interest and should be subject to further work if funds are available, often with smaller components of continued exploration expenditure than higher priority targets.

C – Of only little interest and subject to further work at a low priority if funds are available, but not to be relinquished at this stage.

D – Of no further interest and can be offered for joint venture or relinquished.

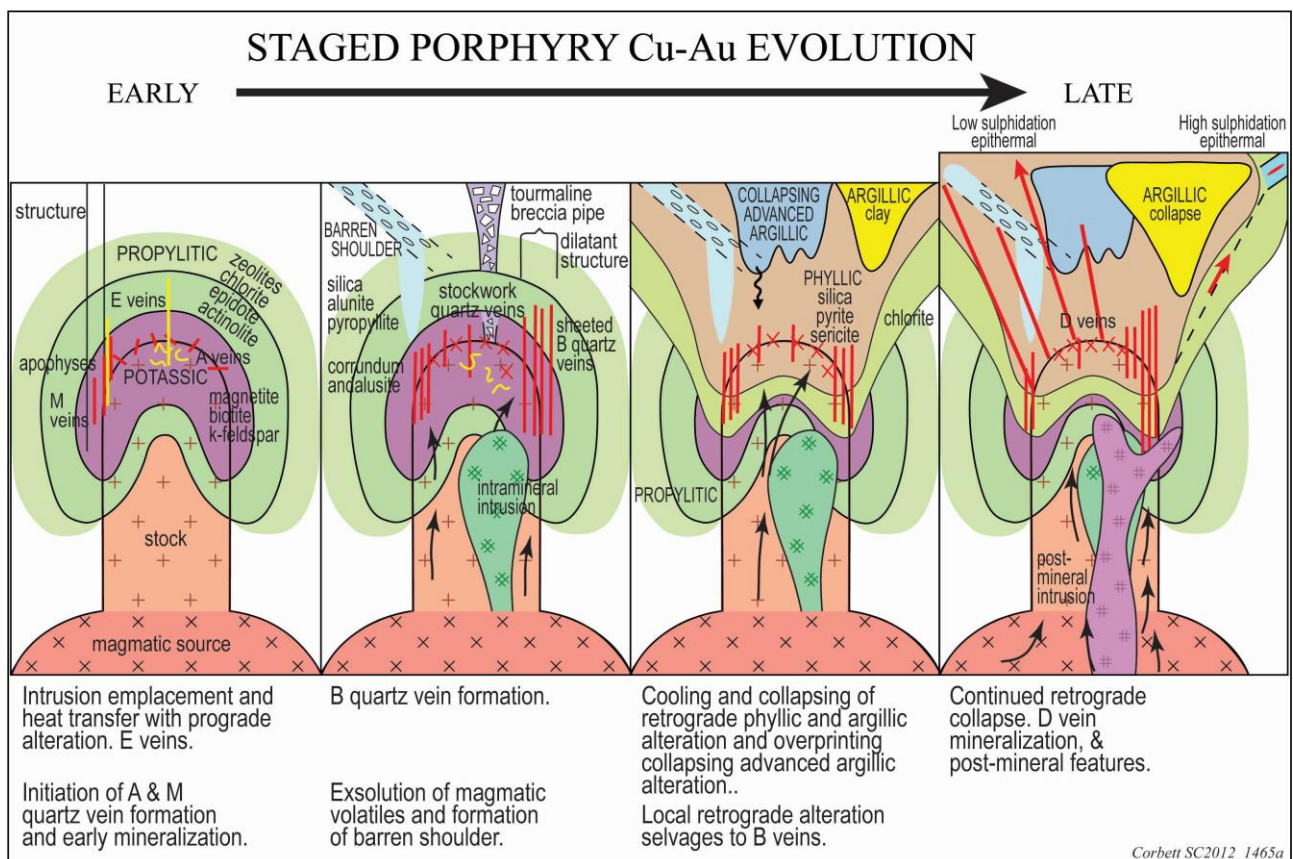


Figure 1 Staged model for porphyry development, from Corbett (2017).

PROSPECT GEOLOGY

Prograde hydrothermal alteration

Prograde hydrothermal alteration in porphyry Cu deposits develops in response to the emplacement into wall rocks of a hot magma body, typically as an apophysis to a much larger magma body at depth. Hydrothermal alteration derived from the cooling intrusion and exsolved volatiles is zoned outwards from the intrusion into the wall rocks as potassic, then to inner and outer propylitic alteration (figure 1). While disseminated mineralisation is recognised in many porphyry deposits, much of the Cu mineralisation derived from the cooling much larger magmatic source at depth, after cooling of the apophysis and occurs within veins which cut the intrusion and immediate wall rocks, and like alteration is spatially and temporally zoned.

Porphyry Cu deposits must display repeated intrusion emplacement to achieve economic metal grades and size. The temporal and spatial zonation in alteration and mineralisation are used to identify overprinting events and to vector towards blind intrusions.

Zonation patterns as applied to Stavely are discernible as:

Potassic alteration is mainly apparent as secondary K-feldspar (orthoclase, although lower temperature adularia may be present) recognised as fracture-vein or mainly disseminated within the matrix to porphyry intrusions, as well as magnetite and secondary biotite (figure 2). Possibly the best example of a potassic altered intrusion is fault controlled at DDHSMD022 183-206 (photo 1), while K-feldspar (photo 2), secondary biotite (photo 3) and sheeted magnetite (photo 4), all overprint earlier sericite alteration within wall rocks outside the source intrusion.

