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COMMENTS ON THE

ALFA BRECCIA

AND SOME OTHER ASPECTS OF THE

STAVELY Cu-Au EXPLORATION PROJECT

WESTERN VICTORIA, AUSTRALIA

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SUMMARY

The Alfa Breccias, recognised west of the structural contact between the Stavely volcanosedimentary and ultramafic rocks, comprise two main styles of magmatic hydrothermal breccias with variable relationships to mineralisation and potential exploration targets.

The Alfa 1 Breccias, which host Cayley Lode above the Low Angle Structure, are typical of milled matrix breccias developed in the deep levels of phreatomagmatic diatreme breccia pipes, and both pre- and post-date porphyry Cu-Au emplacement as magmatism continued during progressive uplift and erosion. The breccia matrix is dominated by comminuted wall rock, locally dominated by original microdiorite, along with clasts of distinctive rounded, silicified, pink felsite and lesser silicified ultramafic, pyrite, chalcopyrite-chlorite and quartz-magnetite. Other features typical of diatreme flow dome complexes include a flow banded dacite likened to a deeply eroded portion of an endogenous dome and collapsed blocks of bedded tuffs as an indication the diatreme(s) vented to the surface. Erosion may have removed in the order of 1 km from this breccia pipe, to accommodate the likely deep epithermal-'out of porphyry' setting of the Cayley Lode. Relogging of several drill sections should, with a priority AB, should seek to clarify these geological relationships and explore for a porphyry Cu-Au target emplaced into dilatant root zone of this breccia pipe(s).

The Alfa 2 Breccias are dominated by structurally-controlled magnetite-actinolite-pyrite ± chalcopyrite, emplaced below the Low Angle Structure as inner propylitic-outer potassic alteration above a magmatic source, which may represent a targeted porphyry Cu-Au intrusion; evidenced as mineralised by: 4 types of porphyry dykes, numerous rucked up quartz-magnetite-chalcopyrite-bornite-epidote clasts, quartz veins and a major anhydrite-magnetite-haematite-pyrite-chalcopyrite-bornite lode. Continued work, with a priority A, should model the structural control (44 structure) which localised and Alfa 2 Breccias so that it can be traced down-dip to a magmatic source.

The current geological model suggests three events of magmatism, alteration and Cu-Au ± Mo mineralisation proceeded during progressive uplift and erosion of the Stavely magmatic arc, with local intervening compression and tectonic erosion. The earliest Victor tonalite batholitic Mo-porphyry has been uplifted and intruded by the Thursday's Gossan suite of diorite to dacite intrusions, followed by the Alfa event. The Alfa 2 Breccias formed at a deeper crustal level than the Alfa 1 Breccias, possibly overlying an apophysis in the buried batholithic magmatic source, where ore fluids ponded and then migrated up the steep-dipping 44 structure. By contrast the Alfa 1 Breccias may have been localised where the dilatant Cayley flexure intersects the batholith margin. Here, Cayley Lode locally transects the Alfa 1 Breccias as an overprint of zoned high sulphidation state Cu sulphides upon an earlier D vein. Therefore, the pyritic D veins with sericite selvages throughout the Thursdays Gossan district might have been emplaced during the Alfa event. The Cu-rich ore fluid which formed the Cayley Lode may have migrated laterally to the margin of the Alfa batholitic magma source to rise rapidly within the dilatant Cayley flexure. A targeted porphyry Cu-Au intrusion may have been emplaced into in the root zone of the diatreme breccia complex.

The deep drill hole SMD117 bored for 1712m transects deep ocean floor sediments, tuffs and lavas as well as the eastern north-south structure. Extensive epidote alteration, obscured at the surface by thrust Victor porphyry, and G (quartz-magnetite-pyrite-chalcopyrite) veins underlie the NS trending portion of the surficial chalcocite anomaly and so represent a priority B exploration target.

Pyrophyllite in the DDH SMD136 flow banded dacite suggests magmatic volatiles evolved to a low pH during the domes rise within the dilatant Cayley flexure hosted by the incompetent diatreme breccia pipe and might display a link the evolving low pH fluid source for the Cayley Lode.

Continued exploration should consider the several possibilities that could account for the deposition of bonanza (100 g/t) Au identified with watery, possible low temperature, quartz in DDH SMD106.

INTRODUCITON

A total of 11 days was devoted in March-April 2021 to a field review of recent drill core at the Stavely Project, with a brief to consider several aspects of current exploration as:

- The nature and significance of many recent breccia drill intercepts,
- Recent deep porphyry drill holes, SMD114 and SMD117,
- Pyrophyllite in DDH SMD136
- The Cayley lode including the high grade Au intercept in DDH SMD106

The assistance in this work is gratefully acknowledged of Stavely geological staff Chris Cairns, Jennifer Murphy, Hamish Forgan, Stephen Johnson, Michael Agnew, Hanna Lee and Sarah Heard.

All assays quoted for individual samples are for the 1 metre interval in which that sample occurs.

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.

THE ALFA BRECCIA

Many recent drill holes bored at Stavely intersect magmatic hydrothermal breccias divided here into two main types of Alfa Breccia, distinguished by location, appearance and origin (figures 1 & 6).

The Alfa 1 Breccia (photos 1-5) is currently traced along strike for about 800m as a tabular, steep SW dipping, intrusive breccia, mostly on the SW hanging wall side of the Cayley Lode in the vicinity of the underlying volcanic-ultramafic contact (figures 1-4). Here, it transects the microdiorite which constitutes much of the comminuted matrix (figure 4), discernible in the type section, DDH SMD146, 100-200m. The drill intercepts inspected to date host milled matrix breccias, collapsed blocks of bedded breccia and associated intrusions, all typical of deeply eroded diatreme breccia pipes, that result from polyphasal phreatomagmatic eruption and brecciation (Corbett and Leach, 1998, p. 61-64). There is a relationship with intrusive rocks as: the abundant felsite clasts, minor dykes and a flow banded dacite interpreted as a deeply eroded endogenous dome (DDH SMD, 136; figure 7, photos 1-5), as well as mineralised clast of possible intrusive origin below (photos 27-32).

Elsewhere, some porphyry intrusions have been emplaced into pre-existing diatreme breccia pipes (Lepanto, Philippines; Garcia, 1991 in Corbett and Leach, 1998: Grasberg; MacDonald and Arnold, 1994; and Onto, Indonesia; Burrows, et al., 2020), while other diatreme pipes transect pre-existing porphyry Cu-Au deposits and stope-out mineralisation (El Teniente; Cannell et al. 2005; and Caspiche, Chile; Sillitoe et al., 2013: Dizon, Philippines; Malihan, 2007). At the youthful Onto system, porphyry Cu intrusions (0.69 Ma) were emplaced into a polymictic breccia pipe (0.8Ma) which hosts younger (0.35-0.44 Ma) high sulphidation state covellite-dominate Cu-Au mineralisation (Burrows, et al., 2020; Rennison et al., in press). Here, much of the Cu-Au mineralisation, classed as 'out of porphyry' in nature, as it lies within the breccia pipe above an earlier porphyry. This mineralisation was therefore derived from the underlying magma source after the earlier breccia and porphyry events. As with the Alpha 1 breccias at Stavely, collapsed blocks of bedded tuff at Onto indicate these phreatomagmatic breccias vented to the surface. Stratigraphic reconstruction of the youthful Onto system provides a depth to porphyry emplacement of only 1,250m below the palaeosurface (Burrows, et al., 2020; Rennison et al., in press). Similarly, many low and high sulphidation epithermal Au deposits are genetically related to diatreme breccia pipes (Corbett and Leach, 1998).

In the model below, development of the 'out of porphyry' Cayley Lode may have been triggered by this phreatomagmatic eruption(s) which tapped the buried magmatic source rocks and vented to the surface, although now deeply eroded. Therefore, the manner in which the Cayley Lode transects the Alfa 1 Breccia provides an interesting paragenetic constraint within the well preserved Cambrian Stavely Magmatic Arc. The setting of the porphyry-related Cayley Lode might now be regarded as transitional between deep epithermal and 'out of porphyry'.

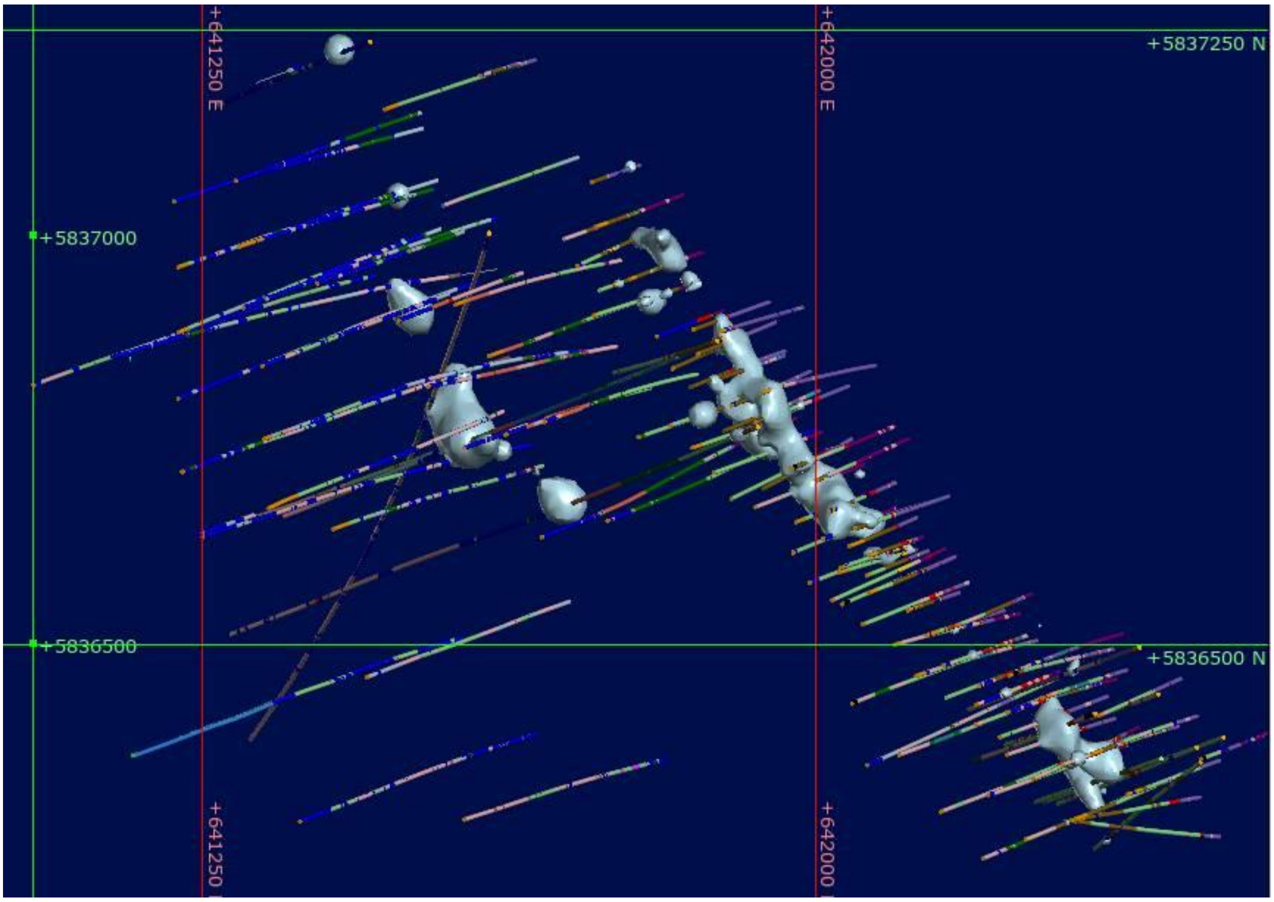

Figure 1. Two bodies of Alfa hydrothermal breccia in pale blue. The Alfa 1 brecciation the right lies on the hanging wall (SW side) of the Cayley Lode and volcanosedimentary/ultramafic while the structurally controlled Alfa 2 Breccia occurs to the west, best intersected in DDH SMD044.

The Alfa 2 Breccia, best recognised in DDH SMD044 (photos 35-47) and some nearby drill holes (SMD047, 031 & 028), lies further the west of the Cayley Lode and the Alfa 1 Breccias (figures 1 & 2). This breccia is characterised by high temperature wall rock alteration, mineralised dykes and a sulphide-bearing lode, as well as rucked up mineralised clasts, all localised by a shear apparent at a low angle to the core axis in several drill holes. Exploration should therefore trace this shear down-dip towards a source, which may represent an exploration target for porphyry Cu-Au thought to be mineralised from the presence of mineralised dykes and rucked up breccia clasts. The Alfa 2 breccia is interpreted to have developed prior to, and at a deeper crustal level than the Alfa 1 breccias, during progressive uplift and erosion. The similarity of the mineralised felsic porphyry dykes in the Alpha 2 breccias with less mineralised features in the Alfa 1 breccias provides a link between these two breccia types.

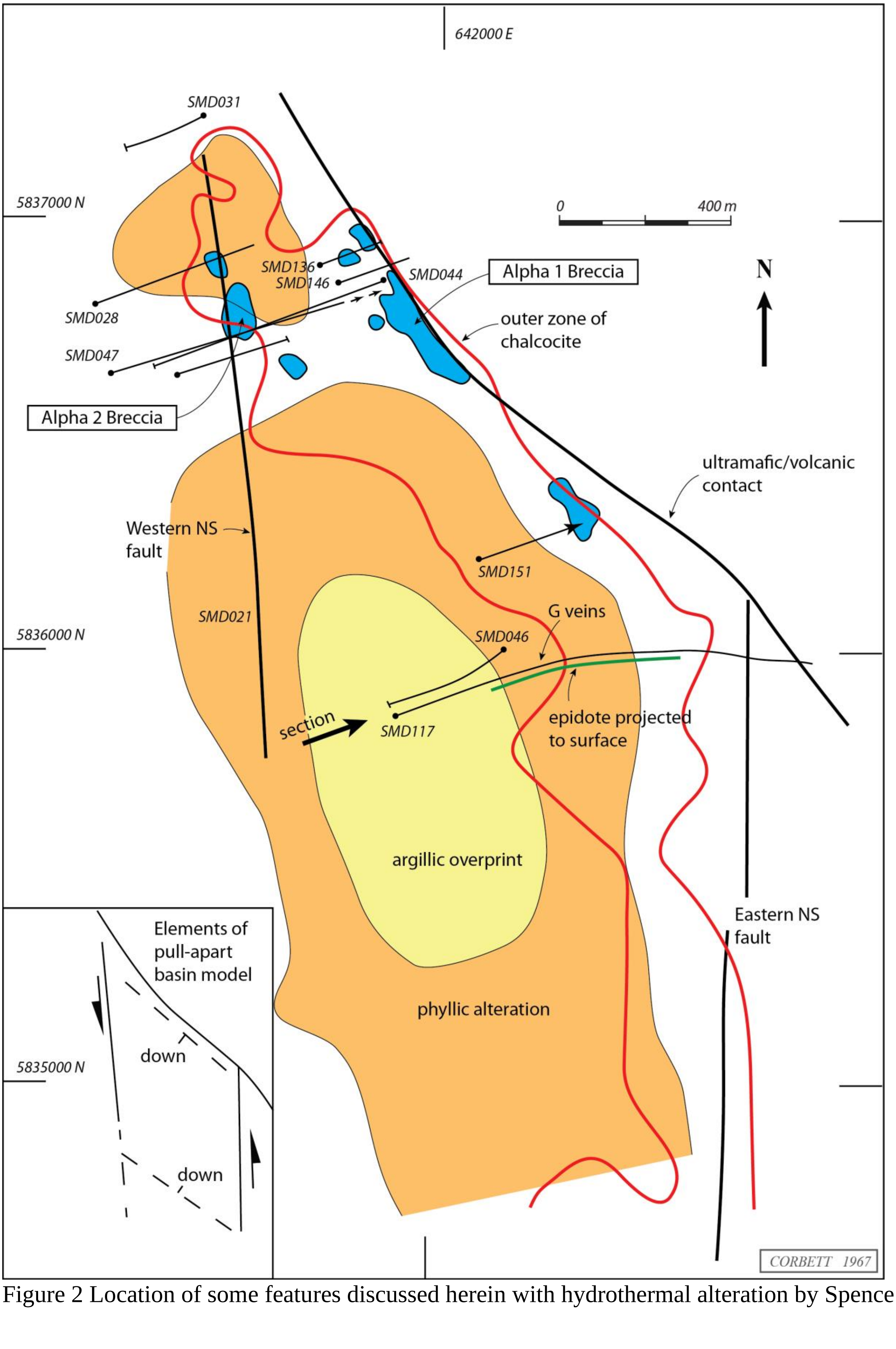

Figure 2 Location of some features discussed herein with hydrothermal alteration by Spence (1996).

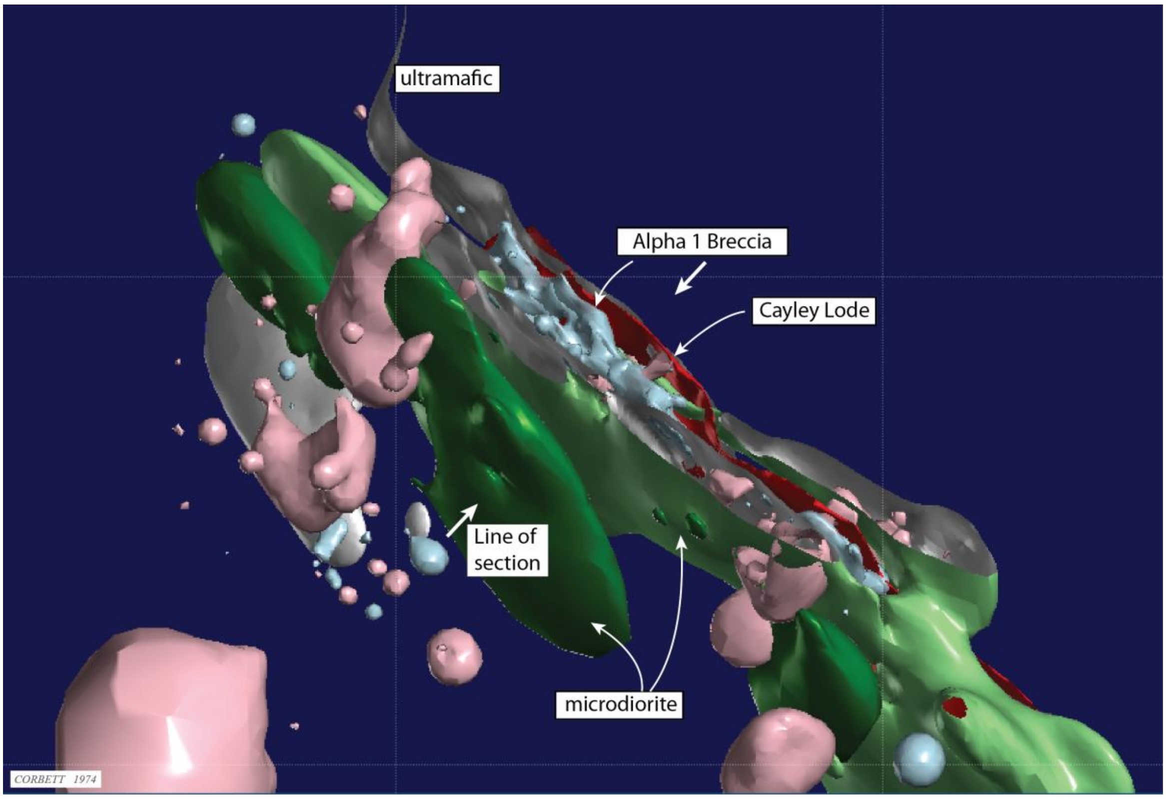

Figure 3 The geological setting of the felsite clast Alfa Breccia in the hanging wall of the Cayley Lode and cross-cutting the microdiorite.

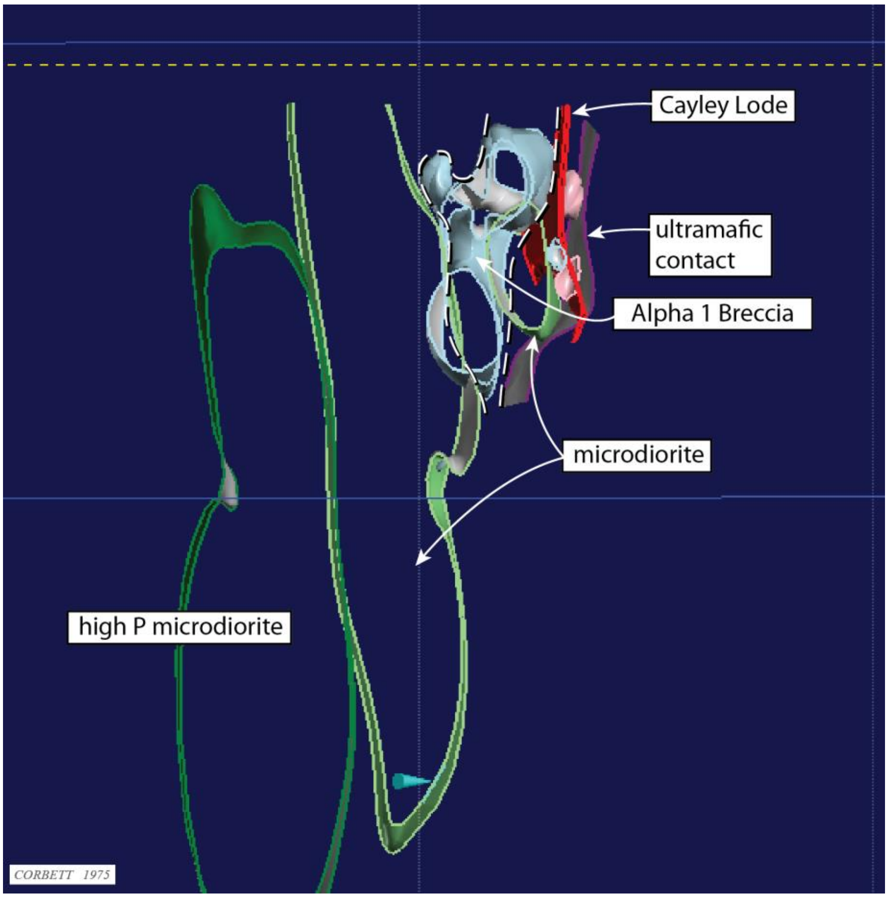

Figure 4 Cross section through the Alfa breccia located on figure 5 looking north. The change to a flatter dip at depth of the contact between the volcanosedimentary sequence and the ultramafic rocks may restrict Alfa 1 breccia formation on this section. The Alfa breccia in blue cuts the microdiorite in dark green while the high-P microdiorite is in light green further to the west.