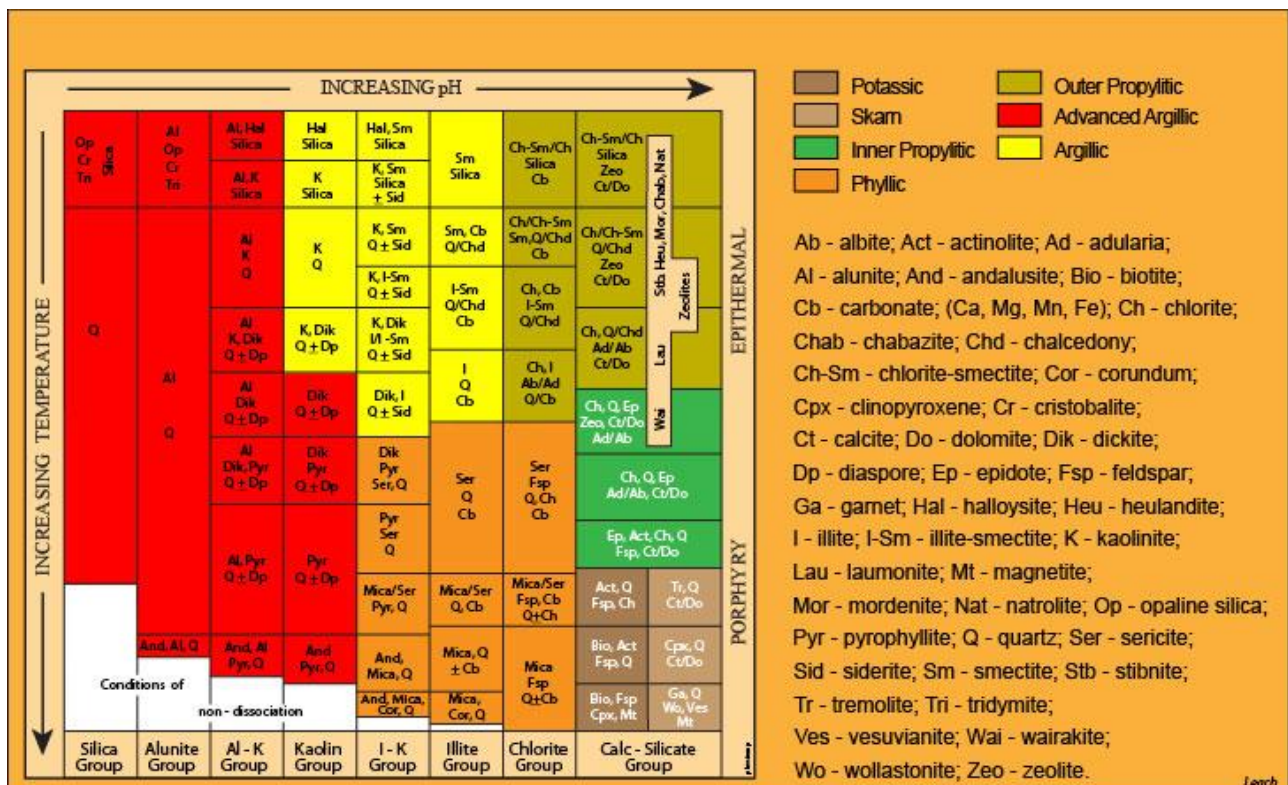


Figure 2 The minerals which constitute common alteration styles plotted on pH vs temperature, from Corbett and Leach (1998).

Inner propylitic is categorised herein by the presence of epidote-carbonate and varies to contain actinolite in the higher temperature range before the progression to potassic alteration, moving towards the speculated source intrusion (figures 1-3). Some workers place actinolite with K-

feldspar within potassic alteration (figure 2; photo 1) while others use actinolite as a vector within inner propylitic alteration towards potassic alteration (Corbett, 2017). Epidote is common within wall rocks (photo 5) locally grading to adularia, the low temperature form of K-feldspar, or albite (photo 6) and in higher temperature conditions actinolite is discernible (photos 1 & 8). Similarly, in lower temperature conditions, epidote grades outwards to marginal chlorite (photo 10).

Outer propylitic alteration in porphyry systems is characterised by chlorite-carbonate \pm haematite \pm zeolite alteration and varies to argillic alteration dominated by illite-chlorite (Corbett, 2017; figures 1 & 2). At Stavely chlorite overprints sericite (photo 9) locally with central epidote (photo 10).

Consequently, prograde hydrothermal alteration at Stavely overprints an earlier event of porphyry-related retrograde phyllic alteration and grades outwards from the speculated source intrusion to wall rock vein hosted potassic (K-feldspar, secondary biotite, magnetite) to actinolite to epidote to chlorite, as might be expected marginal to a magmatic source (figures 1-3). Smaller stock-like intrusions and dykes may also display potassic alteration.

Retrograde hydrothermal alteration

In porphyry systems retrograde hydrothermal alteration is dominated by phyllic alteration as sericite-pyrite which occurs in two settings:

- Upper level argillic-phyllitic alteration typical of that recognised in the upper level of the porphyry-related hydrothermal system (figure 1).
- As selvages to D veins and within fault or shear zones which may coalesce to form larger bodies.

Upper level phyllic alteration which is recognised in many Stavely drill holes is typical of that documented from many porphyry Cu systems (figures 1-3; Corbett and Leach, 1998; Corbett 2009). At Stavely this alteration varies from local uppermost clay-pyrite (argillic) alteration (photo 11) to deeper level typical higher temperature sericite-pyrite (phyllitic) alteration (photos 9, 10, 12 & 13). Silica is locally recognised as silica-sericite-pyrite alteration. In the models in use here, cooling porphyry systems exsolve volatiles dominated by SO₂ which, aided by circulating hydrothermal cells, rise and mix with groundwaters to form sinks of hot acidic waters in the upper portion of porphyry Cu deposits. Later as the porphyry apophysis cools, in the process of drawdown, these waters collapse upon the porphyry environment and react with the wall rocks to become cooled and neutralised and so produce phyllic alteration. Cooler less acidic fluids deposit later and commonly higher level argillic alteration, and the progressively cooled and neutralised fluids create chlorite-dominant alteration at depth marginal to the phyllic alteration apparent at Stavely (photo 14). Hot very acidic waters create advanced argillic alteration described in the literature as lithocaps. Phyllic alteration may contain pyrophyllite which is not necessarily an indicator of an advanced argillic alteration related to a lithocap (figure 2).