Magmatic activity

Intrusions with associated alteration and mineralisation may be grouped into three overprinting eras developed in response to continued magmatism during typical magmatic arc uplift and erosion within the Thursday's Gossan region of the 30 km long segment of the of the Stavely Magmatic Arc that characterises the Stavely project (figure 2), as:

- Earliest Victor Porphyry extends south of Thursday's Gossan as a region of a surficial clay alteration (including weathering) overprint on phyllic (sericite-pyrite) alteration. A coarse grained batholitic tonalite intrusion (Ashley, unpubl. petrology report) intercepted in DDH's SMD117 and SMD046 (figure 2), is characterised by abundant thick porphyry style A veins which may be Mo-rich, but poor in Cu mineralisation and with negligible Au. The older Victor Porphyry is locally thrust over younger rocks. Later weathering of the pyrite in this and later phyllic alteration has provided low pH ground waters to facilitate formation of the supergene chalcocite ore body, from hypogene Cu emplaced after the Victor porphyry.
- The Thursday's Gossan magmatic event varies from diorite to dacite intrusions, and includes the quartz diorite porphyry with abundant poorly-mineralised quartz-magnetite M veins. Further work is expected to distinguish the Thursday's Gossan event dacites from those associated with the Alfa breccias.

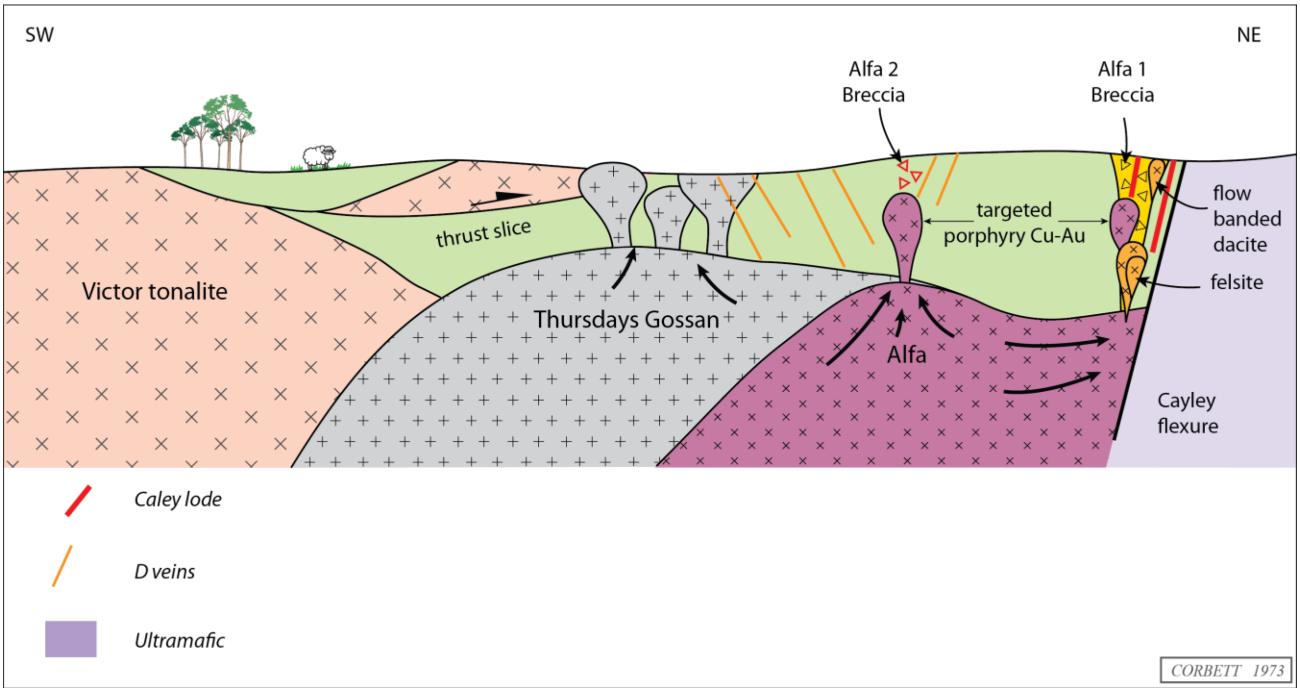

Figure 5 Interpretation of three eras of magmatism, alteration and mineralisation interpreted for the Stavely district, which young from left to right.

- Although the Alfa event igneous rocks is expected to be more clearly defined in the planned program designed to relog of several drill sections. Prominent units recognised to date include:
    - Felsite, identified as a fine grained, pink, hard, siliceous, (K-feldspar altered) well rounded, breccia clasts, represents a characteristic component of the Alfa 1 milled matrix breccias (photos 1-4), varying to less common angular clasts which constitute the dominant component in other breccias (photo 5). A paragenetic relationship of continuous emplacement during the Alfa I event is provided in DDH SMD136 (126m), where a felsite dyke cuts the flow banded dacite (below), and is in turn cut by a D vein. However, ragged felsite clasts down-hole suggest synchronous emplacement between the felsite and flow banded dacite. Felsite is also recognised in the Alfa 2 Breccias (DDH SMD044, 695 and 587m) as locally ragged juvenile

clasts (photo 6) and brecciated felsite dykes which contain sulphide mineralisation (photos 7 & 8) and so could be linked to a more significant mineralised source.

- Flow banded dacite is intersected over a significant interval in DDH136 at 115-180m is likened to a deeply eroded portion of a endogenous dome associated with diatreme flow dome complexes (figure 3). Although termed a dacite here, further work might categorise this rock as a rhyolite. Pyrophyllite alteration in this rock may provide a link to the magmatic source for the Cayley Lode ore fluids (below).
- Three dacite types are recognised to date in the Alfa 2 Breccias as:
  - A black felsite (fine grained dacite) clasts in DDH SMD31 display embayed margins and partly consumed wall rock clasts (photo 9) indicative of juvenile clasts which were at least partly molten while erupted.
  - Dacite includes a coarser grained pink, K-feldspar altered, dacite which comprises the dominant clast type in DDH SMD031 (photos 6 & 10) shown in photo 10 as one large interpreted juvenile clast.
  - Feldspar dacite porphyry present as uncommon clasts in DDH SMD031 is dominated by discernible fine grained feldspar laths.
- The type specimen of microdiorite used here (photo 11) and sent for petrology, is from DDH SMD136 at 47.4m and may represent a remnant within the Alfa 1 Breccia formed by comminution of microdiorite to form the breccia matrix, such as in the DDH SMD146 type section (photos 1-3). Other examples of microdiorite viewed during this drill core inspection appeared sufficiently different to prompt consideration that this rock unit may require subdivision during the planned relog of drill core (below).
- Green often pyrite-bearing alteration, of probable porphyry, is recognised within the matrix of some breccias (photos 16, 42-47, 64) and also as common clots or clasts (photos 1, 7, 63) and variations between these two settings (photos 27-30, 65, 34), remains poorly defined. A sample has been submitted for petrology (Appendix I).
- Three styles of porphyry dyke have been identified within the Alfa 2 Breccia unit in DDH SMD044 in addition to the felsites cited above, as:
  - P1 occurs a clasts dominated by fine grained magnetite, bright red haematite, and chalcopyrite, in a short section of poorly drilled core, which contains 1 m of 1.11% Cu, 0.18 g/t Au and 279 ppm Mo (photo 12). The Mo is regarded as significant and a sample has been sent for petrology.
  - P2 has to date been recognised over short intervals within the breccia (DDH44 at 604 and 695m; photos 13 & 14) mostly as clasts as a fine-medium grained quartz-albite-magnetite-chalcopyrite rock with up to 0.3% Cu and has been sent for petrology.
  - P3, a probable microdiorite, occurs as a brecciated magnetic micordiorite in the interval DDH SMD044, 668-690m which is well developed within this Alfa 2 Breccia unit, and has been sent for petrology (photos 15 & 16). Note how photo 16 better features this strong shearing in the Alfa 2 Breccia as these two photos are taken from sections in different orientations.

From the presence of microdiorite as a significant intrusion in the Alfa 2 breccias and as the comminuted wall rock in the Alfa 1 breccias, the possibility cannot be ruled out that this rock unit represents a precursor to the Alfa breccia event.

Character of the Alfa Breccias

While other variants are expected to arise during continued analysis, work to date has defined two main types of the Alfa breccias, as:

Much of the **Alfa 1 Breccia** occurs as milled matrix breccias typical of those recognised within diatreme breccia pipes formed by phreatomagmatic eruptions (figure 3, Corbett and Leach, 1998, p. 61-64; Ross et al., 2017). These rocks display a character of clast comminution (milling) during both violent upward transport and subsequent collapse (see also photos in Corbett short course notes, Ch 3, p. 46-75). In the type section of DDH SMD146, microdiorite is interpreted to have been heavily comminuted to form the breccia matrix and mixed with mainly comminuted and rounded hard, pink, felsite clasts (photos 1-3), to form this characteristic texture. The breccia character varies to include examples dominated by angular felsite clasts of < 10mm (photo 5). Other breccias of entirely finely comminuted ?microdiorite have the appearance of a green grit made up of rock flour and so can be difficult to distinguish from sedimentary or igneous rocks (photo 27). The green matrix is also derived from the comminution of intermediate andesite-dacite dykes identified in DDH SMD121, and submitted for petrology (Appendix I). Other breccias include a chaotic mix of variably milled clasts of different types with local fine layering (photo 4), formed during post-eruption collapse.

The milled matrix breccias are considered to have been formed by violent upward vapour-rich explosions derived from the rapid depressurisation of rising typically felsic intrusions. Ground waters are commonly involved in many phreatomagmatic breccia eruptions. Michael Agnew pointed out that heating of the serpentinites would have provided abundant water at depth, which could have been vapourised by a hot intrusion to promote eruption. Rare rebrecciated breccia clasts (photo 17), intrusive breccia dykes (photo 18) and contacts between breccia bodies (photos 19 & 20) all testify to the polyphasal nature of this breccia body. Some apparent cross-cutting relationships may represent the contacts of collapsed blocks with breccia matrix (photo 21) while collapse is also apparent in the adjacent wall rocks (photo 22).

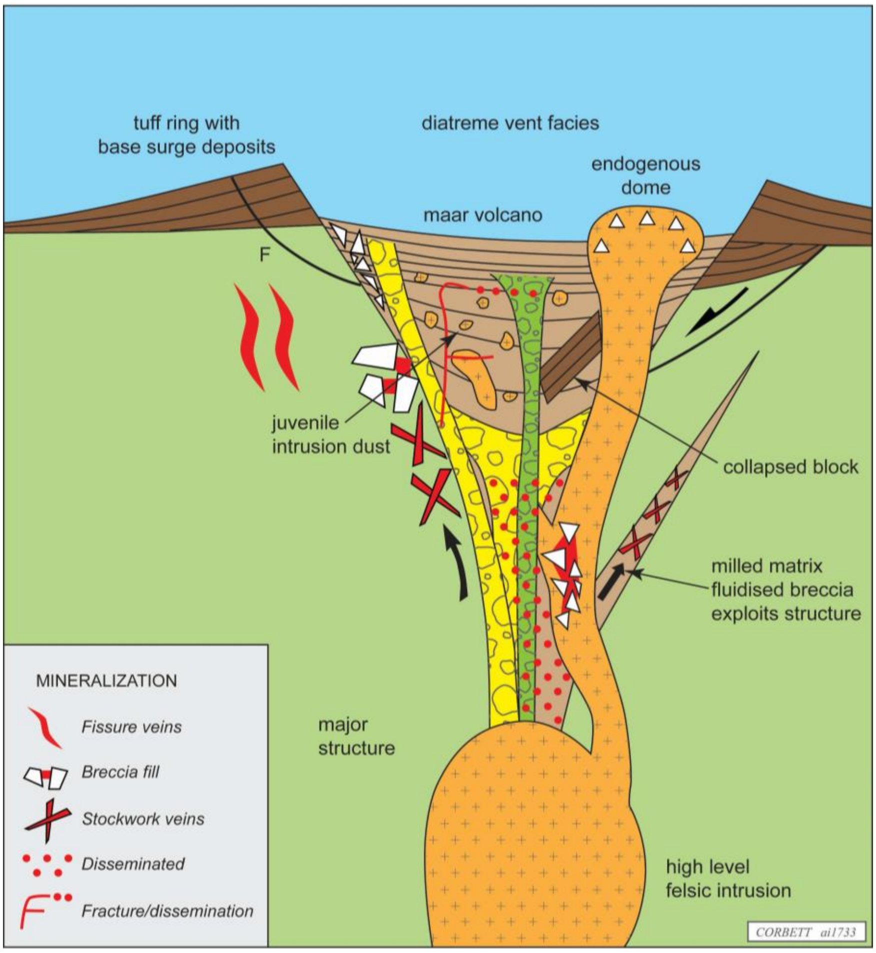

Figure 6 Conceptual model for typical diatreme flow dome complexes, from Corbett and Leach (1998) updated as Corbett (2021).

Bedded tuff deposits within the Alfa 1 Breccia (photos 23-26) are similar to those recognised elsewhere (Corbett op cite; Ross et al., 2017) developed in the upper portions of diatreme breccia pipes, including surficial maars which host lacustrine deposits, and within the adjacent tuff rings. Layering develops by repeated air fall deposition of fine pyroclastic ejecta and at Stavely features sedimentary structures such as fine layering, load clasts and rare graded bedding (photo 26) with layers and disseminations of hydrothermal pyrite (photos 23 & 26). The chlorite-illite altered green basal layers to many beds commonly give way to upper fine illite-kaolinite altered white layers (photos 23-26). This may reflect initial deposition of heavier microdiorite-derived detritus followed by lighter dacite-derived detritus. Drill intercepts such as in DDH's SMD136 and SMD146, host steep dipping bedded tuffs which display brecciated contacts between segments distinguished by variations in the nature of the bedded tuff and angle of bedding to the core axis. These drill intercepts of bedded tuff are interpreted to have bored through stacked blocks of bedded tuff which collapsed to deeper levels within the breccia pipe, both syn- and post-deposition. Wood clasts are recorded to have collapsed to depths of 600m below the current surface in some diatreme breccia pipes (Corbett and Leach, 1998). Although no accretionary lapilli, typical of subaerial formation were recognised, these tuffs suggest the diatreme breccia pipe vented to the surface. Lacustrine sediments, commonly deposited in maars developed as the surficial portions of diatreme flow dome complexes, may in future need to be distinguished from the pre-existing deep ocean shale/siltstone sequence. However, the uppermost surficial deposits are anticipated to have been removed by significant (possibly 1 km) erosion from the Stavely breccia pipes. It is more likely that the current 800m strike extent estimated for the Alfa 1 breccias represents a series of nested diatremes with associated now eroded domes, rather than one single body. Some drill intercepts of breccias dominated by bedded shale/siltstone clasts, with felsite and silicified ultramafic clasts, grade to marginal less brecciated clasts including disrupted bedding. These bodies of poorly brecciated bedded rocks might be indicative of collapse within the wall rocks at the margin of the breccia pipe (photo 22). Consequently, the Alfa 1 Breccias are characterised by a major upward injection phase and subsequent collapse.

A long intersection of flow banded dacite recognised in DDH 136 from 115-170 (figure 5) is typical of the style of intrusive dome associated with many diatreme breccia pipes. Although deeply eroded where intersected here, these intrusions commonly vent to the surface of diatreme breccia pipes as endogenous domes. Curiously, this flow banded dacite hosts a cross-cutting silicified felsite dyke with a D vein pyrite overprint, at about 125 m. Down hole the felsite clasts within the flow banded dacite at 180-185 m are clearly not milled but ragged, suggesting a molten form when emplaced. Further work should consider what appears to be a transition between flow banded dacite and microdiorite immediately above the ultramafic contact in DDH 136, 180-190 m, where some alteration is reminiscent of the dark alteration identified as Alfa 2 Breccias. This might provide a link between these two Alfa Breccia systems currently considered to have formed at different crustal levels.

The Alfa 1 Breccias contain abundant disseminated and clast pyrite and chalcopyrite, some resembling clasts of D veins, much of which is rimmed by green chlorite alteration (photos 27-29). D veins and Cayley Lode transects the Alfa 1 Breccia, such as in DDHs SMD121 and SMD127 suggesting these two events are synchronous with possible related magmatic sources. Other porphyry-related clasts within the felsite clast breccia include quartz-chalcopyrite-magnetite (photos 31-32), although also similar to the initial phase Cu-sulphide Cayley Lode (photo 72). Some of the same dark green magnetic, pyrite-bearing, clasts are recognised in Alfa 1 Breccia (photo 30) are more abundant in the Alfa 2 Breccias (photo 62, 63, 7, 48) and so, along with the felsite dykes, may provide a genetic link between these two breccia types. There are many silicified clasts within the Alfa 1 Breccia in which the presence of chromite and local fuchsite is indicative of an origin as silicified ultramafic (photos 4, 33 & 34). Rounded silicified ultramafic clasts with preserved chromite grains are a common component of the Alfa Breccias and one instance of massive silicified ultramafic with enclosed chromite grains was recognised within the ultramafic in this core inspection (photo 35).

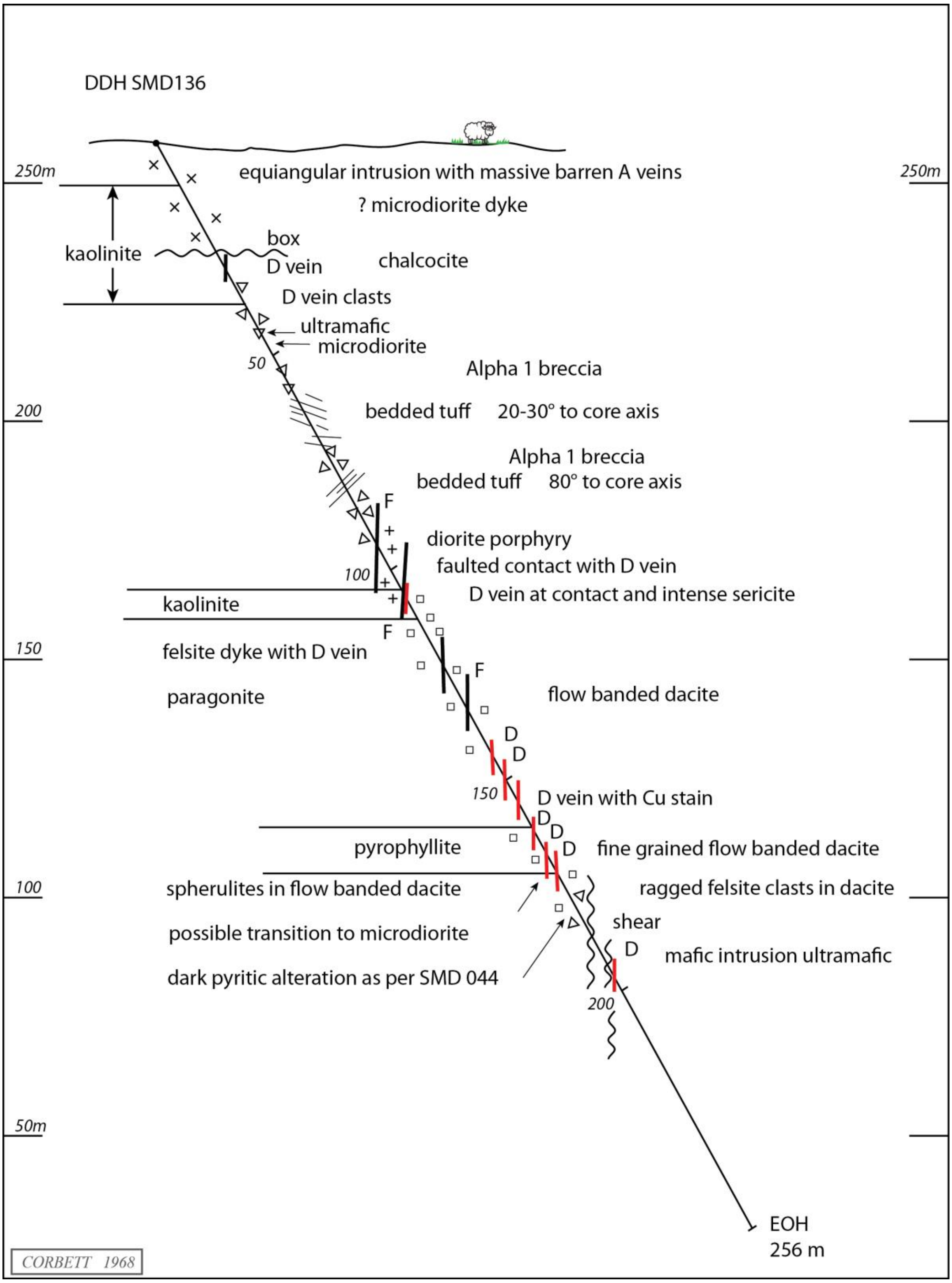

Figure 7 Log of DDH SMD136.