Generally in porphyry deposits phyllic alteration overprints most mineralisation formed earlier with associated magnetite destruction and pyrite introduction, discernible as chargeability anomalies. While phyllic alteration is not considered as a significant mineralising event, the causative acidic oxidising fluids may promote deposition of some metals which might emanate from the magmatic source at depth at the same time as phyllic collapse, commonly within B veins and D veins.

At Stavely, in the drill holes inspected in this review, much of the prograde alteration overprints sericite which must therefore have been derived from an earlier porphyry event, of possibly large scale proportions, but possibility of lateral fluid flow within the permeable siltstone host rocks cannot be ruled out.

Selvage phyllic alteration is recognised as sericite-pyrite selvages to B or D veins which may locally be zoned to marginal chlorite alteration and is also recognised as sericite-pyrite with variable silica or clay within fault and shear zones (photos 15 & 16). In porphyry systems, this phyllic alteration occurs at a variety of crustal levels from shallow where D veins lie above the source intrusion or deep levels fault-controlled marginal to source intrusions. Stavelly features an unusual abundance of D veins, in settings such as near the low angle fault, which are interpreted to have been derived from a deeper level (including lateral) porphyry source.

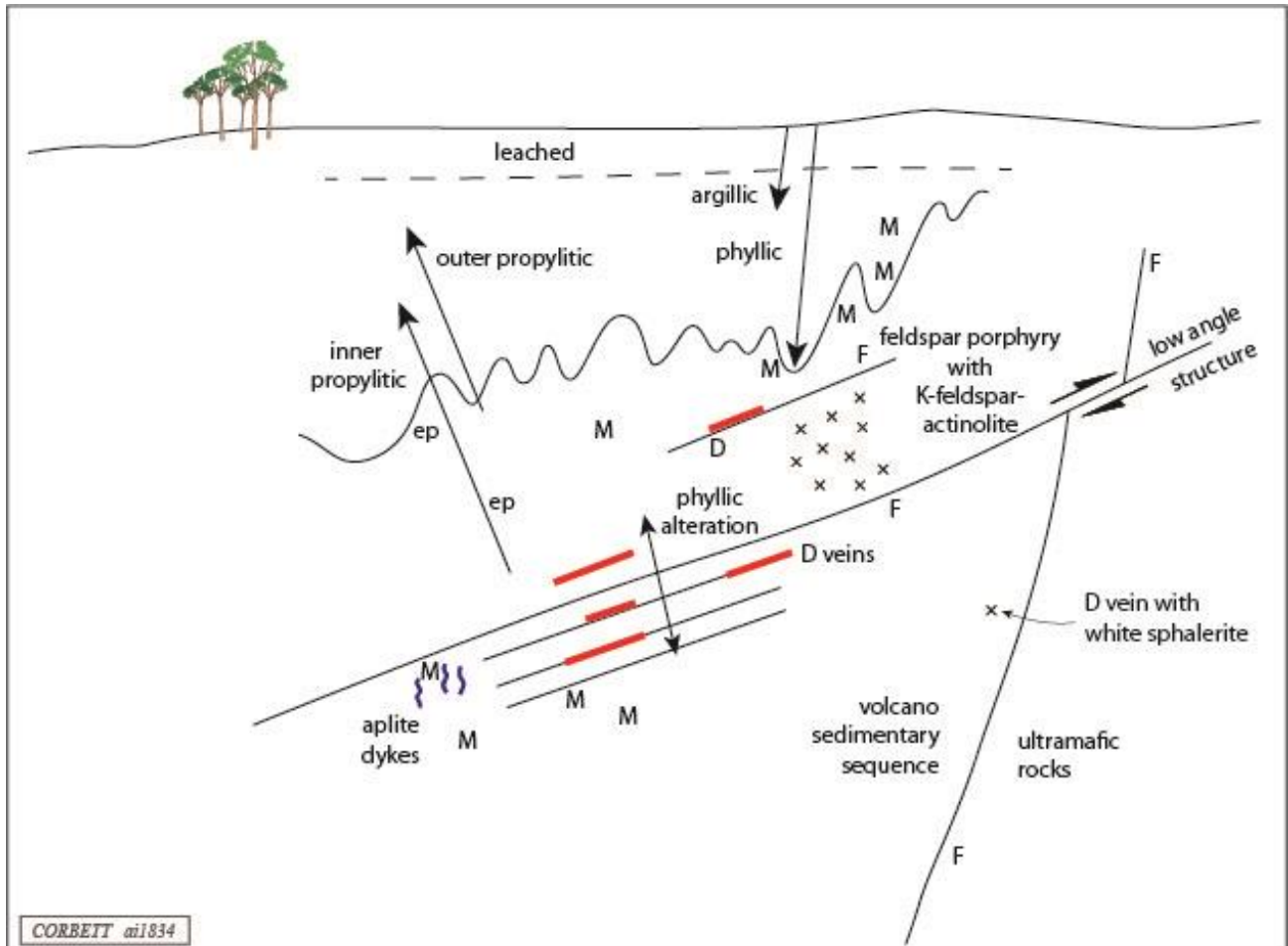


Figure 3 Cartoon to illustrate some of the relationships discussed herein. M is for M veins, ep is for epidote, D for D veins.