The flared nature of may diatreme breccia pipes (figure 6) is apparent in the cross section illustrated as figure 3. However, on this section the variation to a flatter dip for the contact between the volcanosedimentary sequence and the ultramafic rocks may restrict the downward projection of the Alfa 1 breccia, which therefore might appear rootless on this cross-section. It is necessary to define the deeper levels of the diatreme breccia complex as a likely setting for later porphyry mineralisation.

Alfa 1 and porphyry Cu-Au target

Many porphyry Cu deposits display an association with diatreme breccias, described above. Some porphyry Cu-Au deposits are cut by younger phreatomagmatic breccia pipes emplaced at a higher crustal level after uplift and erosion within the arc (El Teniente and Caspiche, Chile; Dizon, Philippines). At Wafi, Papua New Guinea, the porphyry predates the diatreme breccia which is exploited by later higher crustal level high sulphidation fluids, which upgrade the porphyry mineralisation, all derived from a deeper magmatic source emplaced during progressive uplift and erosion (Corbett and Leach, 1998). At Lepanto, Philippines (Garcia, 1991 in Corbett and Leach, 1998), as well as Grasberg (MacDonald and Arnold, 1994) and Onto (Burrows, et al., 2020), Indonesia, the polyphasal porphyry intrusions have been emplaced into earlier diatreme breccia pipes, with local endogenous domes. The youthful Onto porphyry Cu intrusions (0.69 Ma) were emplaced into a polymictic breccia pipe (0.8Ma) which hosts younger (0.35-0.44 Ma) high sulphidation state covellite-dominate Cu-Au mineralisation (Burrows, et al., 2020; Rennison et al., in press), in the porphyry-epithermal transition. Although these workers do not record endogenous domes, the style of polymictic breccias developed within a pipe which contains uppermost bedded tuffs, is consistent with a diatreme origin. Here, the incompetent breccias may have facilitated a shallow level emplacement of the porphyry estimated to top out at paleodepth of 1250m in a reconstruction by Rennison et al. (in press). Thus, an apparent sequence of events at Onto might be: emplacement of magma source at depth -> diatreme breccia pipe eruption to surface -> porphyry emplacement with low Cu-Au grade early prograde Cu-Au mineralisation -> degassing of volatiles from the magma source which acidified and reacted with the wall rocks to provide horizontal layers of vertically zoned advanced argillic alteration -> entry of mineralised liquid phase of the ore fluid which mixed with the low pH fluids to provide the high sulphidation state covellite-pyrite ore. This has clear parallels to the Cayley Lode fluid evolution.

At Stavely, a felsite intrusion which dominates as clasts is currently the most likely driver for the diatreme breccia which is cut by the Cayley Lode and also contains clasts of chalcopyrite (photos 27 & 28), plus quartz-magnetite-chalcopyrite-pyrite (photos 31-32). Similar felsite in the Alfa 2 breccia hosts chalcopyrite-bornite ± magnetite ± epidote as an indication some phases of this intrusion are mineralised. The Cayley Lode could have formed by a two stage process, an initial pyritic D vein, followed by the Cu mineralisation which evolved in the paragenetic sequence: magnetite-haematite->chalcopyrite->bornite->chalcocite-covellite-enargite, as also recognised at the Magma vein, Arizona (Hammer and Paterson, 1968). Magnetite-bearing clasts in the Alfa 1 breccia could be related to the early second stage of this paragenetic sequence (photos 31, 32, 72), or a porphyry Cu-Au style intrusion, especially as epidote is locally present in the Alfa 2 Breccia clasts. Remarkably similar pyritic D veins with sericite wall rock selvages cross-cut the entire Thursday's Gossan district and represent the Thursday's Gossan boulders. As D veins are normally late in the paragenetic sequence of porphyry vein development, these D veins might have formed either as a late phase of the Thursdays Gossan magmatism, or within both the Thursdays Gossan and Alfa events, or solely within Alfa event. The synchronous relationship with the Alfa 1 breccias favours the latter possibility.

Emplacement of the Alfa magmatic source, as the Stavely magmatic arc underwent uplift and erosion, accounts for eruption the Alfa breccias followed by development of the Cayley Lode, sourced from fluids which migrated to the margin of a batholithic magmatic source, and then evolved as a result of the rapid rise up the dilatant Cayley flexure (figure 5). The association between the Alfa 1 breccia and Cayley Lode contributes towards clarification of Cayley Lode setting within the deep epithermal - porphyry transition. Many of the spine-like intrusions at Northparkes (Goonumbla) display a relationship to a shoulder-like steep-dipping margin to the underlying batholith, apparent on the data of Heithersay et al. (1990). Exploration should consider the possibility a porphyry Cu-Au target is also related to that Alfa-Cayley magmatic source in a manner in which the Resolution Porphyry and Magma Vein may be related to the same buried magmatic source.

Just as the Onto Cu-Au deposit in Indonesia hosts early low grade porphyry mineralisation overprinted by a fluid which deposited the covellite mineralisation, the Alfa event magmatic source at Stavely might account for emplacement of a sequence of events as: Alpha 1 diatreme breccia pipe -> speculated porphyry Cu-Au -> 2 stage Cayley Lode, although lode mineralisation was derived from the batholith rather than the porphyry (figure 5). Such an intrusion could have risen to an elevated crustal position in the incompetent Alfa 1 breccias are recognised at Onto, Lepanto and Grasberg (above). Factors to consider in the exploration of such blind intrusion could include: localisation in a most dilatant portion of the Cayley flexure discernible as well developed Cayley Lode, abundant Cu mineralisation within the overlying breccia derived from rucked up clasts and the abundance of higher level intrusions such as the flow banded dome in DDH SMD136.

The **Alfa 2 Breccias** are best illustrated by the drill intercept SMD044 at 585-690 m, although portions of nearby drill holes such as SMD047, SMD31 and SMD28 could be linked to this breccia. DDH SMD44 intersects two segments of most intense Alfa brecciation at 590-623m and 650-670m with intervening fracture controlled alteration dominated by the P3 dyke (photo 16, figure 8). The upper breccia includes an intercept of 10m @ 2.5% Cu from 583-593m in which the highest metal grades of 8.97% Cu and 1.125 g/t Au are recognised with brecciated P1 intrusion with magnetite-pyrite-chalcopyrite (photos 12, 40). This breccia displays cross-cutting relationships with dacite up-hole and possible andesite/dacite down-hole which is overprinted by phyllic alteration and contains a Cu-bearing D veins (one to 4430ppm Cu) and a magnetic microdiorite dyke. The Alfa 2 Breccia in DDH SMD044 has been emplaced within a shear at a low angle to the core axis (photo 16) in which the banded anhydrite-magnetite-haematite-pyrite-chalcopyrite-bornite lode (photo 56) is no doubt also aligned (figures 8 & 9). True width of the structurally-controlled breccia is significantly less than the drill intercept.

The less intense breccias between the two main strongly brecciated drill intercepts of the Alfa 2 breccia are dominated by a P3 dyke which displays dark green interpreted actinolite with magnetite, pyrite and local epidote and/or chalcopyrite in the form of fractures (photo 36), crackle breccias (photo 37), shears (photo 38), and dyke-like fluidised breccia (photo 39). (The interpreted actinolite has been sent for petrology, Appendix I). Selvage Kfeldspar/albite alteration may also be present. Note in these photos the strong structural control to this alteration-mineralisation consistently at a low angle to the core axis. Much of this 608-670m interval exhibits Cu anomalism of an average >1000ppm over 62m, not including the 1m @ 1.37% at 622-3m. A pyritic shear locally exhibits white low temperature sphalerite within the adjacent wall rock, with up to 1000ppm Zn, as a suggestion this intrusive mineralisation continued to a cooler stage (photo 40).

Within the strongly brecciated portions at 590-623m and 650-670m in DDH SMD044 and other nearby drill intercepts, the wall rocks become strongly sheared, with clast rotation and brecciation accompanied by introduction of the magnetic dark green alteration interpreted to contain actinolite (to be checked by petrology). A typical example of the Alfa 2 Breccia shown in photo 41 (in DDH SMD047), is characterised by clast rotation with accompanied milling and magnetite-?actinolite alteration with the introduction of disseminated, fracture and clast chalcopyrite, along with other mineralised and felsite clasts. Other examples of Alfa 2 Breccias, mainly within DDH SMD044, exhibit alteration associated with fluidised textures (photo 42) while most comprise a mix of brecciated and altered wall rock with introduced mineralised clasts (photos 41-47). The most outstanding feature of the Alfa 2 Breccia is the abundance of these rucked up milled mineralised clasts dominated by quartz with an additional mix of epidote, magnetite, chalcopyrite, bornite and specularite (photos 41-51). Many clasts display reaction rims with spongy quartz (photos 42, 43 & 45), while others include bornite-epidote (photos 7, 49 & 50). Curiously, mineralised clasts or clots are well developed within the brecciated felsite dykes (photos 7, 8 & 48) and suggest these dykes may have tapped a mineralised felsic magma source. Rucked up milled clasts are also present in the drill intercepts of Alfa 2 breccia in DDH SMD031, 044 and 047, the latter with a possible banded quartz vein clast (photo 51). An incipient quartz-chalcopyrite vein at 623.1m in DDH SMD044 (photo 52) lies adjacent to an interval of 1m @ 1.37% (622-3m) and sheeted A veins were noted in that vicinity. The P2 intrusion (photos 13, 14) is recognised mostly as breccia clasts while P2 dykes display irregular contacts with the breccia with magnetite and albite/?Kfeldspar alteration (photo 53). The P3 intrusion is discernible as a strongly brecciated, sheared and altered microdiorite in DDH SMD044, 570-590m, as a major component of a long drill intercept of Cu anomalism, 62m @ 1000ppm (photos 15 & 16). The shearing at a low angle to the core axis no doubt also controls the emplacement of the fracture-controlled alteration and lode mineralisation up hole. The P1 magnetite-haematite intrusion (photo 12; 1m @ 1.1% Cu & 279ppm Mo), lies within an interval of 10m @ 2.5% Cu at 583-594m, dominated by the magnetite-anhydrite-haematite-chalcopyrite-bornite lode (photo 53 & 54) and laminated magnetite-haematite chalcopyrite (photo 55), both developed at a low angle to the core axis in the upper portion of the Alfa 2 Breccia in DDH SMD044 (figure 6). This prograde magnetite-bearing lode displays some similarities to the Cayley Lode as early magnetite and later chalcopyrite and bornite.

The common occurrence of prograde actinolite within the Alfa 2 breccias is of particular importance as an exploration vector towards any underlying porphyry target, as it dominates in the transition between inner propylitic and potassic alteration environment for porphyry Cu-Au mineralisation (Corbett, 2019a). Paul Ashley identified actinolite in DDH SMD031 and similar alteration in DDH SMD028 appears to lie in a more distal setting with fracture controlled actinolite in DDH SMD044 with possible albite selvages (photo 58) and with an illite-kaolinite overprint in the cores of the zoned fracture alteration (photo 59). Samples of Alpha 2 breccia have been sent to Ashley to confirm the visual estimation of actinolite (Appendix I).The abundance of bornite relative to chalcopyrite within the felsic dykes in DDH SMD044 (photos 7 & 8) as also within a carbonate vein which cross cuts the in Alfa breccia in DDH SMD047 (photo 57), in this instance, suggests a higher temperature setting close to a porphyry source. Bornite in the Cayley lode is a reflection of declining pH not rising temperature. The brecciation and alteration recognised in DDH SMD044 is also identified in nearby drill ones SMD028, 031 and 047. In keeping with this distal setting, a shear in the Alfa 2 Breccia in DDH SMD028 hosts fine sulphide blebs (photo 60). Rare albite, or less likely Kfeldspar, replaces permeable and reactive clastic layers in the sedimentary sequence in DDH SMD047 (photo 61). A similar dark chlorite-magnetite-pyrite-?actinolite alteration is recognised throughout the Alfa 2 Breccia within the breccia matrix and is also common as clasts or blebs (photos 48, 50, 62-64). These clasts or blebs are also recognised in the felsic dykes (photos 7 & 8), as well as the Alfa 1 Breccia (photo 30) especially at the base of the flow banded dacite in DDH SMD136. The variant of pyrite-chalcopyrite rimmed by chlorite is present in both Alfa Breccia types (photos 28, 29, 42-47). Much of the variation in character in different drill intercepts of Alfa 2 Breccia results from the injection of fluid and clasts into different host wall rocks recognised as: andesite in DDH SMD044 (photos 36-39 & 44), dacite breccia in DDH SMD31 (photos 6, 9, 10, 49 & 50) and sediments in SDM047 (photos 62-65). Similarly, all the breccia intercepts feature fluid input on structures at a low angle to the core axis possibly becoming more distal to the source from DDH's SMD044 to SMD031 and SMD028, where a shear hosts fine milled sulphide blebs (photo 60).

The shear-like structural control to the Alfa 2 brecciation lies at a low angle to the core axis of drill holes bored on the roughly 250^o azimuth (photos 16, 36, 37, 38, 40, 56 & 60). This shear might have developed as part of the same kinematic scenario (transient sinistral strike-slip movement on the NS-NNW arc bounding structures) as the flexure that hosts the Cayley Lode. Here, the NW orientation of the Cayley flexure might vary from NW to WNW if dilation in the 44 structure is stronger that for the Cayley structure, although any SW dip remains unknown (figure 9). Continued 3D modelling should attempt to better estimate the orientation of the 44 Shear prior to continued progressive drill tests to greater depths in an attempt to identify a buried porphyry target (figure 9) associated with the magmatic source for the Alfa 2 Breccias.

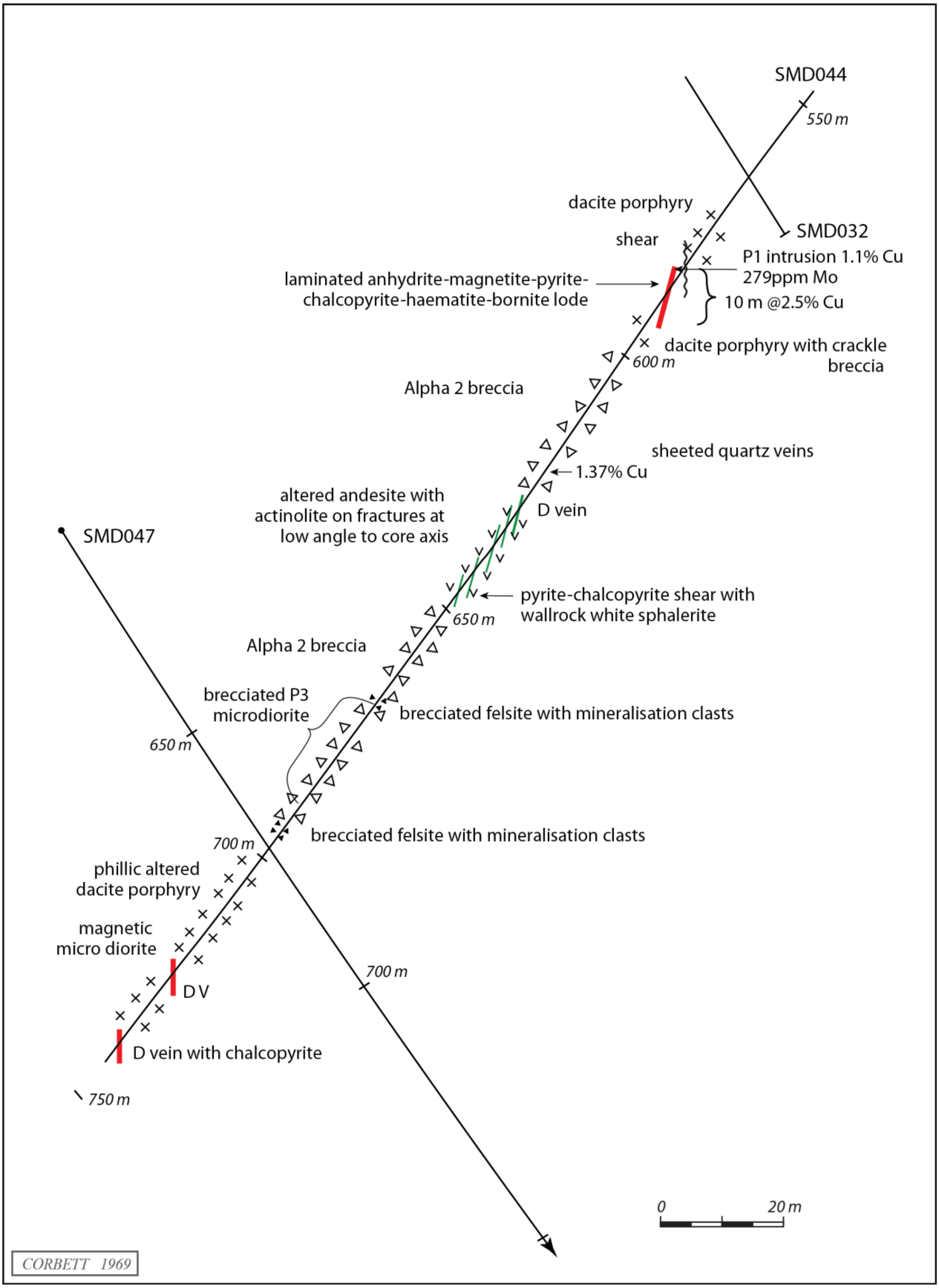

Figure 8 Intercept of the Alfa Breccia in DDH SMD044.

Alpha 2 breccia and a porphyry Cu-Au target

The presence of wall rock magnetite-actinolite alteration, developed as the transition between inner propylitic and potassic alteration, is indicative of a setting close to a heat source which may represent a porphyry Cu-Au target. The mineralised nature of this heat source is evident from the presence of several styles (P1, 2, 3 and felsite) of mineralised dykes and a significant lode. All these features are structurally controlled at a low angle to the core axis. This structural trend should be traced down-dip to target a possible porphyry Cu-Au target. Continued 3D modelling should test the interpretation herein derived, from comparison with the kinematics responsible for formation of the Cayley lode (figure 9).

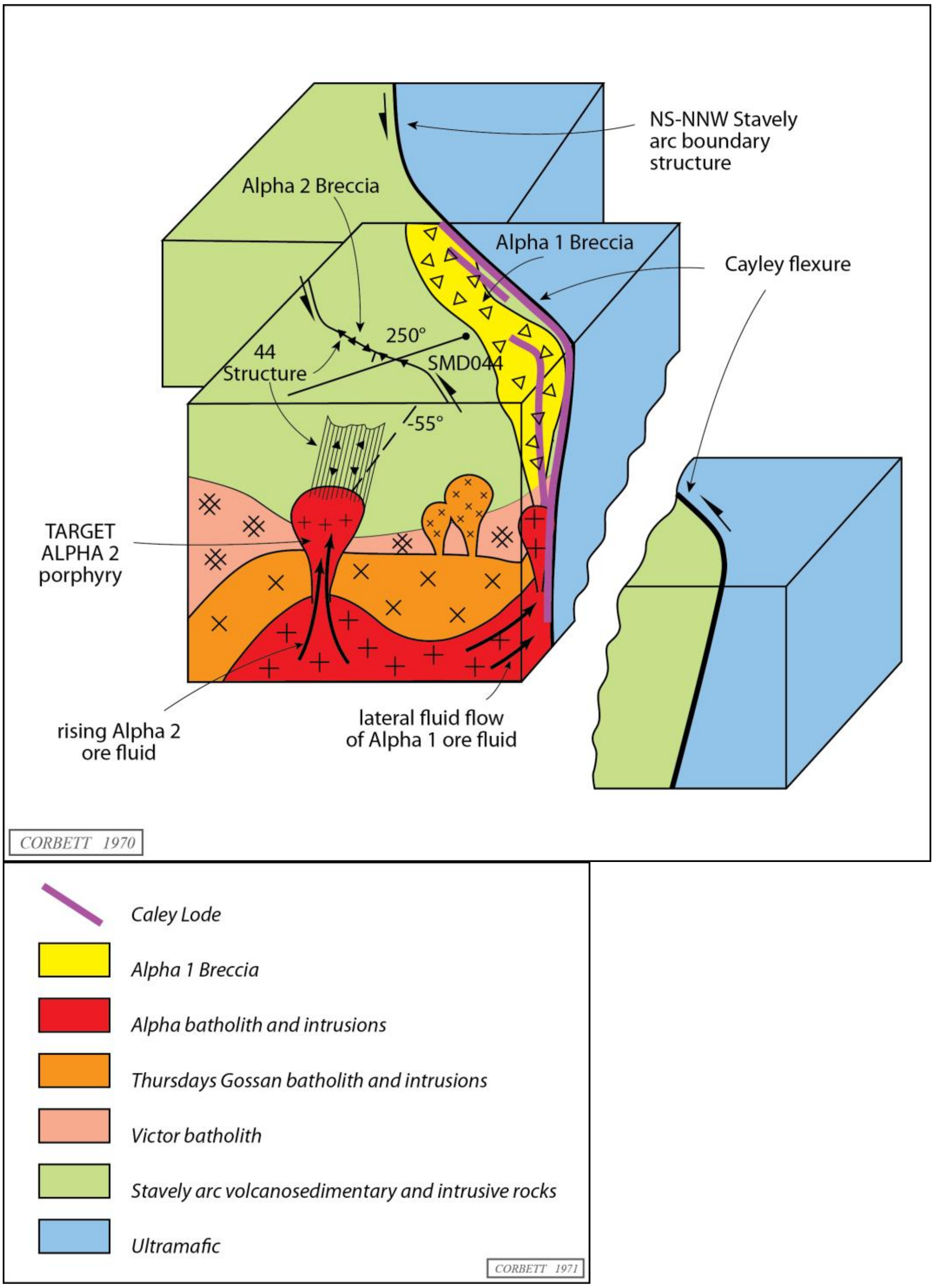

Figure 9 Sketch of some elements discussed herein illustrating the possible low angle between the dilatant 44 structure and drill holes bored into the Alfa 2 Breccia, in particular DDH SMD044.

Others

The tentative silica matrix Alfa 3 Breccia (photo 66) has been identified only in DDH SMD151, which was in progress being bored at the time of this inspection, at the southern end of the current drill program (figure 2). Here, a limited drill intercept of milled matrix breccia with dark magnetic clasts typical of other breccias contains open space fill of massive, quartz (of a low temperature appearance) with chalcopyrite and red haematite. Further work might expand on this observation.

Conclusion

The Alfa Breccia is currently considered as two main variants developed in different, but possibly linked, geological settings distinguished partly by crustal level of formation. The higher crustal level Alfa 1 Breccias are likened to phreatomagmatic breccias recognised within deeply eroded diatreme breccia pipes, typical of those which transect porphyry Cu-Au bodies after uplift and erosion, where they may vent to the surface and are therefore related to a transition to epithermal mineralisation. Erosion has removed in the order of 1 km from the upper portion of the Alfa 2 Breccia bodies which is transected by D veins and the Cayley Lode in keeping with the 'out of porphyry' (deep epithermal) setting for this mineralisation. In this setting, ore fluids migrated to the margin of a buried batholitic source and up the dilatant Cayley flexure.

The Alfa 2 Breccias have formed at greater depth localised by shearing which transects variable wall rocks. Many features such as: chalcopyrite-bearing magnetite-actinolite alteration, mineralised dykes, rucked up quartz-chalcopyrite-magnetite ± epidote clasts, as well as the anhydrite-magnetite-haematite-chalcopyrite-bornite lode and chalcopyrite-bornite vein mineralisation, all aid in the use of these breccias a vectors towards blind magmatic source. Exploration should follow the shear control to this brecciation, alteration and mineralisation down-dip to the point where this structure taps an apophysis to the magmatic source ,which may grade from a wallrock porphyry to a deeper typical porphyry Cu-Au manifestation such as at Magma-Resolution in Arizona.

Recommendations

This first pass examination of a small portion of the Stavely drill data base provides a tentative categorisation for the Alfa Breccias for modification during continued exploration.

The Alfa 1 Breccias should be relogged with a <u>priority AB</u>, in several drill sections along the 800m strike to more clearly define this rock type and delineate any variations. Some rock types such as the microdiorite should be more carefully delineated and possibly subdivided. A porphyry Cu-Au target may emerge in the root zone of the diatreme-flow dome complex

A 3D model that progressively incorporates additional drilling of the Alfa 2 Breccia should be used to trace the shear control to alteration and mineralisation down dip with a <u>priority A</u>, towards a magmatic source.

DEEP DRILL HOLES

Drill hole SMD117 lies on the same drill section as the preciously inspected DDH SMD046 (figures 2 & 10; Corbett, 2019b). This earlier work speculated that two shallow west dipping thrust faults might have been intersected by DDH SMD046 and other drill holes to the east. Although DDH SMD117 intersects an appropriate structure in the position of the upper thrust a structure and another fault which might correspond to the lower thrust, the latter zone appears parallel to the core axis and not at a high angle as might be expected in this model. The coarse grained Victor porphyry with thick barren quartz A veins and intense phyllic alteration is present at the top of both drill holes SMD046 and 117 and terminates at the position of the speculated thrust. Therefore, the speculated thrusts may be present, but the inter thrust Mo-bearing porphyry may not continue to the east. In this model the deeper crustal level tonalite has been thrust to the east and obscures underlying younger rocks.

DDH SMD117 was bored towards the east to a depth of 1712m terminating near the faulted contact with the ultramafic without an intersection of the Cayley Lode. It transects the eastern NS fault of the speculated pull-apart basin model (figures 2 & 8). Projection at 82^{o} west of this structure from the estimated surface trace, apparent on the aeromagnetic data, coincides with a significant fault in the drill core which is exploited by dacitic intrusions (1200-130m, figure 10). There is a conformable contact between amygdaloidal basalt-andesite up-hole and the laminated shale with lesser fiamme and crystal tuff and andesite 100m down hole from this fault. Therefore, the NS structure interpreted from the magnetic imagery appears to exist at depth and is exploited by intrusions. The locally brecciated amygdaloidal basalt-andesite seems consistent with a sea-floor setting. However, these rocks contain some shale and appear conformable with the more dominantly laminated shale sequence downhole. Some localised graded clastic units are interpreted as debris flows. The amygdaloidal andesite-basalt and laminated shale in the lower portion of DDH SMD117 appear typical of a deep ocean floor setting whereas extensive epiclastic rocks might have been expected within the speculated pull-apart basin model. Although exploited by intrusions, the eastern NS fault does not appear as a significant rock type geological contact, although this is not essential for the interpretation of this structure as the eastern boundary of the pull-apart basin. This structure limits the extent of epidote alteration (below), and strike slip movement of just a few metres could promote development of the speculated pull-apart basin model (Corbett and Leach, 1998).

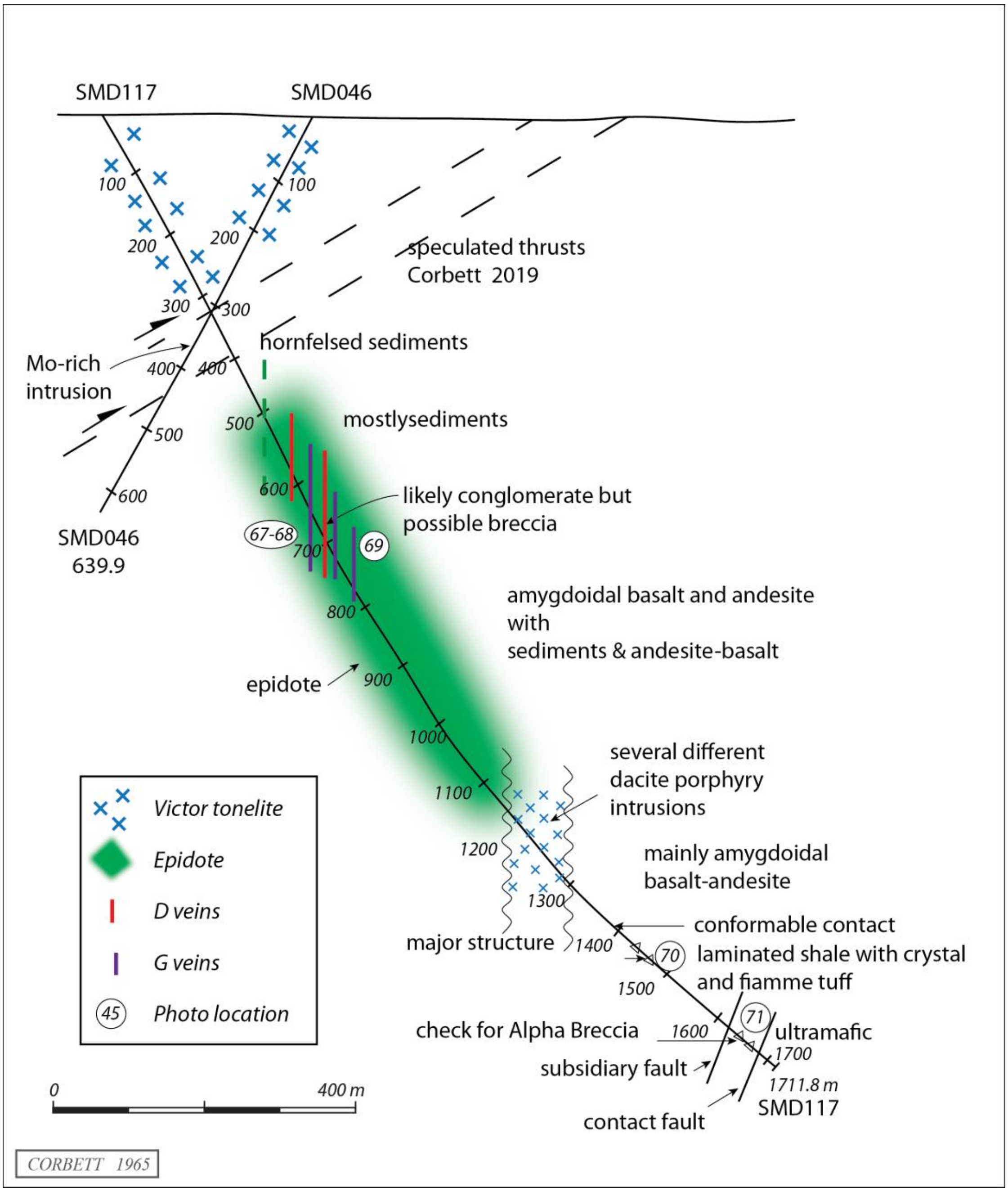

Figure 10 Cross-section through DDH’s SMD046 and SMD117.

A drill intercept in DDH SMD117, 685-695m is currently logged as epidote altered conglomerate, but may with further work be redefined as Alfa breccia (photos 67 & 68). These permeable host rocks are expected to have promoted epidote alteration within the matrix, while the intercalated sandstones have been silicified to become competent hosts for D and G veins at about 680-690m. An intercept of breccia in the immediate hanging wall of the contact between the volcano-sedimentary sequence and ultramafic from about 1640-1680m lies in a likely portion for Alfa breccia and so requires further consideration with increased understanding of these rocks (photo 71, figure 10).

Of interest is that DDH SMD117 intersects prograde inner propylitic epidote alteration and the quartz-magnetite-haematite-pyrite-chalcopyrite-anhydrite veins. In the region from 500 to 1100m down hole epidote ± magnetite ± calcite alteration is best developed as an in-fill to permeable clastic hosts (photos 67-69, figure 10). Some veins and selvages that may host actinolite, albite and chalcopyrite. One occurrence of albite may be Kfeldspar. Epidote veins become dominant in the lower portion of this intercept. No epidote was recognised downhole from the intersection with the eastern NS structure (1200-1300m). Although the orientation of the veins remains unknown, many are intersected at a low angle to the core axis. These magnetite-chalcopyrite bearing veins are likened to prograde G veins formed marginal to porphyry intrusions (Corbett, unpubl short course notes) within propylitic alteration. Numerous typical Stavely D veins with sericite selvages also occur within this zone including one at 630m with a relationship to magnetite and so possibly evolving from prograde to retrograde.

The inner propylitic alteration, characterised by mainly epidote-magnetite-calcite with local albite-?actinolite and associated G veins, is typical of features recognised marginal to porphyry intrusions (Corbett 2019a). It is recognised 400-950m below the surface, possibly obscured by a thrust fault at the upper margin and constrained by the eastern NS fault at the lower margin (figures 4 & 10). Curiously, the epidote alteration lies below the region of the soil geochemical anomaly/chalcocite blanket where it changes from aligned parallel to the Cayley Lode/ultramafic contact, to aligned NS above a magnetic anomaly adjacent to the eastern NS structure (figure 2). Continued exploration should seek to trace the extent of this alteration zone, with an emphasis upon the identification of actinolite, albite or Kfeldspar which would help to vector towards the speculated porphyry heat source. Other existing drill holes in this vicinity should first be reviewed for the presence of epidote close to end of hole.

CAYLEY LODE

An intercept of the Cayley Lode at DDH SMD106, 116-118m, which assayed 100g/t Au, was found to contain quartz with a watery appearance not unlike quartz associated with low temperature low sulphidation epithermal Au deposits. Two fluid flow trends could account for the formation of bonanza grade Au with low temperature quartz.

In fluid flow path A in figure 11, the D vein precursor of the Cayley Lode may have evolved from the low sulphidation epithermal quartz-sulphide Au ± Cu style mineralisation to low sulphidation epithermal quartz Au style mineralisation which is characterised by high grades of free Au (Corbett and Leach, 1998; Corbett, 2013 & 2021a). Many Au deposits feature early quartz-sulphide and later high Au grade epithermal quartz Au mineralisation – Lihir, PNG; Round Mountain and Sleeper USA; Emperor, Fiji; Chatree, Thailand.

The expected fluid flow for the formation of the Cayley Lode overprint on a pre-existing D vein, as also recognised in the Magma vein Arizona (Corbett, 2019b), and illustrated as path C in figure 11, features a change in the sulphidation state of the Cu sulphide minerals in association with ore fluid evolution to a lower pH as: chalcopyrite -> bornite -> chalcocite -> covellite -> enargite. Magnetite-haematite ± quartz-pyrite represents the initial stage of the overprint of the pre-existing D vein lode (photo 72). It is possible the evolved low pH fluid associated with formation of high sulphidation state Cu sulphides could have been cooled and neutralised by reaction with wall rocks to evolve from a high to lower sulphidation fluid as illustrated in fluid flow path D in figure 11. This fluid flow trend accounts for overprints of bonanza grade free Au upon many high sulphidation epithermal Au deposits such as the direct shipping ore mined at El Indio Chile in the 1970's, along with several bonanza Au deposits in such as La Zanga and Orcopampa in Peru, the Link Zone at Wafi in Papua New Guinea, while examples in Australia include the Mt Carlton Au mine and Anastasia prospect in North Queensland (Corbett unpubl. short course notes).

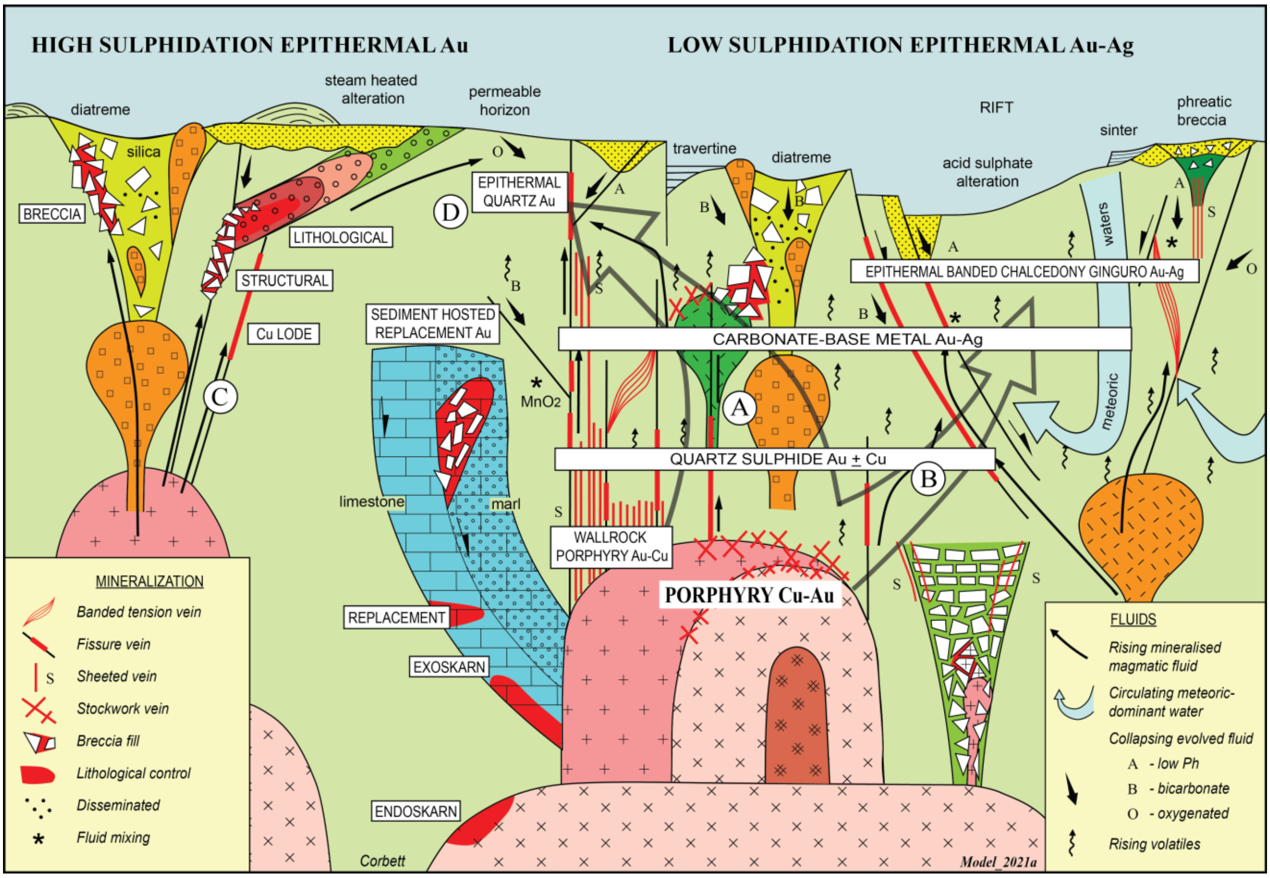

Figure 11 Possible fluid evolution paths in porphyry-epithermal systems (from Corbett 2021a, 2021b).

In conclusion the potential for bonanza Au grades associated with the Cayley Lode should not be overlooked. Anomalous Pb and Zn could be indicative of fluid evolution which commonly passes though carbonate-base metal Au mineralisation to the bonanza Au grades as recognised at Butte Montana and Mt Carlton.

PYROPHYLLITE IN DDH SMD136

Pyrophyllite has been identified mainly in the deepest portion of the flow banded dome intersected by DDH SMD136 at 167-172 m and locally up hole (figure 6). Supergene kaolinite is recognised in the upper portion marginal to the base of oxidation. Hypogene kaolinite occurs at the upper margin of this intrusion and higher temperature pyrophyllite dominates at the lower margin. They are separated by paragonite, the Na muscovite formed at a temperature range between kaolinite (<200°C) and pyrophyllite (>250°C, pH 4-5) and higher pH (>4.5), (see Corbett unpubl. short course notes). It is interpreted, fluids migrated towards the margins of the cooling flow banded dacite as it rose rapidly within the incompetent Alfa 1 breccia. SO_2-rich volatiles exsolved from the rising intrusion have taken on a low pH character, apparent as pyrophyllite in the deeper higher temperature margin and kaolinite in the shallow level, while paragonite dominates in the near neutral pH central portion of the intrusion (figure 12).

The development of pyrophyllite in the flow banded dacite may demonstrate a link to fluid evolution responsible development of the high sulphidation state Cu-sulphide minerals in the Cayley Lode. The intrusion-related fluid is anticipated to have been more volatile-rich than the liquid-dominated Cayley Lode. Fluid flow paths for advanced argillic alteration developed by the cooling and neutralisation of hot low pH fluids are illustrated in figure 12. Note also that pyrophyllite may occur within phyllic alteration and form if the moderate pH fluid responsible for phyllic alteration becomes more acid and the resulting wall rock alteration moves to the left on figure 12 as path B alteration to promote pyrophyllite formation.

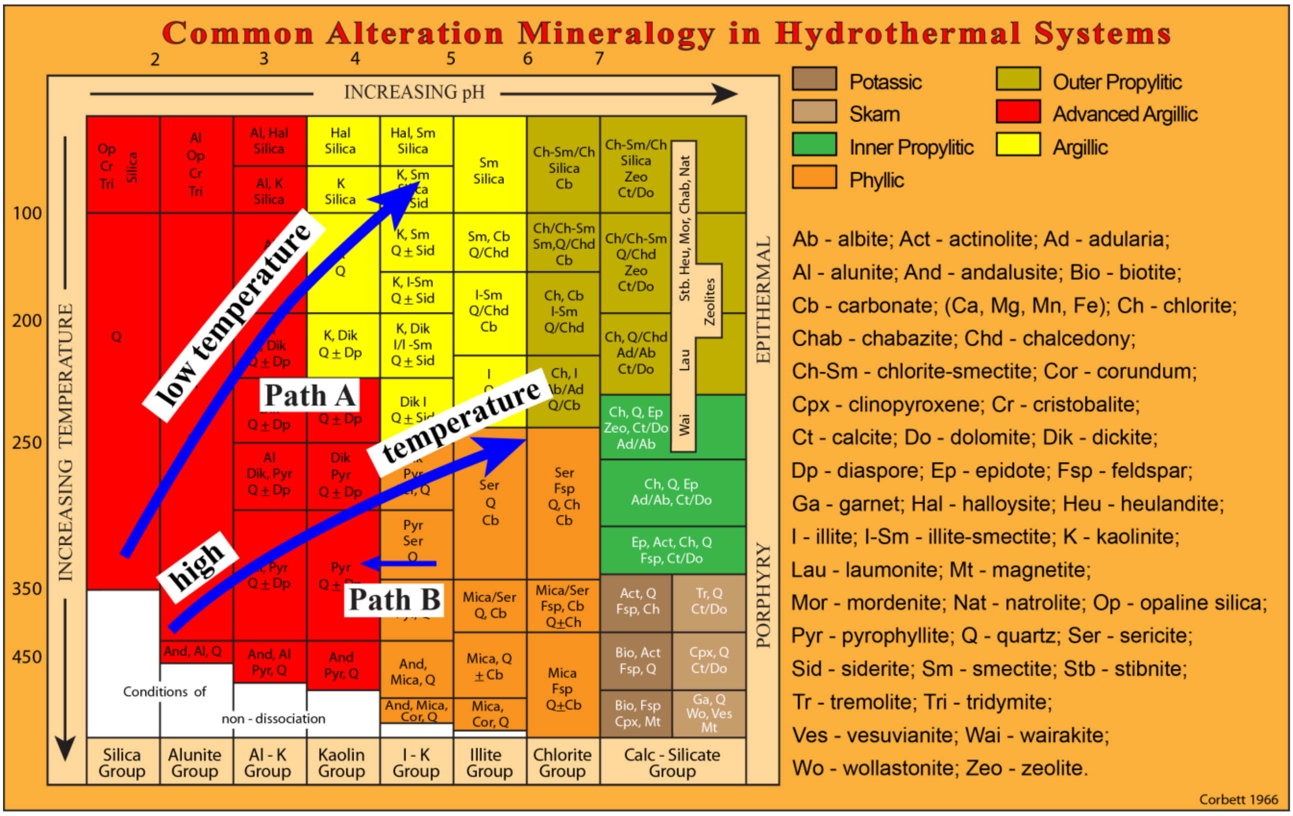

Figure 12 Fluid flow paths which account for the development of pyrophyllite in porphyry-epithermal ore deposits.