Mineralisation

Mineralisation is recognised as:

- Molybdenite developed on fractures (photo 17), within quartz-molybdenite-sulphide veins (photo 18) and D veins (photo 19). Many porphyry Cu deposits feature halos of Mo anomalism outside the limits of Cu and Au anomalism, developed as concentric rings, which can therefore be used as a vector towards source intrusions. Although no doubt complicated by multiple porphyry events, construction of a 3 dimensional model of Mo anomalism at Stavelly could be useful.
- Rare wall rock hosted C style chalcopyrite veins, typical of those which introduce chalcopyrite into B or M veins, were recognised in this review and are expected to have been derived from a mineralised porphyry (photo 20).
- D veins vary from dominated by coarse crystalline pyrite (photo 15) with minor chalcopyrite, to rare veins in which bornite and covellite (photos 21 & 22) have been deposited from an ore fluid which has evolved during migration to a higher crustal level to host lower sulphidation Cu sulphides (see Enaudi et al., 2003). Some low temperature base

metal bearing D veins are considered to have been emplaced after an event of uplift and erosion (photo 23), as is common in many porphyry Cu deposits.

- Laminated quartz-magnetite veins represent the main interest in this review as they are interpreted to have been derived from a deeper mineralised intrusion (photos 24-29). The M veins are transitional from earlier A veins and are cut by some D veins with magnetite destructive alteration (photos 30-32). This is the typical paragenetic sequence if the M and those D veins were derived from the same porphyry. However, the M veins consistently occur within sericite altered rocks (photo 24) which are not magnetite destructive and so this sericite is taken to be derived from a pre-M vein porphyry. Multiple sets of M veins are common (photo 7 & 24), typically with early magnetite-poor A veins. The uppermost M veins contain a watery almost chalcedonic to opaline quartz consistent with a low temperature of formation (photo 25), while many display selvages of actinolite alteration, and so have been deposited at lower temperature conditions and higher crustal level than the normal potassic alteration setting in which these veins usually occur (photos 26-29). The development of many M veins as sheeted sets is consistent with formation within a dilatant structural setting which would have promoted the development of veins at this higher crustal level outside the source intrusion. M veins cut (photo 33) and are cut by (photo 34) aplite dykes so may date from about same time in the paragenetic sequence.

Many porphyry Cu deposits (Ridgeway, Australia) host best Cu-Au mineralisation within M veins. At higher temperature within potassic alteration bornite-bearing M veins will be Au-rich, as bornite hosts Au. In cooler conditions, both later and in more marginal settings, M veins host bornite-chalcopyrite and then chalcopyrite as the Cu species. In typical porphyry Cu systems the substantial decline in Cu solubility in the 400-350°C range (Hezarkhani et al., 1999) provides a lower temperature limit for chalcopyrite deposition. The M veins at Stavely occur with actinolite, described (Reyes, 1990 in Corbett, 2017 figure 2.2) as deposited in the 280-340°C temperature range. Consequently, the Stavely M veins have developed at too low a temperature to host significant Cu mineralisation but may vector towards mineralisation in higher temperature conditions.

Structure

The main structural elements discernible in this inspection (figure 3) include:

- The steep west dipping faulted contact between the hanging wall volcano sedimentary sequence and footwall ultramafic rocks on the eastern side of some cross sections.
- The low angle west dipping fault which cuts the cross section data and on some sections appears to offset the steep dipping contact (above) with a late reverse sense for about 70m. A protracted history of activity on this structure extends from the early porphyry as it hosts D veins related to that intrusion to the much later Lalkaldarno dyke.
- It was not possible in this review to estimate the orientation of the sheeted M veins.

Lithology

Lithologies recognised in this review include:

- Siltstone, best developed in the upper and western portions of the cross sections, is permeable and so has readily undergone early phyllic alteration.
- Andesite represents the dominant host rock and varies to andesite porphyry, interpreted as a possible volcanic rather than intrusive rock using the term microdiorite in some data.
- The term feldspar porphyry provides an alternative term to the quartz diorite which currently accounts for the mafic poor nature of some diorites. Some fault-controlled intrusions such as at DDH SMD022 183-206 m display potassic alteration (above).

- Dacite dykes may be late and post-mineral and some could post-date movement on the low angle fault. However, a pyrite vein transects dacite with an earlier andesite porphyry clast in DDH SMD 013 (photo 37), to provide a syn-mineral time of formation.
- UST textures and spotty quartz (photo 35) are typical of the upper portions of intrusions.
- Aplite dykes are recognised as narrow and locally dismembered pink cross cutting dykes which may represent upward terminations of intrusions. While the pink colour could be related to K-feldspar alteration, some dykes feature actinolite alteration selvages (photo 36). Aplite dykes both cut and are cut by M veins and so may have formed about the same time, and might even be related to the same magmatic source.

Discussion

The exploration model under consideration here is that quartz-magnetite veins identified to date may vector towards an as yet unrecognised mineralised intrusion at depth.

Stavely features multiple events of porphyry and vein emplacement, from interpreted different intrusions and possibly emplaced at different crustal levels during uplift and erosion.

An early porphyry is responsible for the phyllic-argillic alteration in the upper portions of many drill holes examined in this review (figure 3). As this alteration occurs in permeable siltstone host rocks, the possibility cannot be ruled out that such a porphyry intrusion may be located some distance laterally rather than simply at depth. Oxidation of the pyrite within the phyllic-argillic alteration provided the acidic ground waters responsible to the development of the leached cap which therefore features both supergene and hypogene kaolin as well as extensive iron oxide. The most abundant D veins examined to date at Stavely are dominated by coarse euhedral pyrite with lesser chalcopyrite and with prominent sericite selvages. As is common in porphyry systems, these D veins display a relationship with fault structures, in particular the low angle fault, and may be better developed in the footwall. These D veins are currently interpreted to be related to the above unseen porphyry responsible for the upper phyllic alteration. One possibility is that the low angle structure was activated during porphyry emplacement and so displays an association with the D veins. In this scenario the 70 meter reverse movement could be later than the M and D vein emplacement.