As discussed above, evolution of the hot magmatic fluid to the low pH responsible for development of the Stavely high sulphidation Cu sulphides (chalcocite, covellite, enargite, would be expected to produce some zoned advanced argillic wall rock alteration as it was cooled and neutralised by reaction with wall rocks (fluid flow path D in figure 11 and path A in figure 12). This is the typical alteration pattern of high sulphidation epithermal Au deposits. Such a trend of rising fluid pH is expected to result in the development of zoned hydrothermal wall rock alteration as a central zone of vughy silica in the drill core, locally recognised within the Cayley Lode grading laterally to alunite -> pyrophyllite -> dickite/kaolinite -> sericite/illite (Corbett, 2020). Such a process could account for the fracture-controlled pyrophyllite derived from reaction with wall rocks of a fluid in the range of 4.5-5 (figure 12), and therefore lacking alunite and not as acidic as expected for the core of typical high sulphidation epithermal Au deposits.

Alternatively, if the hot moderately acidic (low pH) fluid responsible for the development of phyllic alteration by reaction with wall rocks, and which is expected to collapse upon the porphyry system (Corbett, 2019a), best recognised in the Victor tonalite, as well as later intrusions, takes on a lower pH, then the resulting wall rock alteration may contain pyrophyllite (fluid flow path B in figure 11).

As a result some "porphyry lithocaps" contain cores of pyrophyllite with local alunite rimmed by the more extensive sericite (phyllic) alteration, such as at the giant Pebble and Resolution porphyry Cu deposits (Corbett, unpubl short course notes). The pyrophyllite lies within rocks which post-date the Victor tonalite, and could have formed during the Thursdays Gossan intrusion event, but development in association with the Cayley Lode is most likely and more proximal to the source in the microdiorite and tuff than the Alfa breccia.

CONCLUSIONS

The Alfa Breccia, developed as a magmatic hydrothermal breccia, is currently recognised as two main styles.

The Alfa 1 Breccias are recognised as milled matrix breccias characterised by numerous rounded felsite clasts and likened to phreatomagmatic breccias typical of deep level within a diatreme breccia pipe, at Stavely formed within an 800m long belt in the west of the Cayley Lode, which locally transects them and must therefore be younger, or more likely synchronous. Much of the matrix has been formed as comminuted microdiorite. Substantial erosion (in the order of 1 km) is estimated to have exposed a deep level in the Alfa 1 diatreme breccia pipe(s) evidenced by the flow banded dacite interpreted as a deep portion of an endogenous dome and collapsed blocks of bedded tuff also, considered as evidence the pipes vented to the surface. Continued geological analysis, with a priority AB, should better define these breccias and their relationship to mineralisation, especially any possible porphyry Cu-Au style intrusion that might have been emplaced into the breccia root zone, as recognised at the Onto deposit, Indonesia and FSE porphyry, Lepanto, Philippines.

The geological setting of the Cayley Lode continues to be likened to the Magma vein Arizona and the dilatant flexure remains prospective to depth.

The Alfa 2 Breccias based upon the type section in DDH SMD044, but also apparent in other nearby drill holes, formed as an injection of magnetite-rich magmatic fluid along a shear (the 44 structure) at a low angle to the core axis to form a variety of breccias with associated actinolite, chalcopyrite and numerous rucked up clasts of quartz vein material with mixes of magnetite, pyrite, chalcopyrite, bornite and epidote. The four types of dykes recognised to date with magnetite-chalcopyrite mineralisation, along with a anhydrite-magnetite-haematite-pyrite-chalcopyrite-bornite lode, also developed at a low angle to the core axis, all also testify to a likely mineralised magmatic source. Continued exploration, with a priority A, should seek to follow the localising shear to depth in an attempt to identify the magmatic source for this breccia. The geological setting of this target is speculated to be similar to the Resolution porphyry, Arizona overlying at a possible apophysis to the buried batholitic magma source. Similar kinematic conditions to the sinistral strike-slip movement on arc-parallel structures recognised for the Cayley Lode, may have focused fluid flow in the 44 structure.

The current model is proposed that the Stavely magmatism continued within the Thursdays Gossan region of the Stavely Magmatic Arc during progressive uplift and erosion. The earliest now uplifted deeply eroded batholitic Victor Mo-rich tonalite porphyry with intense phyllic alteration, is overprinted by the suite of Thursdays Gossan diorite and dacites culminating in the quartz-magnetite vein-bearing quartz diorite porphyry. Compression has locally thrust portions of the Victor over younger rocks and obscured evidence of alteration and mineralisation such as the alteration intersected at depth in DDH SMD117. The Cayley Lode and Alfa 1 Breccias have developed from fluids which ponded at the margin of the speculated buried Alfa Batholith and were focused into the Cayley flexure. By contrast the fluids responsible for the Alfa 2 Breccias are speculated to have ponded at an apophysis in the buried batholithic source and been tapped by the 44 structure. At the giant Rio Blanco-Los Bronces Cu breccia system (estimated 30 BT @ 0.63-

0.90% Cu) Irarrazaval et al. (2010) record a similar sequence of overprinting porphyry-related magmatism with a later phase of the polyphasal San Francisco batholith accounting for most of the metal deposition.

Similar fluid evolution is recognised at the Cayley Lode to Magma, Butte, Onto and other occurrences, to produce the zoned high sulphidation Cu sulphide ores (Corbett, 2019b, 2021). As the Cayley Lode, including the early D vein stage, cuts the Alfa 1 Breccias, the typical pyritic D veins with sericite selvages which are common throughout the Thursdays Gossan district, and indeed weathered to form the Thursday's Gossan surficial boulders, might now be considered to have developed as part of the Alfa event rather than as a late stage of the Thursday's Gossan magmatism, as previously considered.

The deep drill hole SMD117 bored for 1,712m into the speculated pull-apart basin and crossing bounding eastern north-south fault. This drill hole bores below a slice of Victor tonalite thrust to the east over younger Thursday's Gossan intrusions rocks recognised in DDH SMD046 and intersects the eastern bounding north-south fault at 1200-1300m depth where it is exploited by dykes. The negligible change in rock types across this structure argues against any substantial offset on this structure, which is in keeping with strike-slip activation in the pull-apart basin model. However, the rock sequence through much of this drill hole is more typical of a quiescent deep ocean floor setting rather than epiclastic rocks which might be expected in a down-dropped pull-apart basin. Of interest is that below thrusted Victor cover rocks, DDH SMD117 bores down through a 350m wide zone of inner propylitic epidote-magnetite-carbonate alteration which contains a 100m wide package of prograde G veins of magnetite-haematite-pyrite-chalcopyrite-anhydrite as well as typical Stavely D veins. These width estimates on this section are unconstrained as the orientation to the alteration and mineralisation remains unknown (figures 2 & 10). This drill intercept might be derived from NS trending alteration and prograde mineralisation responsible for the NS portion of the chalcocite blanket. This NS region should be evaluated as a drill target with a priority B.

The possibility cannot be ruled out that the 100g/t Au intercept in DDH SMD106 resulted from fluid evolution similar to that which accounts for the development of bonanza Au grades in several Au mines. Stavely minerals should investigate any other isolated high grade Au intercepts, for the ability to develop into interesting targets.

Pyrophyllite within the flow banded dacite dome intersected in DDH SMD136 reflects evolution of the volatile component of magmatic fluids as the dome rose rapidly within the dilatant Cayley flexure and hosted by the incompetent Alfa 1 Breccias.

RECOMMENDATIONS

The Alfa 2 Breccias should be used, with a priority A, as vectors towards porphyry or related mineralisation by construction of a 3D model which will aid in tracing the 44 structure shear which localises alteration and mineralisation in DDH SMD044 and other nearby drill holes down dip to a drill target.

Relogging, with a priority AB, of several drill sections across the 800m strike length of the Alfa 1 Breccias and associated intrusions may aid in a better understanding or this rock group and its significance to exploration. The microdiorite, which is interpreted to have been milled as a common breccia matrix (DDH SMD146), may require subdivision, and relogging should tabulate any additional occurrences of flow banded dacite such as the interpreted eroded endogenous dome in DDH SMD136.

This relogging might also consider to model proposed herein that the igneous rocks can be attributed to three eras. On the other hand rocks grouped as microdiorite appear to require further subdivision.

Continued (wide spaced) exploration, with a priority A, should test the Cayley Lode at depth, both in order to plan exploration of an underground target, and also to trace that mineralisation to depth. Conceptually, one possibility is that the Cayley fluid could pass down to a magnetite-pyrite-chalcopyrite-bornite±haematite±anhydrite ore as a lode, such as recognised in DDH SMD044, or sheeted wallrock porphyry style vein system (Cadia East) prior to a possible underlying porphyry Cu-Au intrusion (as at Resolution). Here, Au-hosting bornite might be developed at a high temperature rather than lower pH as in the Cayley Lode. Transient sinistral movement on the arc bounding structures could have provided the trigger for Alfa 1 Breccia formation and bled ore fluids ponded at the margin of the cooling low grade batholitic source into the dilatant flexure to form the Cayley Lode.

The epidote alteration intersected in DDH SMD117 at a depth continuing from 500m below the surface, should be considered, with a priority B, as a propylitic alteration vector towards buried hypogene mineralisation that might represent the source of the north-south arm of the surficial chalcocite ore. An initial test should be designed to plan any ongoing exploration.

A suite of just 10 samples have been submitted for petrology (Appendix I) but more are possible. The dark green-pyrite alteration warrants further consideration in the next batch of samples as it might not be as well represented in this batch as expected. The primary focus of this petrology has been to verify the field identification of actinolite and more clearly define the P1-3 intrusions recognised in DDH SMD044.

Consideration could be given, with a priority B/C, to completion of some background geology that is not part of the exploration program such as:

- Construction of an updated regional alteration map to replace that of Spencer (1996). This might include reference to the epidote alteration in DDH SMD117 and pyrophyllite in DDH SMD136.
- This first pass paragenetic sequence of events should be tested and refined.
- A program of age dating might provide a better analysis of the events discussed herein.

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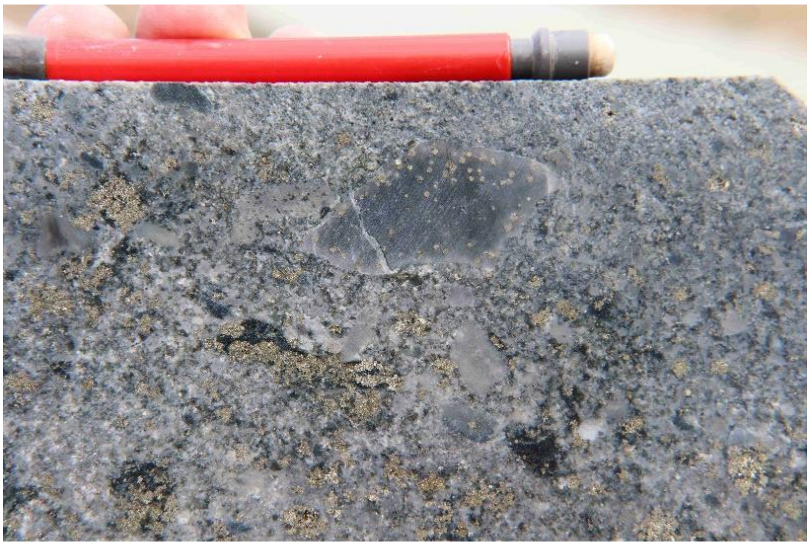

Photo 1 Alfa 1 breccia formed by a mix of altered comminuted rock clasts, including pink felsite with hydrothermal pyrite, DDH SMD146, 178.1m.

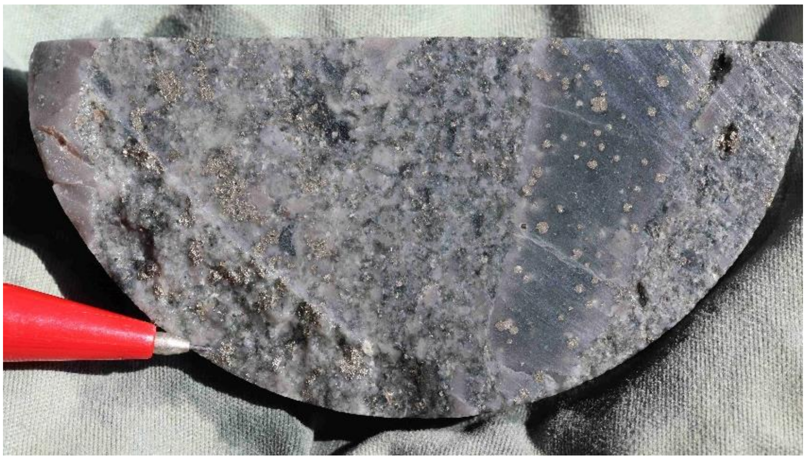

Photo 2 Slice of the above sample showing the felsite clast submitted for petrology from Alfa 1 breccia, DDH SMD146 178.1m.

Photo 3 Alfa 1 breccia formed by a mix of altered comminuted rock clasts, including pink felsite, probable microdiorite with the addition of hydrothermal pyrite, DDH SMD146, 178.1m.

Photo 4 Alfa 1 breccia with pink felsite clasts, a pale silicified ultramafic clast and bedded tuff, DDH SMD131, 76.7m.

Photo 5 Felsite clast within Alfa 1 breccia dominated by angular silicified felsite clasts, DDH SMD131, 74.8m.

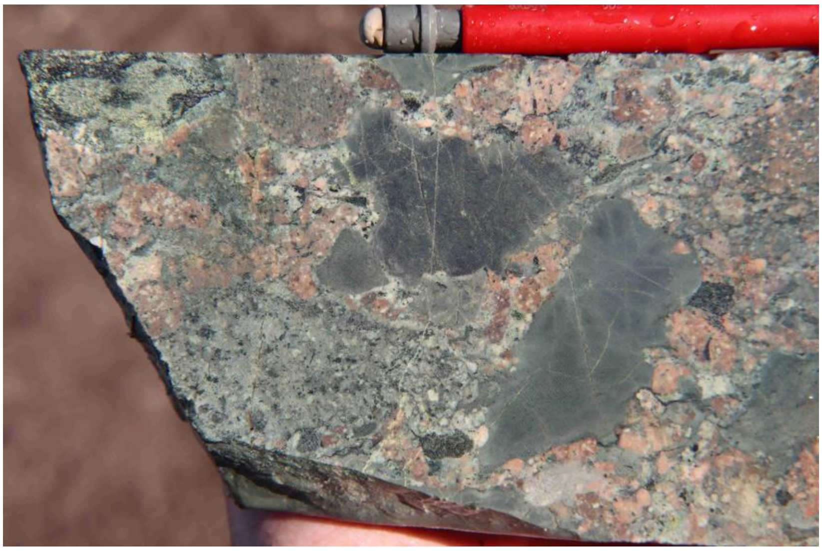

Photo 6 Ragged and embayed fine grained black felsite clasts in Alfa 2 breccia, DDH SMD31, 81.4m.

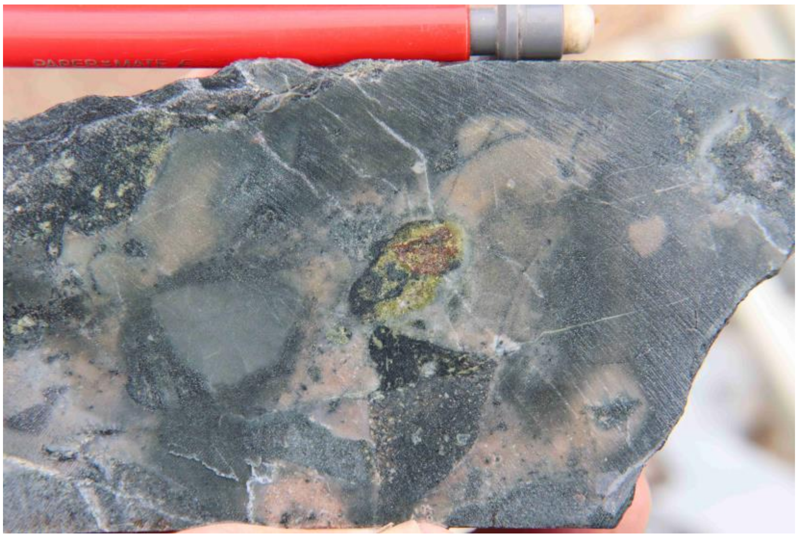

Photo 7 Brecciated felsite dyke within the Alfa 2 breccia with clasts of bornite-epidote and dark magnetite-actinolite alteration, SMD44, 596.5m, 740ppm Cu.

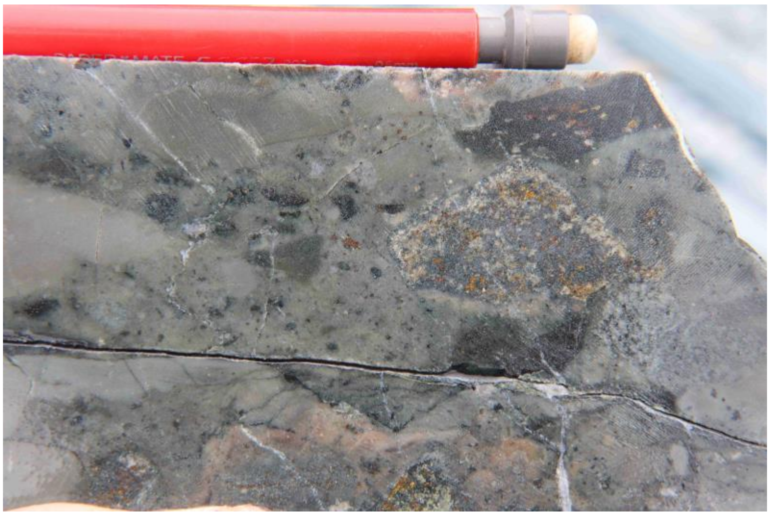

Photo 8 Brecciated felsite dyke within the Alfa 2 breccia with clasts of sulphide-magnetite and the magnetite-actinolite alteration, SMD44, 596.5m, 740ppm Cu.

Photo 9 Ragged and embayed fine grained black felsite clast in Alfa 2 breccia, DDH SMD31, 100.8m.

Photo 10 Dacite clasts within Alfa 2 breccia including a large ragged clast, DDH SMD31, 80m.

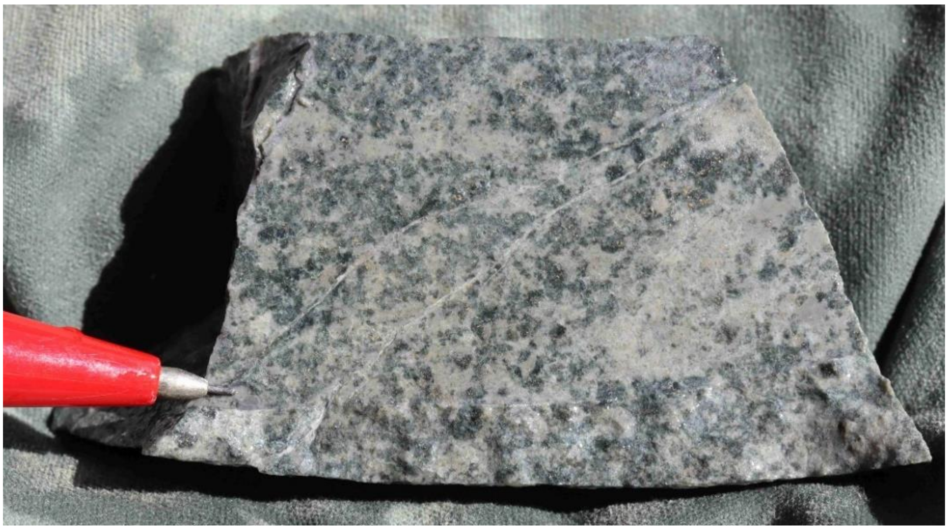

Photo 11 Petrological sample of microdiorite from the Alfa 1, DDH SMD136, 47.4m.

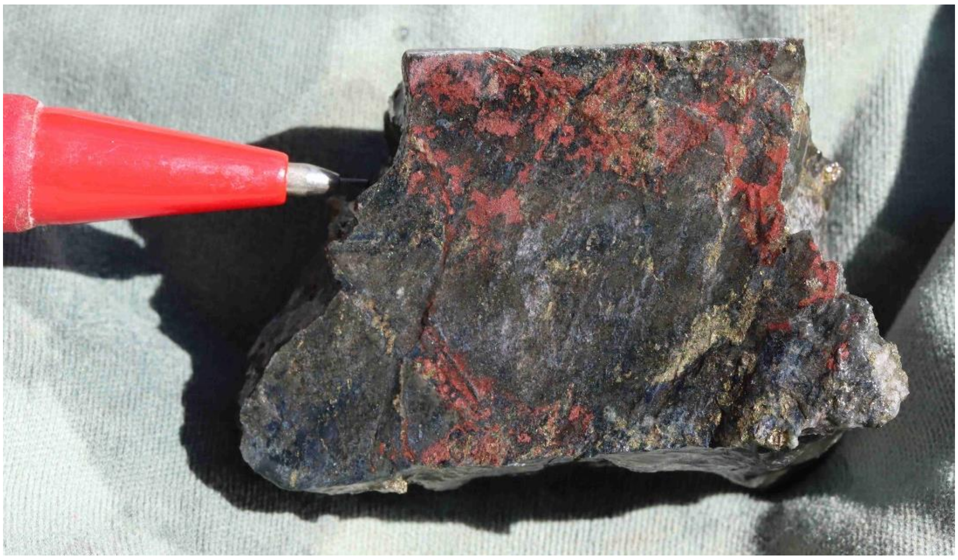

Photo 12 Chip of P1 intrusion showing magnetite-haematite-chalcopyrite alteration, DDH SMD44, 583.1m, 1.11% Cu and 279ppm Mo.

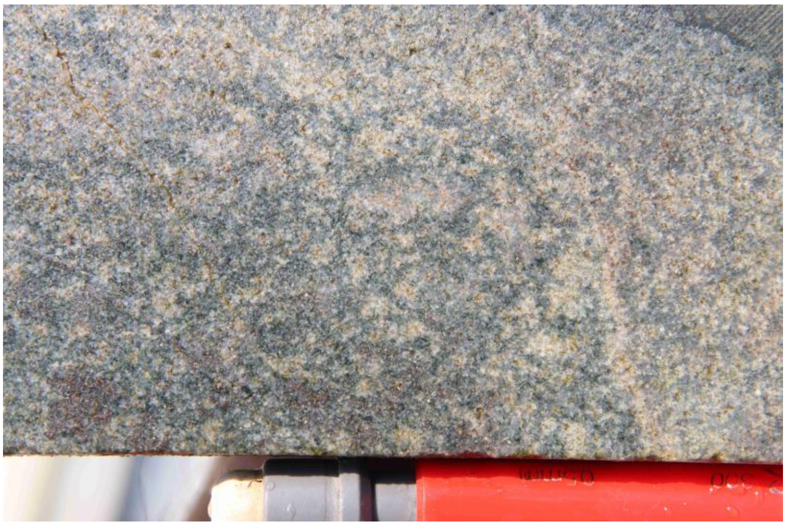

Photo 13 P2 intrusion showing pink ?albite alteration along with magnetite and chalcopyrite, DDH SMD44, 604.1m, 2600ppm Cu.

Photo 14 P2 intrusion with disseminated magnetite-chalcopyrite and a ?albite-chalcopyrite vein, DDH SMD44, 657.3m, 1210ppm Cu.

Photo 15 Brecciated P3 intrusion with a matrix of magnetite-?actinolite, DDH SMD044, 671.9m.

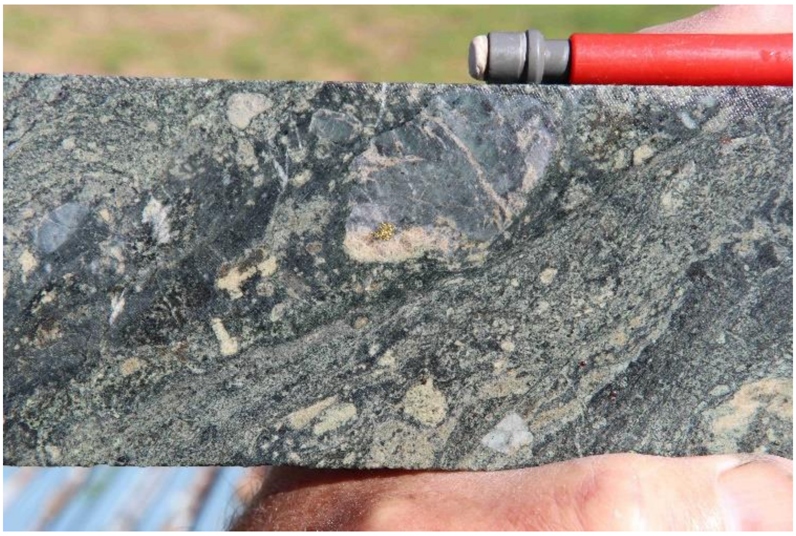

Photo 16 Sheared P3 intrusion with mineralised silicified clast, DDH SMD044, 673.8m.

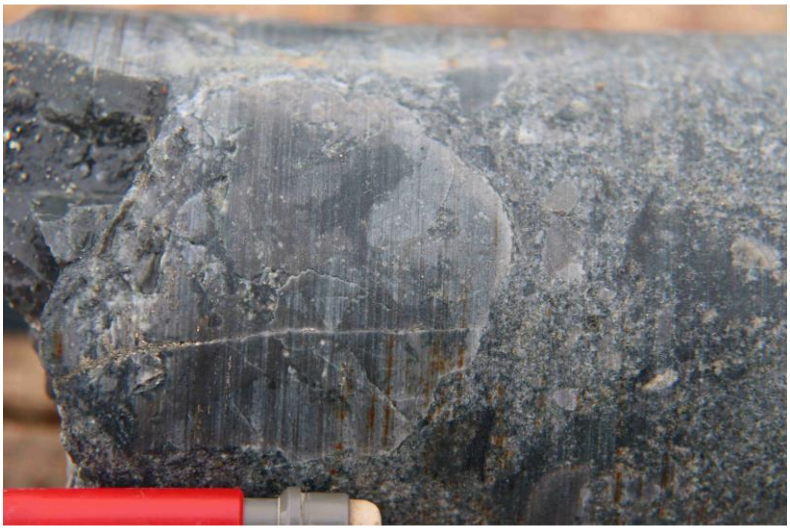

Photo 17 Rebrecciated clast in an Alfa 1 breccia, DDH SMD146, 146.2m.

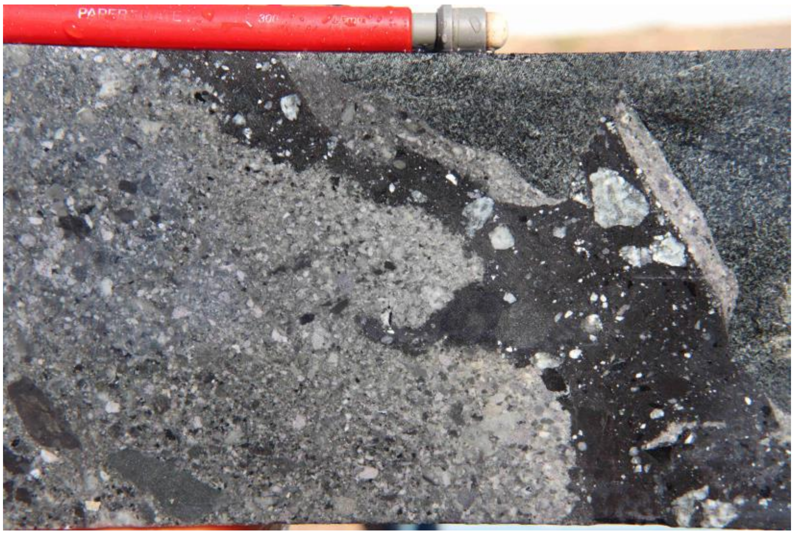

Photo 18 Fine grained milled matrix style Alfa 1 breccia cut by fluidised breccia dyke of milled sedimentary and felsite material, DDH SMD 105, 286m.


Photo 19 Contact between two Alfa 1 breccia bodies, DDH SMD146. 149.9m.

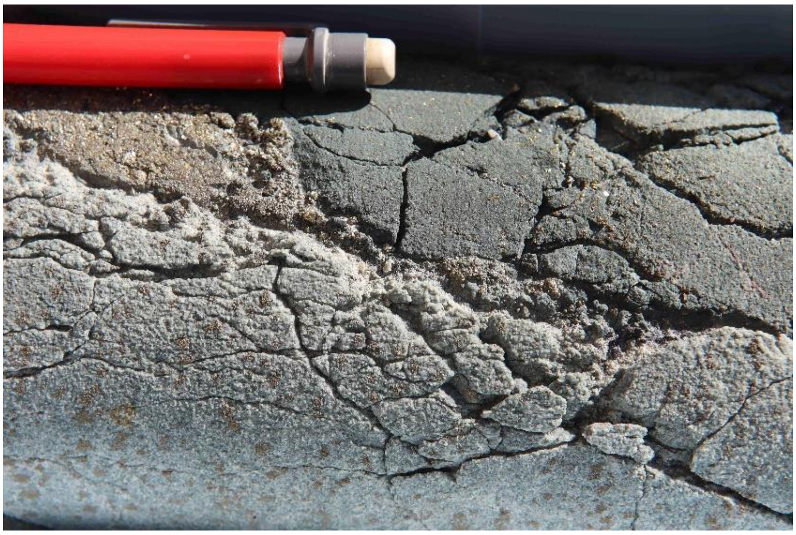
Photo 20 Contact between two Alfa 1 breccia bodies which has been exploited by a D vein, DDH SMD131, 80m.


Photo 21 Contact between two Alfa 1 breccias, with a possible bedded tuff to the right, DDH SMD105, 290.7m.

Photo 22 Disrupted bedding in wall rocks adjacent to an Alfa 1 breccia pipe, DDH SMD105, 307.8m.

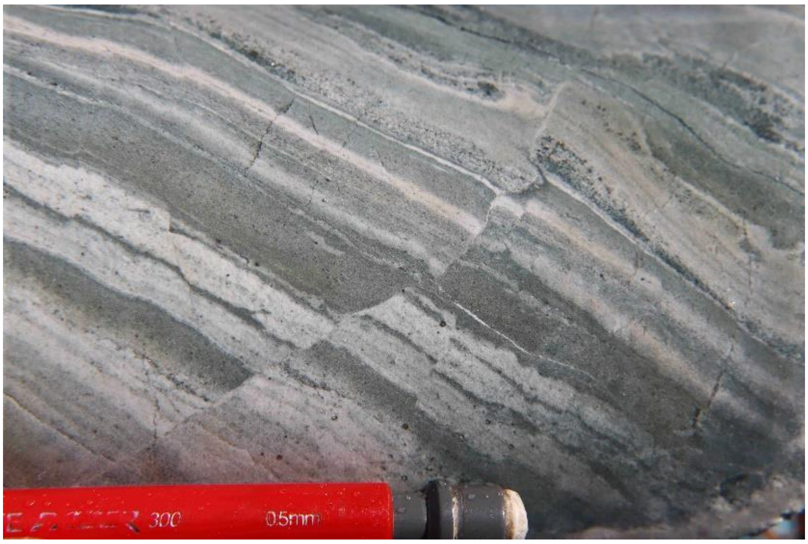

Photo 23 Bedded tuffaceous Alfa 1 breccia showing the green and white layers as well as hydrothermal pyrite, DDH SMD146, 123.2m.

Photo 24 Bedded green and white tuffaceous Alfa 1 breccia possibly grading upwards from upwards right to left, DDH SMD146, 131.5m.

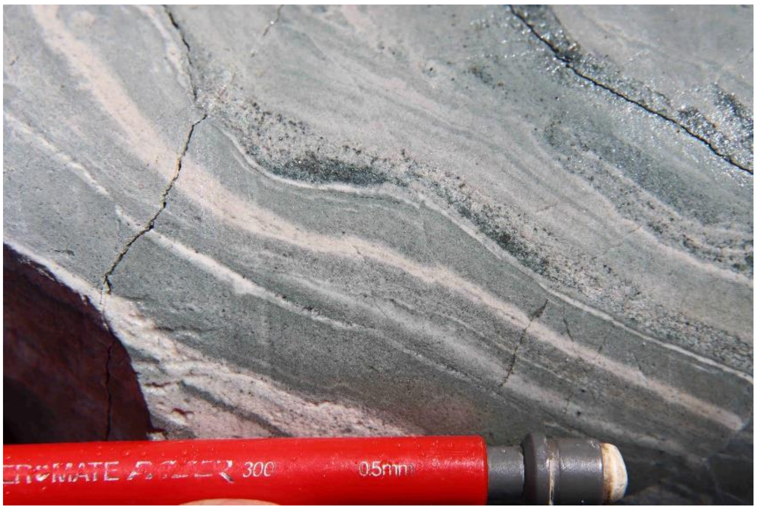
Photo 25 Bedded tuffaceous Alfa 1 breccia showing the green and white layers as well as hydrothermal pyrite, DDH SMD146, 123.2m.

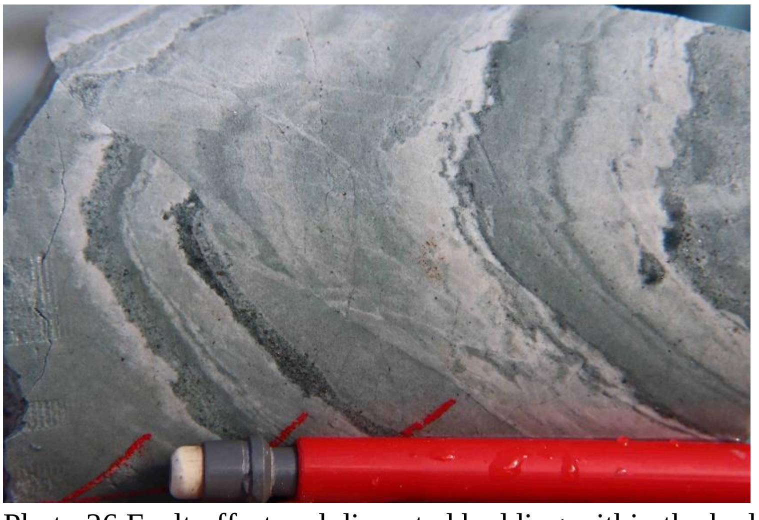
Photo 26 Fault offset and disrupted bedding within the bedded green and white tuffaceous Alfa 1 breccia, DDH SMD146, 123.5m.

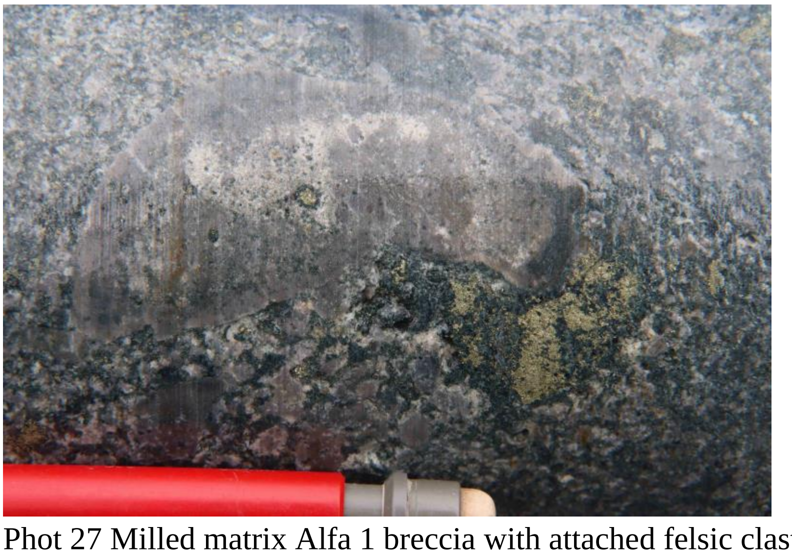
Phot 27 Milled matrix Alfa 1 breccia with attached felsic clast and chalcopyrite rimmed by green chlorite alteration, DDH SMD146, 146.7m.

Photo 28 Milled matrix Alfa 1 breccia with chalcopyrite rimmed by green chlorite alteration, DDH SMD146, 147.4m.

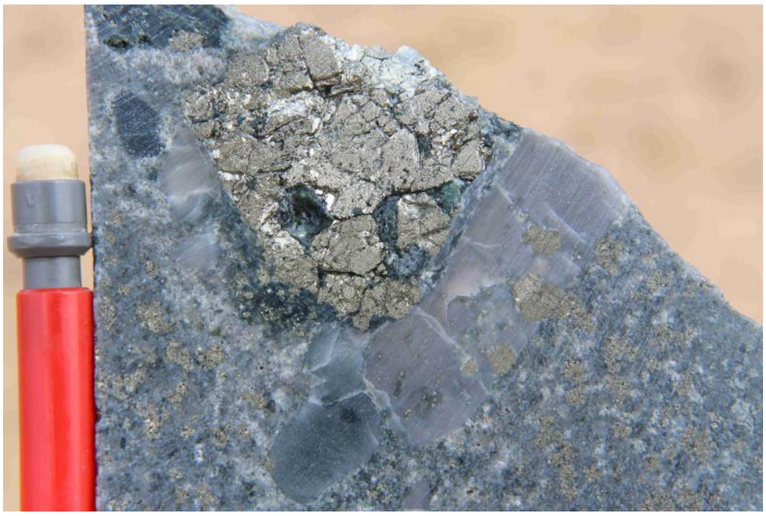

Photo 29 Alfa 1 breccia with a clast taken to be pyritic D vein as well as felsite clast, DDH SMD146, 178.6m.

Photo 30 Alfa 1 breccia with clasts of felsite and the dark magnetite-?actinolite-pyrite alteration, DDH SMD146, 144.6m.

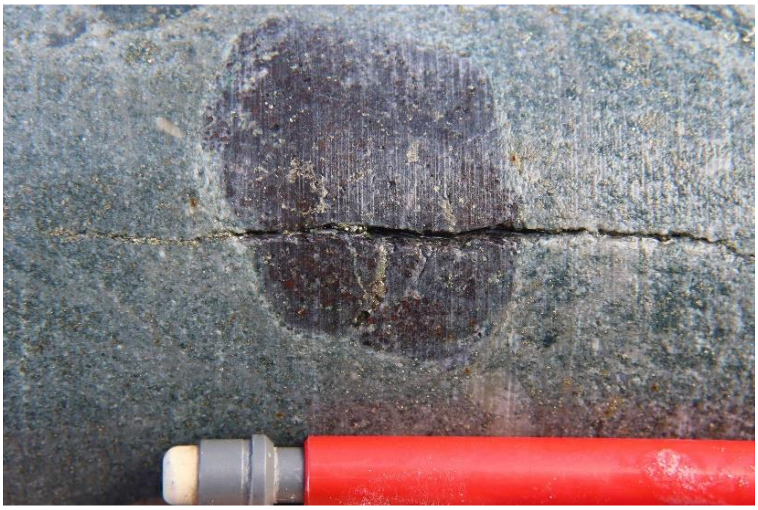

Photo 31 Milled quartz-magnetite-chalcopyrite clast in Alfa 1 breccia, DDH SMD146 144.6m.

Photo 32 Subangular quartz-magnetite-chalcopyrite clast in Alfa 1 breccia, DDH SMD146, 152.5m.

Photo 33 Milled clast of silicified ultramafic with fuchsite alteration in Alfa 1 breccia, DDH SMD131, 74.4m.

Photo 34 Clasts of felsite and silicified ultramafic in Alfa 1 breccia, DDH SMD131, 74m.

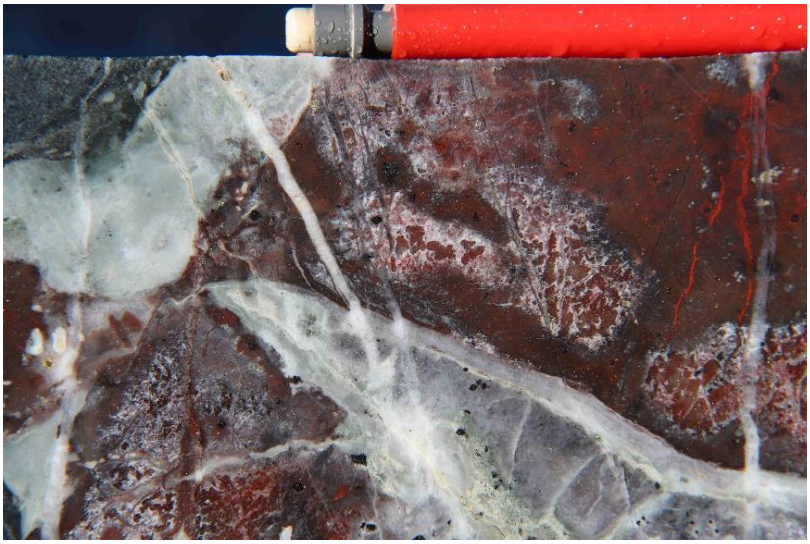

Photo 35 Massive silicification of ultramafic rock with relict chromite grains apparent in the clear quartz in the bottom portion of the photo, DDH SMD132, 231.4m.

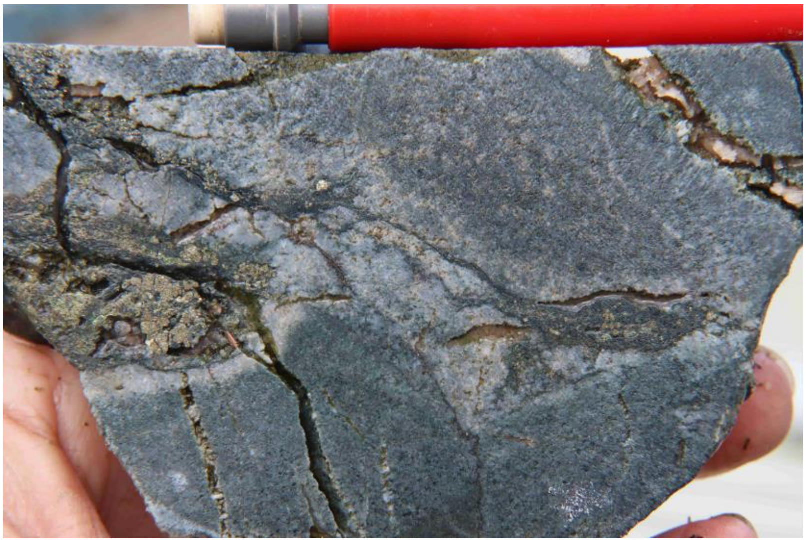

Photo 36 DDH Actinolite-pyrite fill fracture and clast or bleb of sulphide within Alfa 2 breccia, DDH SMD44, 606.9m, 9530ppm Cu.