The currently targeted porphyry responsible for the M veins postdates the porphyry responsible for the upper level phyllic alteration, but appears to predate reverse movement on the low angle structure. The M vein distribution above and below the low angle structure is consistent with the apparent 70m reverse sense of movement having occurred after M vein formation. The presence of the reported younger Lalkaldarno dyke within this structure testifies to a protracted history of activity on the low angle and associated structures. The actinolite selvage alteration and low temperature quartz suggest the M veins recognised to date are distal to the source intrusion and deposited at too low a temperature to host Cu mineralisation. Nevertheless, aplite dykes with actinolite alteration may also be derived from the same intrusion and help to vector towards it.

Other events of porphyry emplacement, formed as part of a larger magmatic event, may account for other styles of D veins and also the high sulphidation epithermal mineralisation examined in this review within drill hole SNDD1. Low sulphidation epithermal quartz-sulphide Au ± Cu mineralisation may overprint that high sulphidation vuggy silica alteration and mineralisation. Hypogene chalcocite breccias examined previously, in DDD HSTRC19D at 151.4m, are typical of those expected in fluid evolution from low to high sulphidation during the rise from a magmatic source. A carbonate-base metal style D vein with low temperature Fe-poor pale sphalerite (photo 23) recognised in this review is expected to have been emplaced at a higher crustal level than the porphyry features examined in this review, after erosion and uplift.

CONCLUSION

Recent drilling continues to support the earlier suggestion that the Thursdays Gossan region displays manifestations typical of the upper portions of a porphyry Cu occurrence. Features such as the argillic-phyllitic retrograde hydrothermal alteration and D veins examined in this review support that model.

Two, as yet not identified, porphyry events are apparent in the drill core examined in this review.

- The early porphyry is speculated to account for the upper level argillic-phyllitic alteration and many of the deeper level pyrite-chalcopyrite D veins with strong sericite alteration selvages, well developed near the low angle structure.
- A later porphyry is speculated to account for the M veins identified in recent drill holes and may be evidenced by aplite dykes. The low temperature quartz and actinolite selvages suggest these veins formed at too low a temperature to host significant Cu mineralisation but act as vectors to the intrusion source.

RECOMMENDATIONS

The current drill program which seeks to trace the M veins down to a mineralised source is an appropriate response to the veins identified to date. Changes in hydrothermal alteration provide a favoured vector towards such a mineralised porphyry. Careful examination of the hydrothermal alteration should see to identify subtle changes from inner propylitic (epidote-actinolite) to potassic (K-feldspar \pm magnetite \pm secondary biotite) wall rock alteration (typically fracture-vein style) and as selvages to the M veins. Higher temperature might then be traced to the intrusion source.

Continued efforts should seek to identify any orientation of the laminated and sheeted M veins that might help to trace these veins to a source at depth.

A three dimensional model of Mo anomalism might help to vector towards porphyry mineralisation.

The continued exploration program at Stavely is provided with a priority A.

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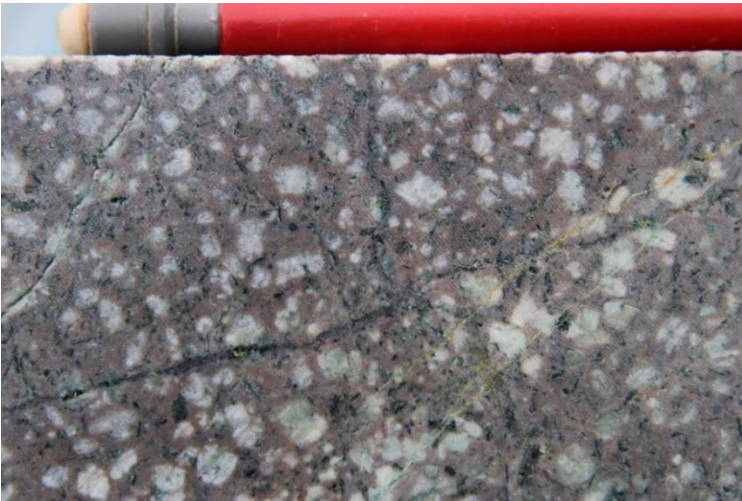


Photo 1 Feldspar porphyry with K-feldspar alteration in the matrix cut by actinolite and lesser epidote fracture veins, DDH SMD022, 195.8m.



Photo 2 K-feldspar developed within fresh andesite wall rock and overprinted by chlorite, DDH SMD017, 308.5m.

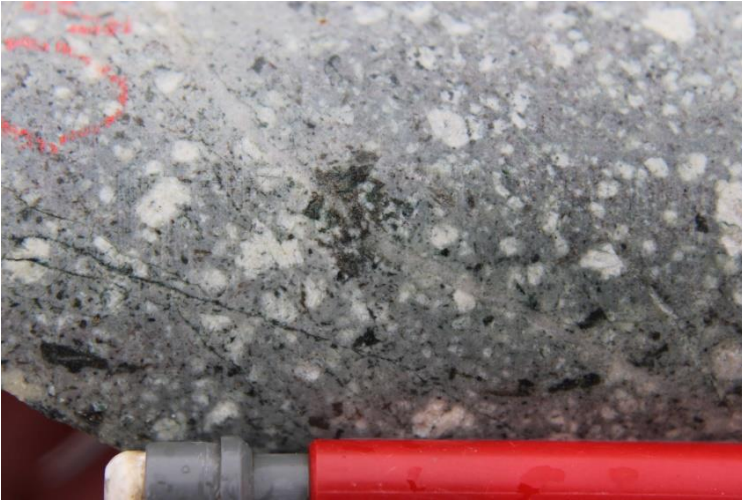


Photo 3 Secondary biotite associated with an A type porphyry vein within sericite altered andesite porphyry wall rock, DDH SMD019, 121m.