Photo 37 Dark green ?actinolite-bearing fluidised breccia within the Alfa 2 breccia, DDH SMD44, 634.4m, 2380ppm Cu.

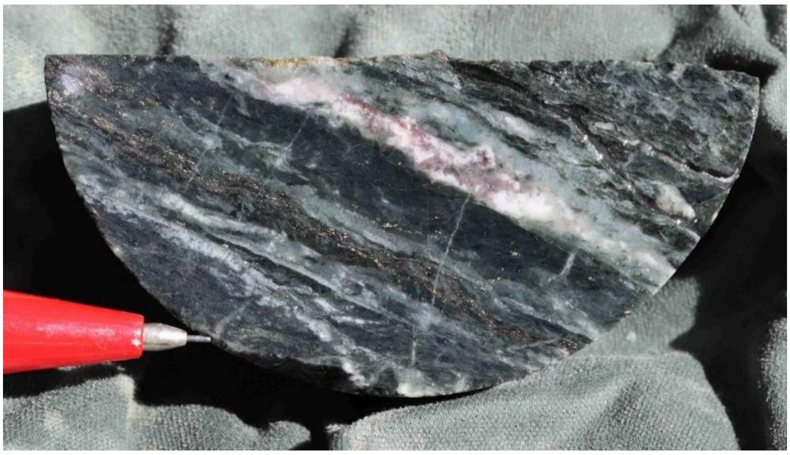

Photo 38 Alfa 2 breccia with a green possible actinolite-bearing, here with a rare quartz-feldspar vein, DDH SMD044, 608.4m.

Photo 39 Green fluidised breccia dyke with chalcopyrite in Alfa 2breccia, DDH SMD44, 689.7m, 2970ppm Cu.

Photo 40 Pyritic shear with Fe-poor low temperature white sphalerite within the adjacent magnetite-epidote-actinolite altered wall rock (top), DDH SMD44,646.7m.

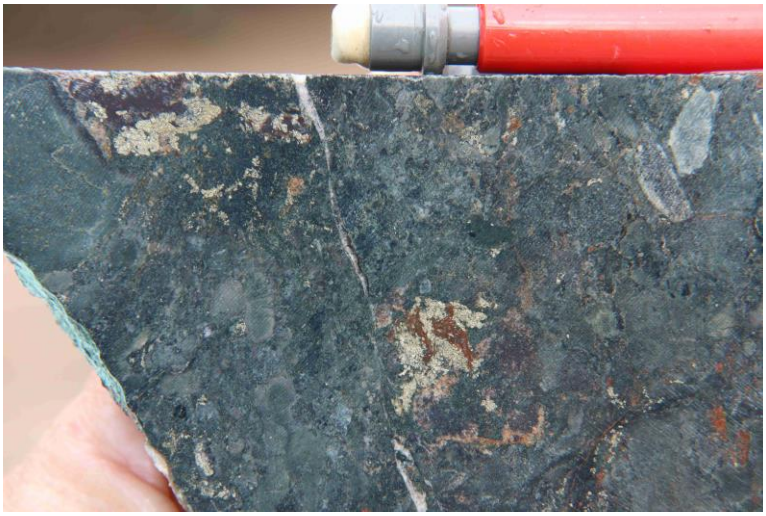

Photo 41 Alfa 2 breccia which comprises clasts of milled and altered wall rock and pyrite-magnetite-haematite, DDH SMD47, 778m.

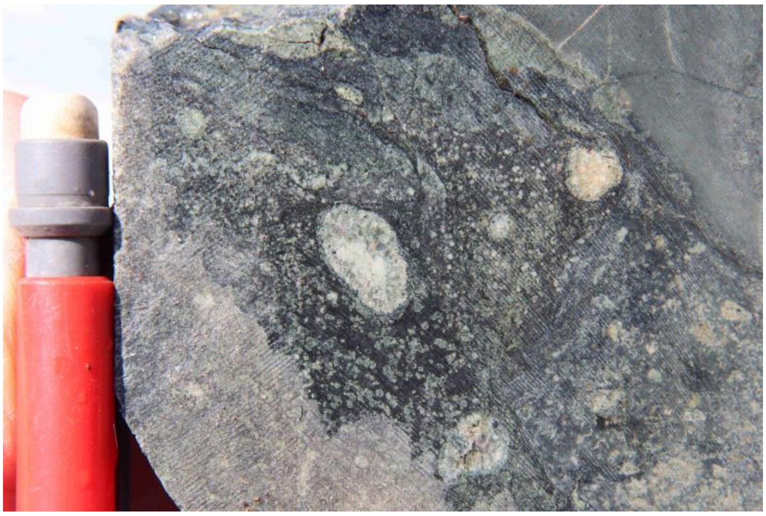

Photo 42 Dark fluidised breccia within Alfa 2 breccia which contains quartz clasts with prominent reaction rims, DDH SMD44, 668.9m

Photo 43 Fluidised portion of Alfa 2 breccia reaction rimmed quartz as well as chalcopyrite clasts, DDH SMD44, 675.6m, 3720ppm Cu.

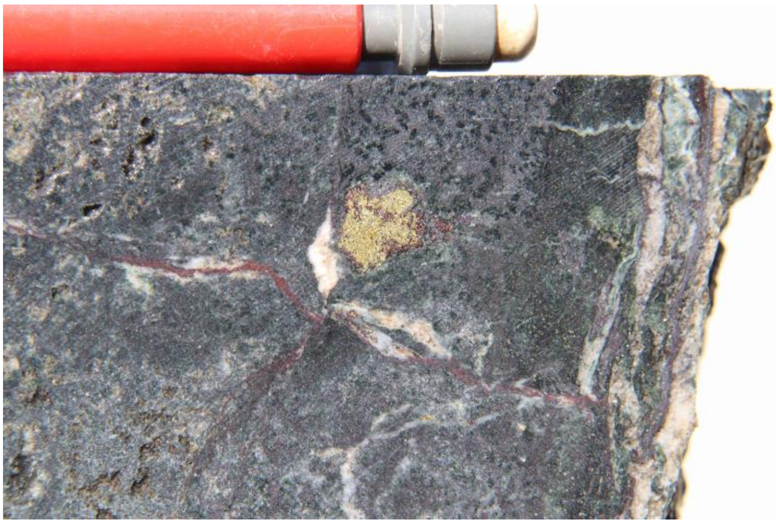

Photo 44 Clast of chalcopyrite-bornite within Alfa 2 breccia, DDH SMD44, 670.5m, 1170ppm Cu.

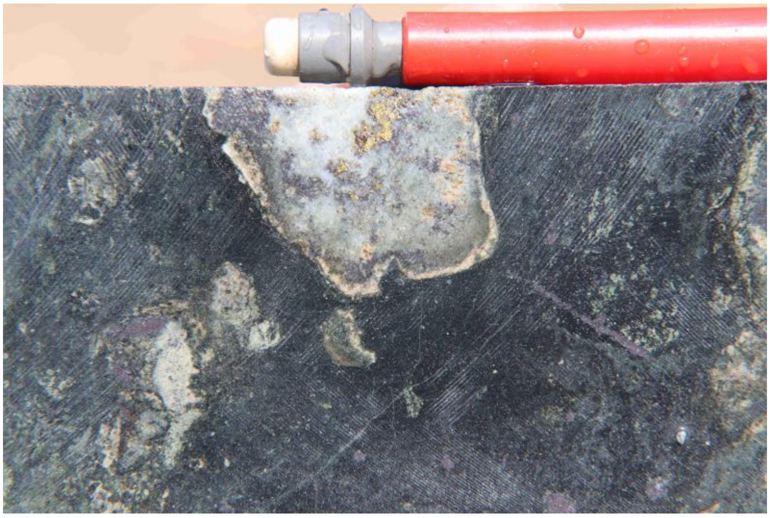

Photo 45 Alfa 2 breccia with quartz-magnetite-chalcopyrite clast with a reaction rim DDH SMD44, 671.4m, 5460ppm Cu.

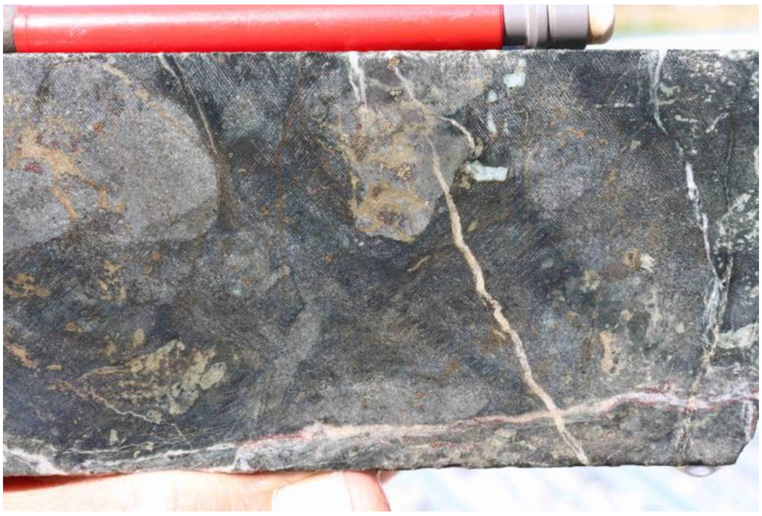

Photo 46 Alfa 2 breccia with clast of quartz-magnetite-chalcopyrite and small quartz-chalcopyrite B style porphyry quartz veins. DDH SMD44, 613.1m.

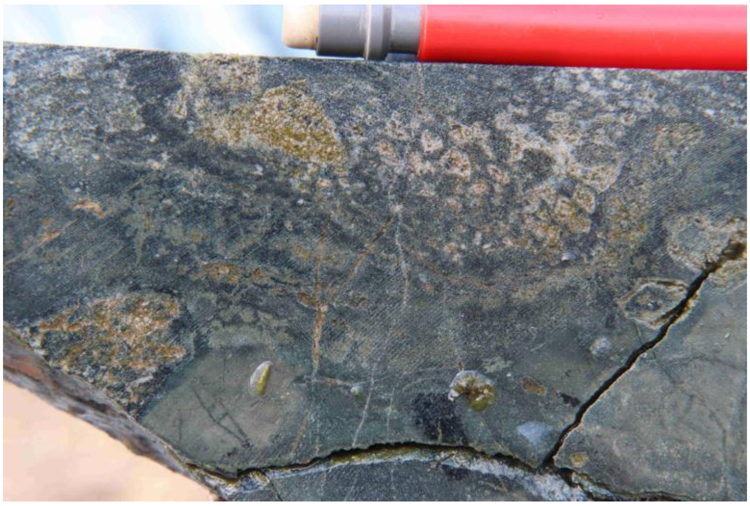

Photo 47 Alfa 2 breccia dominated by green altered wall rock and magnetite-sulphide clasts, DDH SMD44, 605.1m, 3020ppm Cu.

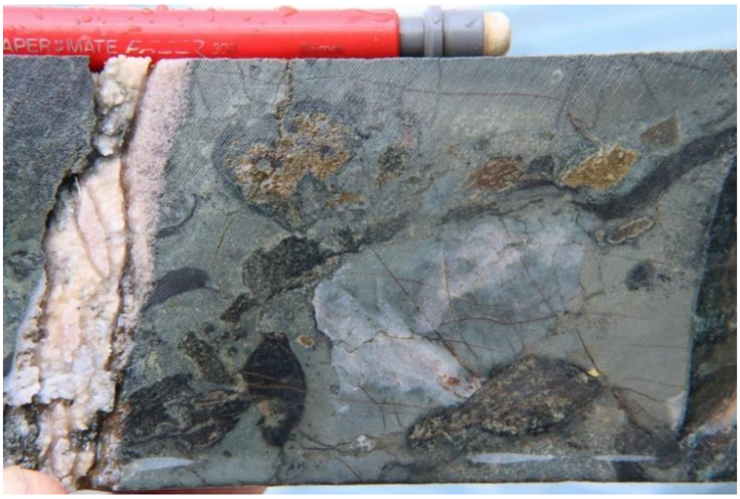

Photo 48 Alfa 2 breccia, with a mix of silica, sulphide and dark green magnetite-pyrite altered clasts cut by a rhodochrosite vein, DDH SMD44, 601.1m, 970ppm Cu.

Photo 49 Magnetite-bornite-epidote clast injected into dacite-dominant Alfa 2 breccia, also shown as the other side of the core in photo 50, DDH SMD31, 76.9m.

Photo 50 Magnetite-epidote clast injected into dacite-dominant Alfa 2 breccia, also shown as the other side of the core in photo 49, DDH SMD31, 76.9m.

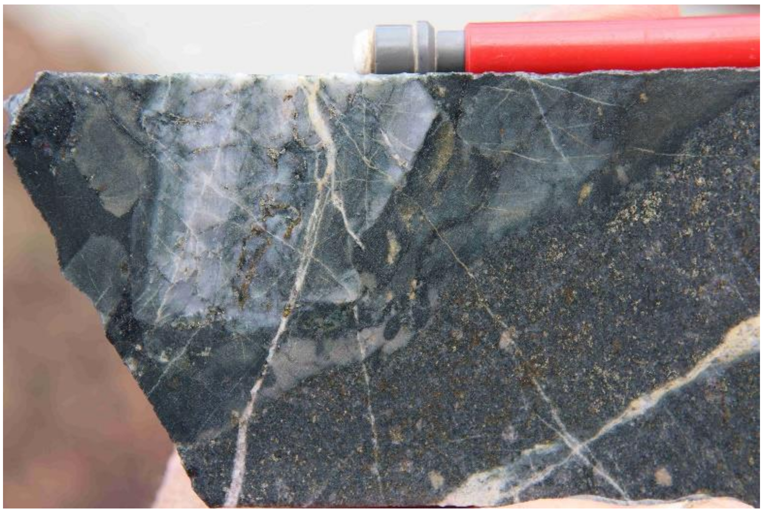

Photo 51 Clast of laminated sulphide-bearing porphyry style quartz vein in polyphasal Alfa 2 breccia, DDH047, 783.9m.

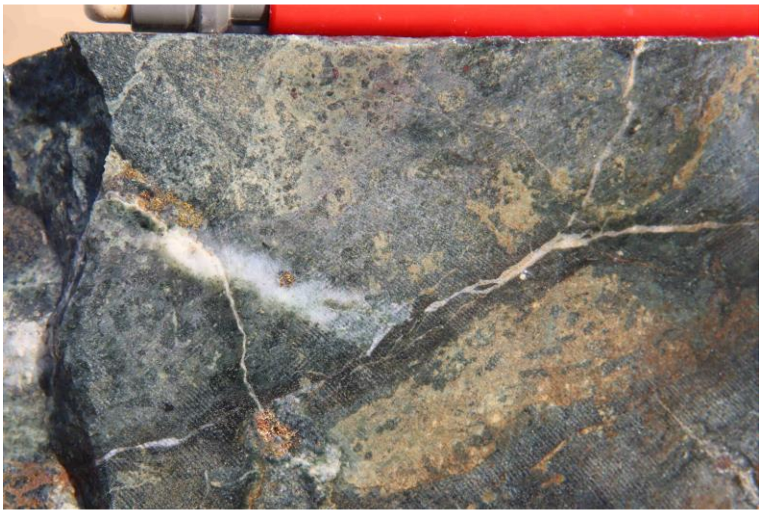

Photo 52 Incipient quartz-chalcopyrite vein within Alfa 2 breccia, DDH SMD44, 623.1m, 1330ppm Cu.

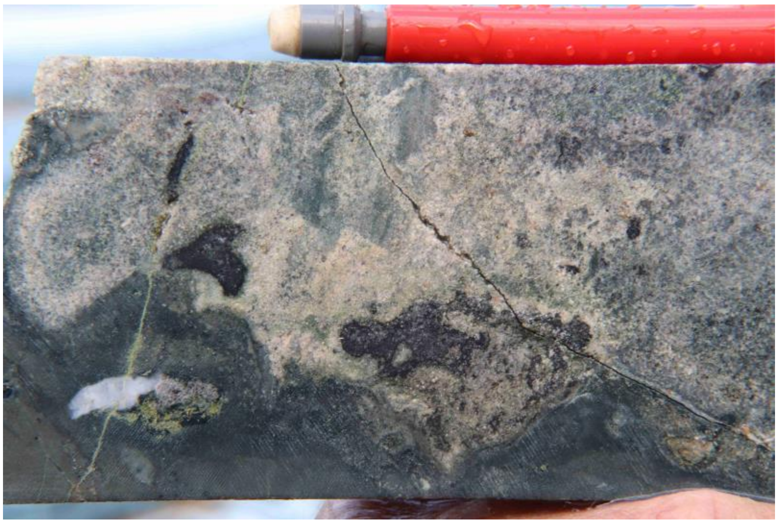

Photo 53 Contact between magnetite-epidote altered Alfa 2 breccia and albite altered P2 intrusion, DDH SMD44, 695.5m, 4960ppm Cu.

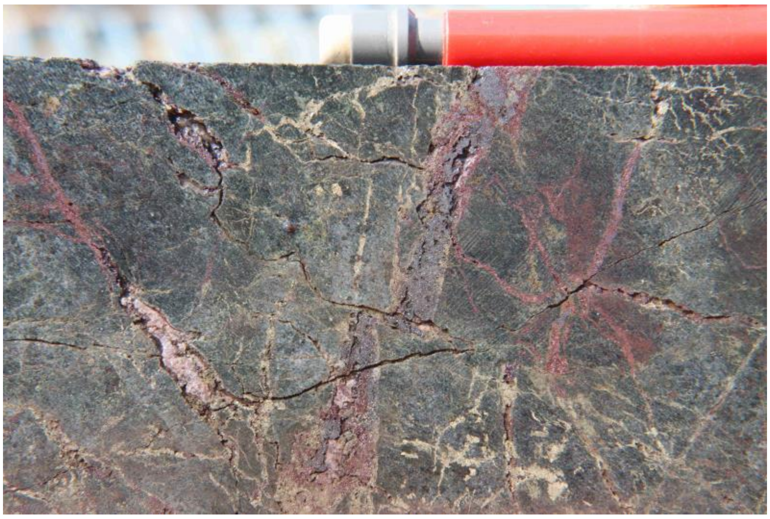

Photo 54 Pervasive and vein magnetite-haematite-chalcopyrite alteration within the Alfa 2 breccia, DDH SMD44, 591.1m, 3100ppm Cu.

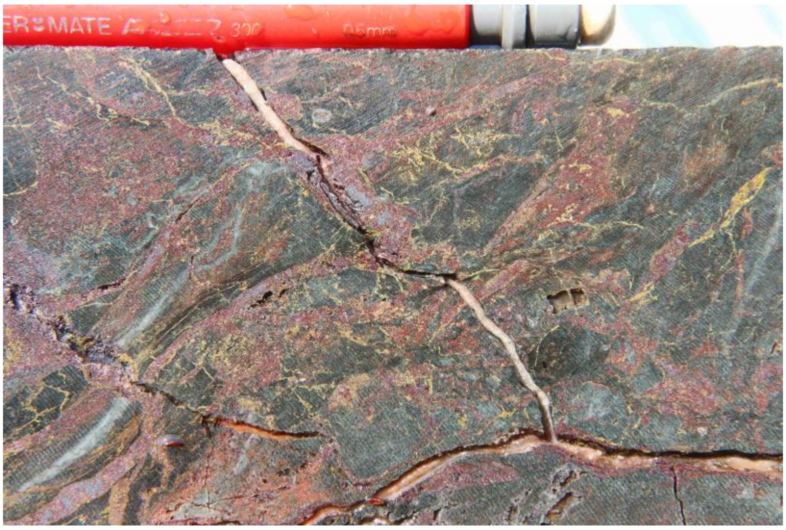

Photo 55 Laminated quartz-magnetite-haematite-chalcopyrite alteration within Alfa 2 breccia, DDH SMD44, 591.1m, 3100ppm Cu.

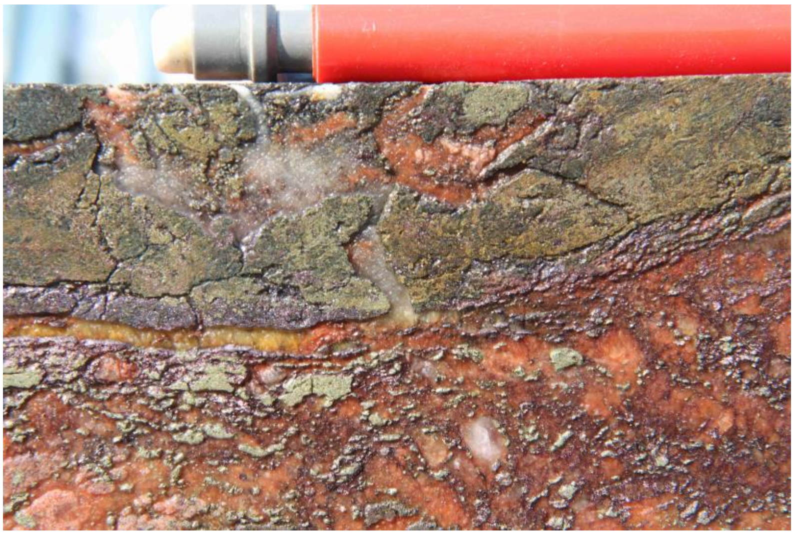

Photo 56 Laminated anhydrite-pyrite-magnetite-chalcopyrite-bornite lode showing bornite band, DDH SMD44, 588.8m, 2.34% Cu.