Photo 4 Quartz-magnetite veins cut pervasive sericite, DDH SMD014, 216.8m.

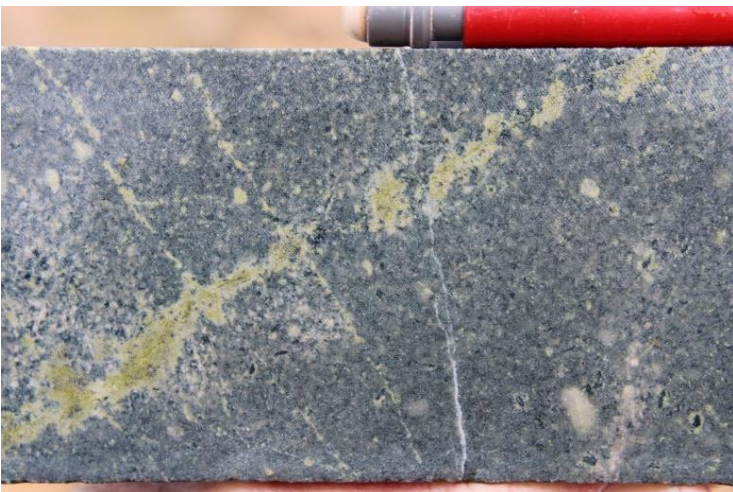


Photo 5 Typical inner propylitic epidote veins within unaltered andesite, DDH SMD013, 338.7m.

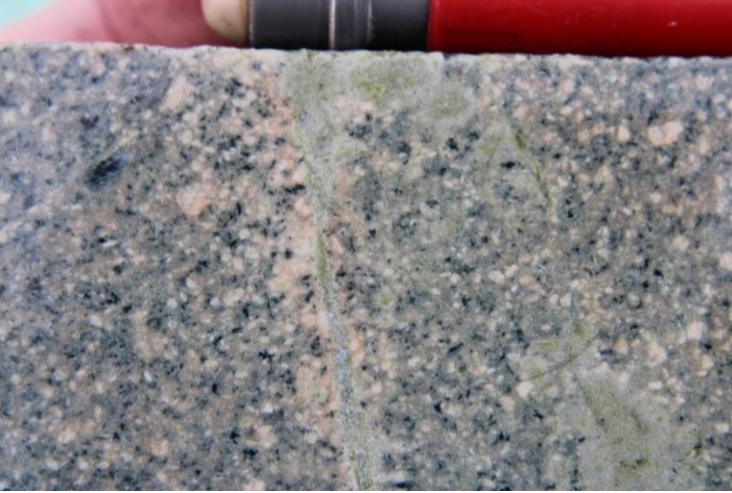


Photo 6 Andesite porphyry hosts inner propylitic alteration epidote vein with selvage of either adularia or albite, DDH SMD013, 414.5m.

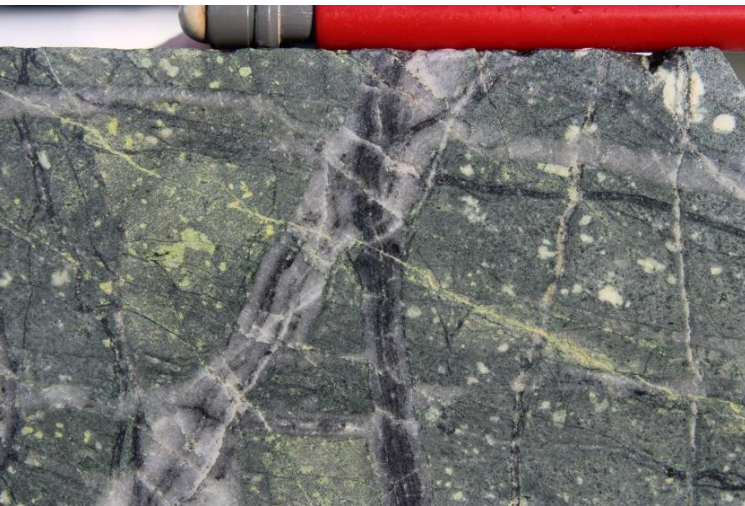


Photo 7 Two generations of quartz-magnetite veins overprinting an A vein within epidote altered intrusion and cut by epidote veins, DDH SMD015, 182.3m.



Photo 8 K-feldspar altered intrusion cut by quartz-actinolite veins, DDH SMD017, 478.6m.

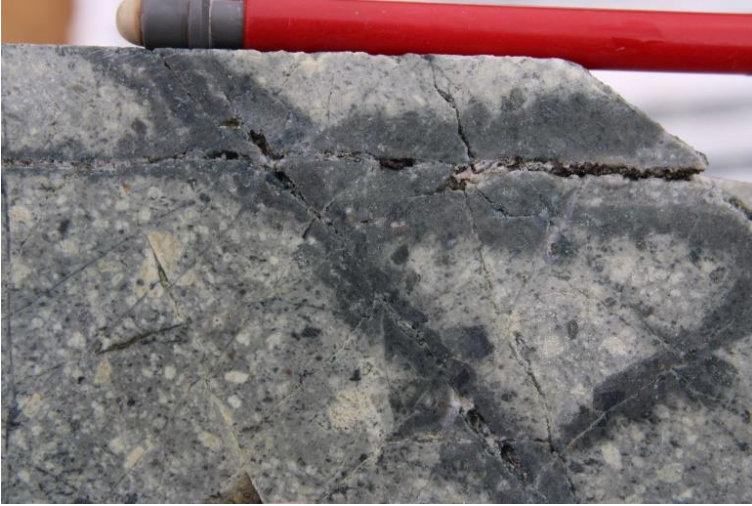


Photo 9 Fracture controlled chlorite overprints pervasive sericite, DDH SMD016, 174.8m.



Photo 10 Pervasive sericite cut by epidote-chlorite vein, DDH SMD013, 161.9m.



Photo 11 Clay as argillic alteration overlying phyllic alteration, DDH SMD24, 38m.



Photo 12 Pervasive sericite with fracture controlled pyrite, DDH SMD014, 166.4m.



Photo 13 Porphyry with pervasive phyllic alteration with quartz veins, DDH SMD020, 158m.



Photo 14 Chlorite-sericite alteration at the margin of pervasive phyllic alteration cut by a B vein, DDH SMD014, 39m.

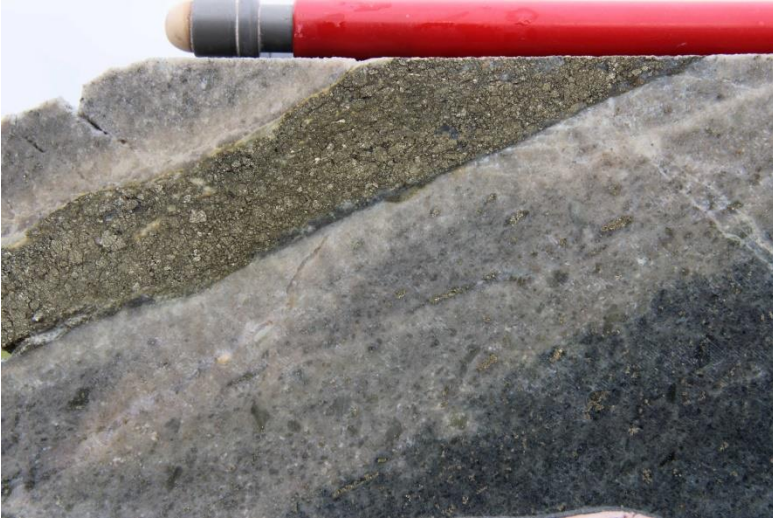


Photo 15 Pyrite D vein with sericite selvage within andesite host rock, DDH SMD013, 302m.



Photo 16 Broad phyllic alteration adjacent to D veins, DDH SMD016, 379m.



Photo 17 Quartz-molybdenite on a fracture, DDH SMD024, 293.7m.



Photo 18 Quartz-pyrite-chalcopyrite-molybdenite, DDH SMD024, 285.9m.



Photo 19 Quartz-pyrite-molybdenite D vein with sericite selvage, DDH SMD024, 332.1m.



Photo 20 Porphyry style chalcopyrite-dominant C vein cuts unaltered andesite, DDH SMD014, 328.3m.



Photo 21 D vein dominated by pyrite and bornite, DDH SMD015, 197.5m.

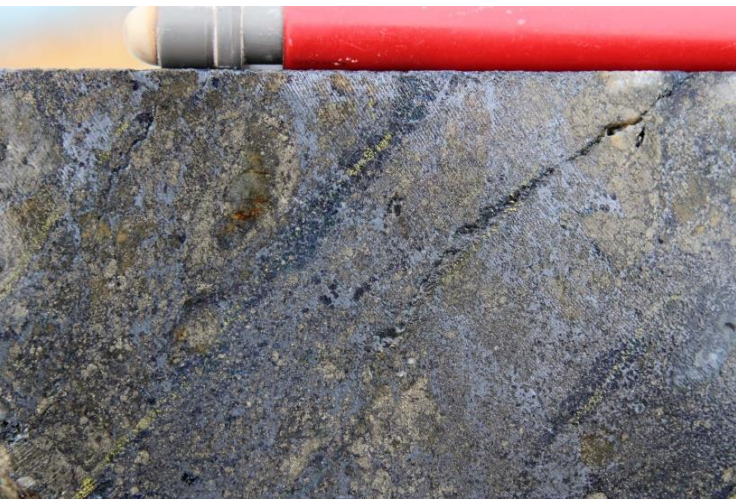


Photo 22 D vein comprising massive pyrite, chalcopyrite, bornite and covellite, DDH SMD015, 205m.

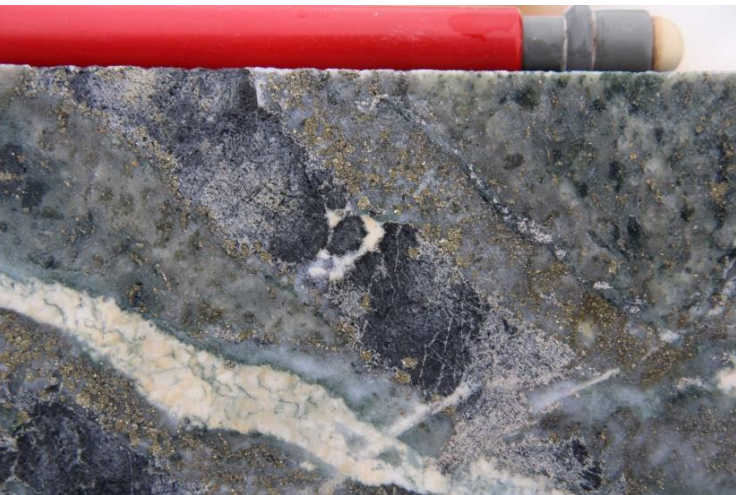


Photo 23 D vein with low temperature carbonate-base metal style mineralisation dominated by quartz, pyrite, low temperature low-Fe sphalerite and rhodochrosite, DDH15, 391.1m.

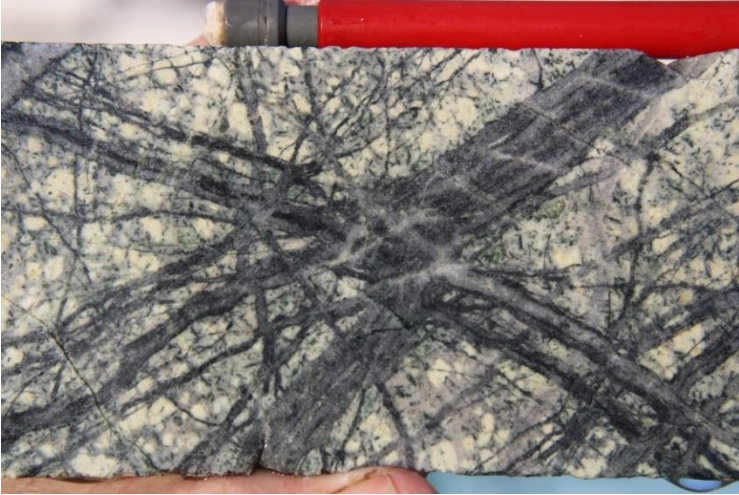


Photo 24 Sheeted and stockwork banded quartz-magnetite cuts earlier phyllic alteration, DDH SMD015, 132.7m.



Photo 25 The uppermost M veins in drill hole 24 contains watery chalcedonic to opaline quartz typical of a low temperature of formation, DDH SMD024, 339.5m.

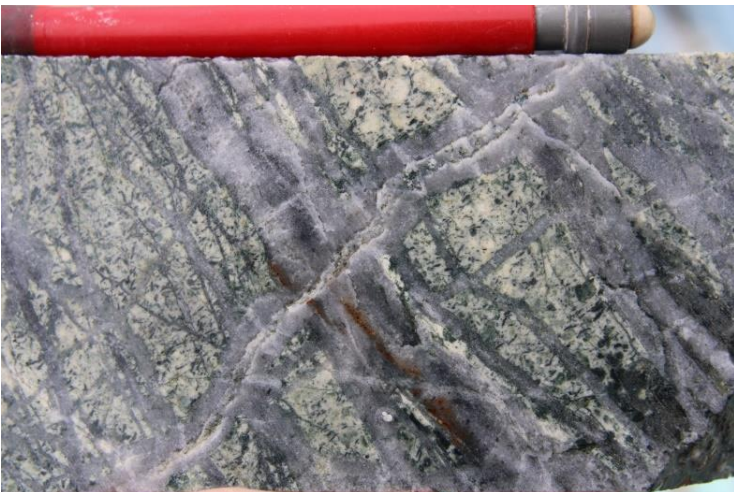


Photo 26 Sheeted A-M veins with selvage actinolite overprints phyllic alteration, DDH SMD022, 167.5m.

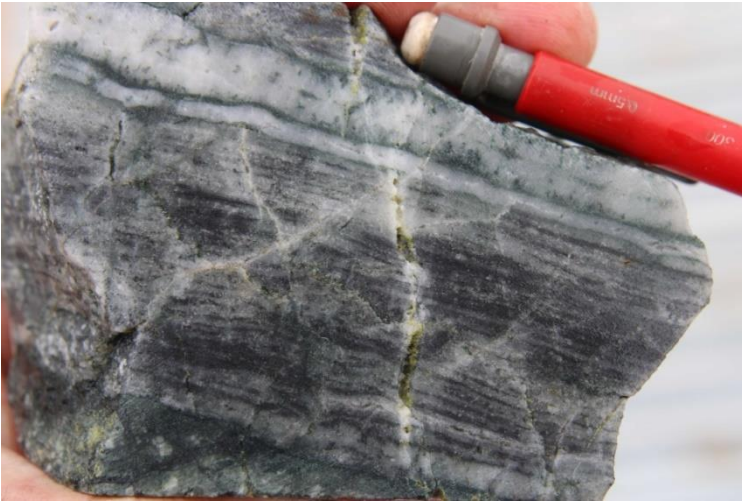


Photo 27 Laminated quartz-magnetite vein with actinolite alteration, DDH SMD017, 430.9m.



Photo 28 Laminated quartz-magnetite veins with actinolite alteration overprinting earlier sericite wall rock alteration, DDH17, 469m.



Photo 29 Laminated quartz-magnetite vein with actinolite alteration, DDH SMD017, 443.6m.



Photo 30 A-M veins cut by a pyrite D vein, DDH SMD023, 156.5m.



Photo 31 Quartz-pyrite D vein with sericite wall rock alteration selvage cuts laminated sheeted A-M veins, DDH SMD023, 122m.



Photo 32 Laminated quartz-magnetite vein cut by a pyrite D vein with alteration of the magnetite to haematite, DDH23, 135.9m.



Photo 33 Aplite dyke cuts quartz-magnetite veins with actinolite alteration, DDH SMD017, 424.8m.



Photo 34 Aplite dyke cut by A-M veins, DDH SMD017, 446.4m.



Photo 35 Spotty quartz typical of the uppermost portion of a porphyry intrusion, DDH SMD023, 177.5m.



Photo 36 Pink possibly K-feldspar altered aplite dyke with selvage actinolite alteration, DDH SMD017, 591.8m.



Photo 37 Dacite porphyry with clast of what is here regarded as andesite but might represent microdiorite, both cut by a pyrite vein.