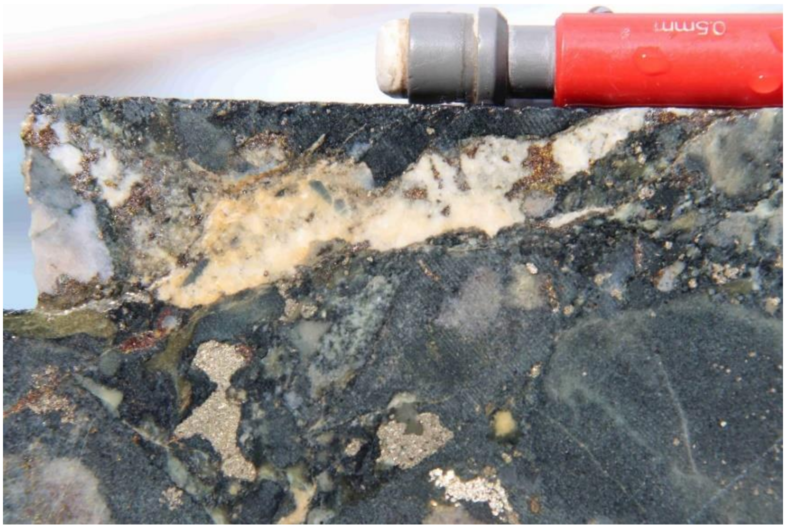

Photo 57 Quartz-carbonate-chalcopyrite-bornite vein with sulphides in the adjacent Alfa 2 breccia matrix, DDH SMD47, 795.4m.

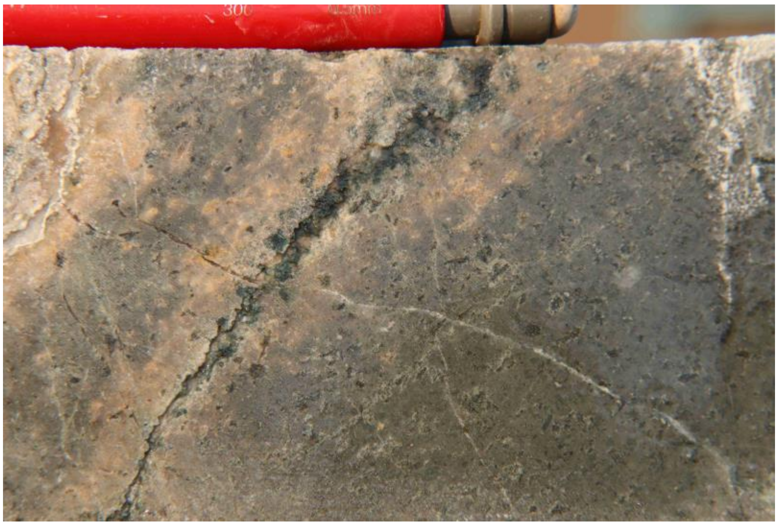
Photo 58 Fracture controlled actinolite with selvage albite, DDH SMD028, 597.7m.


Photo 59 Illite-kaolinite overprints actinolite within fractures, DDH SMD028, 675.5m.


Photo 60 Shear with milled sulphide clasts cuts Alfa 2 breccia, DDH DMD028, 580.7m.

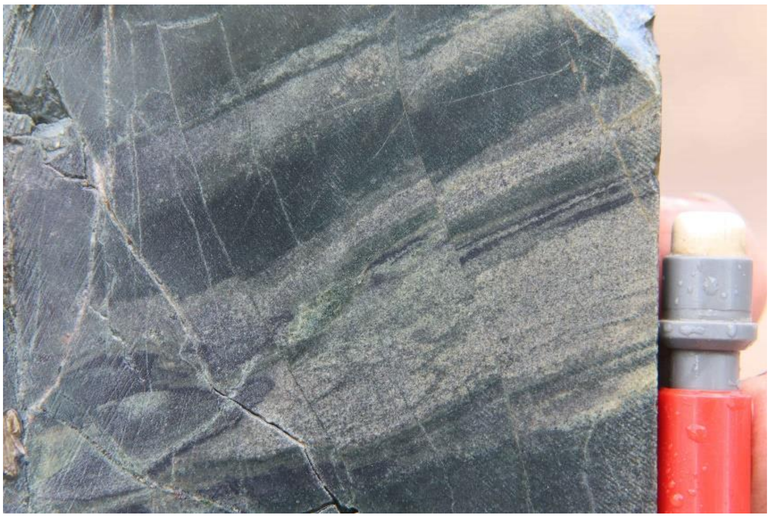

Photo 61 Possible Kfeldspar alteration of a permeable reactive band in the volcanosedimentary sequence, DDH SMD047, 609.5m.

Photo 62 Dark magnetite-pyrite-?actinolite alteration developed within a matrix of the Alfa 2 breccia, DDH SMD047, 773.6m.

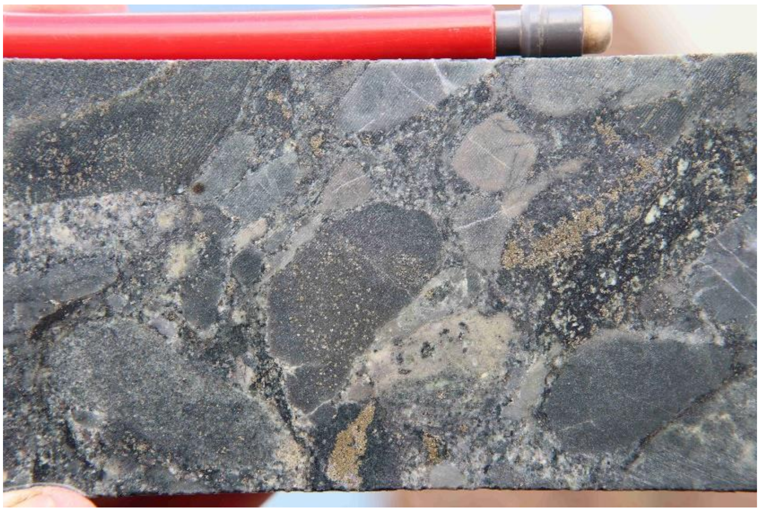

Photo 63 Alfa 2 breccia dominated by sedimentary clasts with infill including dark alteration with pyrite, DDH SMD047, 85.5m.

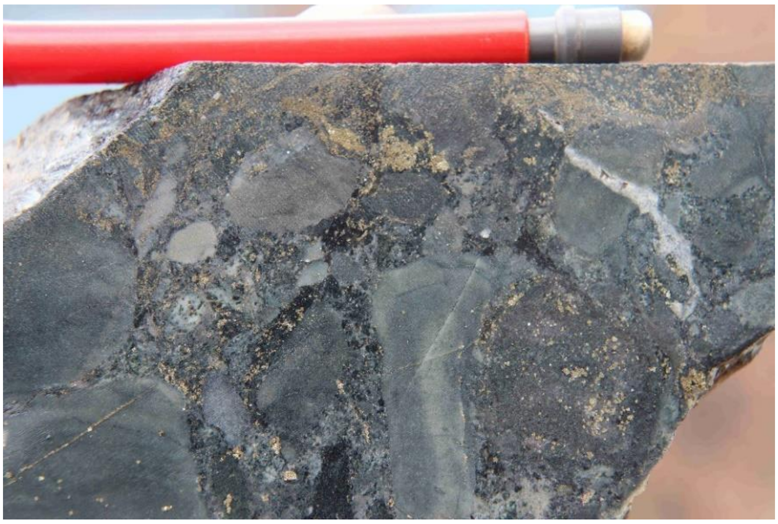

Photo 64 Alfa 2 breccia dominated by sedimentary clasts with infill including dark alteration with pyrite cut by incipient quartz veins, DDH SMD047, 791.8m.

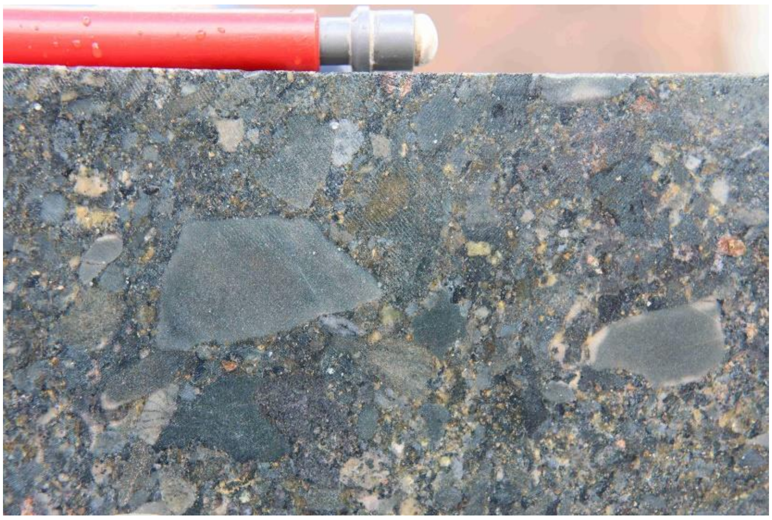

Photo 65 Alfa 2 breccia dominated by sedimentary clasts with infill including dark alteration with pyrite cut by incipient quartz veins, DDH SMD047, 783.9m.

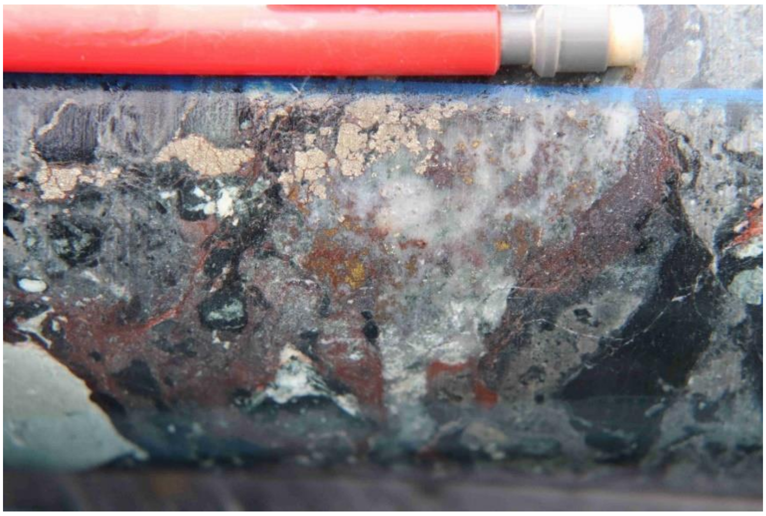

Photo 66 Alfa 3 breccia with silica-chalcopyrite-haematite infill, DDH SMD 151 420.8m.

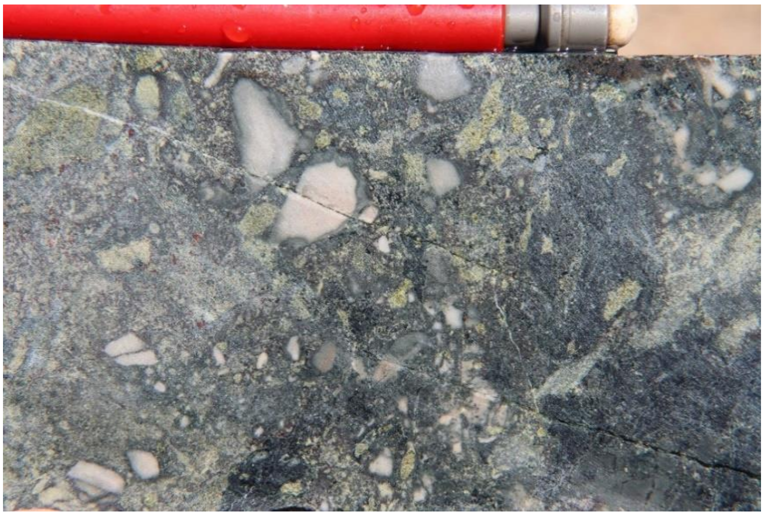

Photo 67 Epidote alteration within a felsite clast dominant permeable host rock which requires verification as either conglomerate, DDH117, 685.3m.

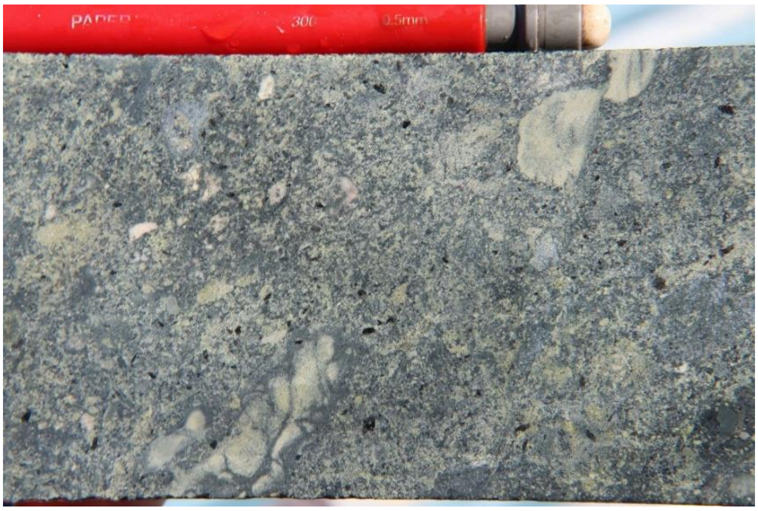

Photo 68 Epidote alteration within a felsite clast dominate permeable clastic rock, which requires verification as either conglomerate, DDH 117, 686.9m.

Photo 69 G vein characterised by magnetite-haematite-pyrite-anhydrite-pyrite ± chalcopyrite without the significant sericite selvage which characterised D veins, DDH SMD117, 723.1m.

Photo 70 Fiamme tuff typical of submarine deposition, DDH SMD117, 1496m.

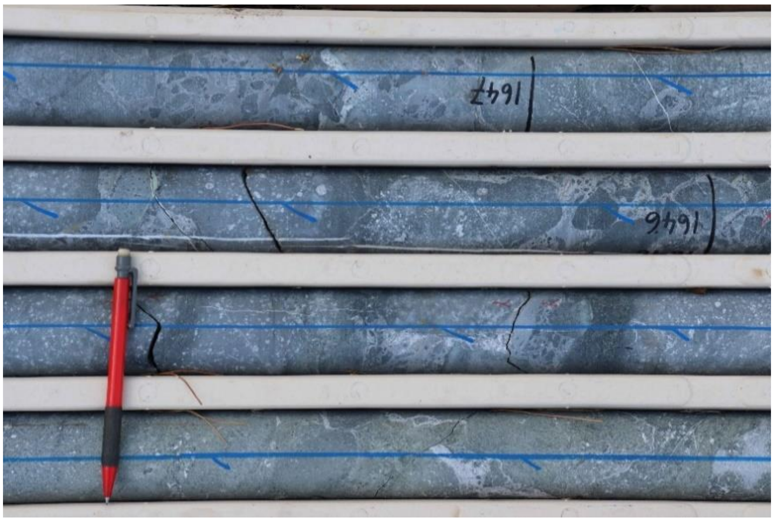

Photo 71 Brecciated shale in the hanging wall of the contact between volcanosedimentary-ultramafic rocks and typical setting of the Alfa breccia, which requires further study, DDH 117, 1646m.

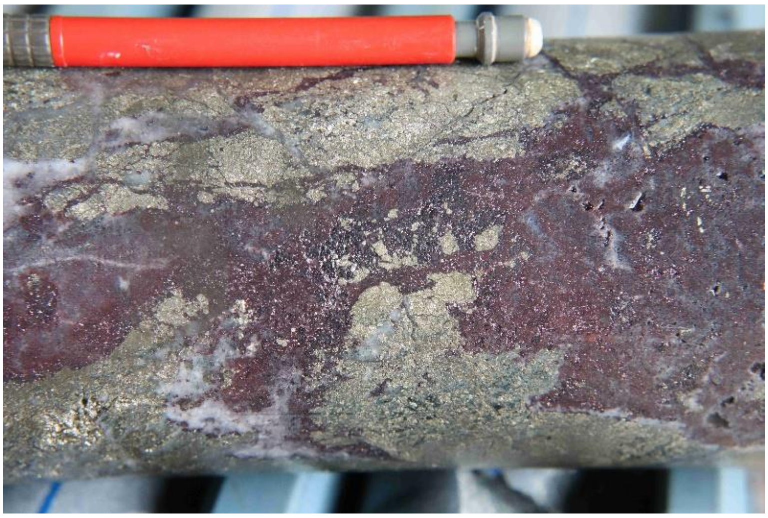

Photo 72 Haematite-magnetite cutting pyrite D vein as the first stage in the development of Cayley lode mineralisation, DDH SMD151, 420m.

APPENDIX 1

Letter to Paul Ashley

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21.4.2021

Paul

I hope this finds yourself and family well. Find 10 drill core samples from Stavely, two araldited back together.

Stavely has thrown up a bit of curly geology. The Cayley lode cuts a (deeply eroded) phreatomagmatic diatreme breccia pipe or probably pipes over a 800m strike (samples 3 & 4, termed the felsite clast Alfa breccias) while deeper breccias (termed the magnetite matrix Alfa breccias) host rucked up mineralised clasts and mineralised dykes (samples 2, 5 & 6). I am keen to know whether my field identification of actinolite is correct as an inner propylitic vector towards a blind porphyry (samples 8-10). I will send my report when it is ready.

Chris has a question concerning SMD44 657m in report No 8. – Could the chromite be derived from dismembered ultramafic rocks and rimmed by magnetite during hydrothermal alteration?

1. DDH SMD121, 167.8m – contact between fine grained dacite and andesite dykes which are elsewhere disrupted to form the phreatomagmatic milled matrix breccias. Any comment including on the alteration?

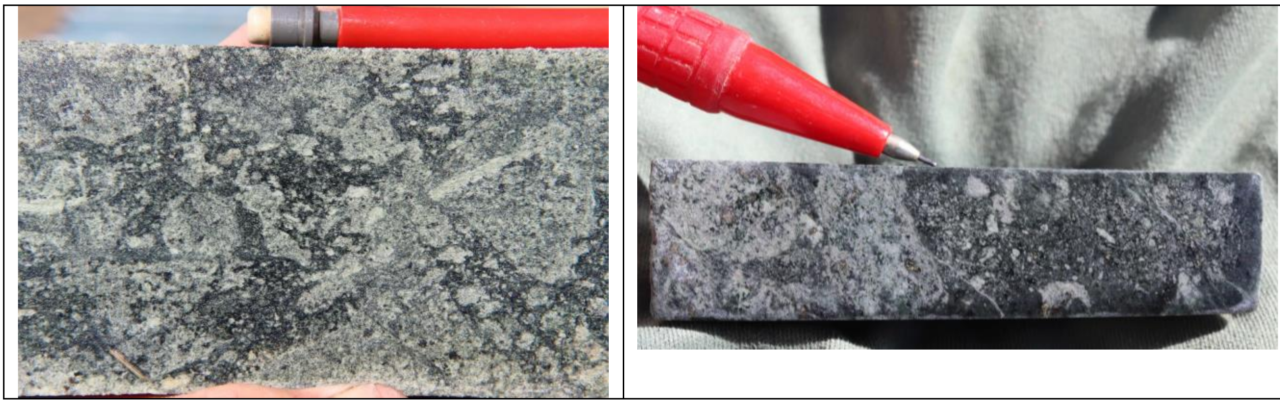
2. DDH SMD044, 583.2m – field term is the P1 porphyry from within the magnetite matrix breccia, which assayed 1.1% Cu, 0.18ppm Au and 279 ppm Mo. Sorry it is such a miserable sample but this was the biggest after a redrill. What do you think of this rock?

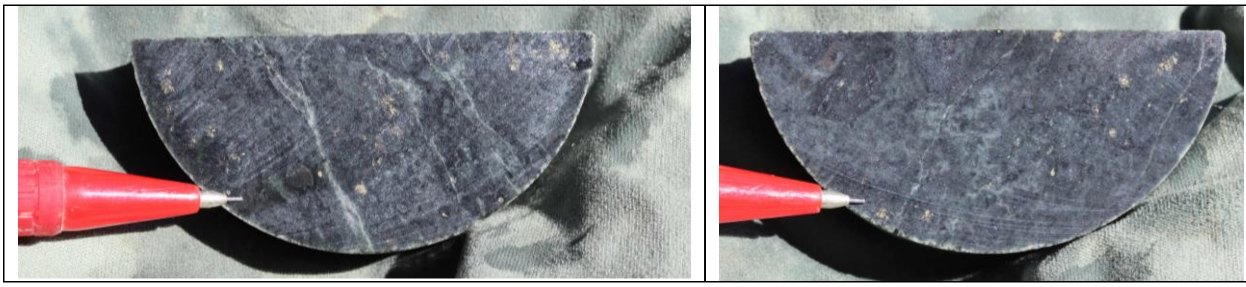
3 DDH SMD146, 178.1m – milled matrix breccia from the phreatomagmatic felsite clast breccia unit. Is the large rounded felsite clast the same as the majority of the smaller less milled clasts which look coarser grained?

4. DDH SMD146m, 178.2m – sampled for a dark green magnetic alteration with pyrite alteration in the same breccia as above. However not much survived our sample prep. Another example is shown below should you see any of this stuff in others of these samples.

5. DDH SM044, 606.9 - field term is the P2 porphyry from within the magnetite matrix breccia and with disseminated chalcopyrite. Any comments? In the field it has a pink appearance.

6. DDH SM044, 685.1m – field term is the P3 porphyry from within the magnetite matrix breccia. I've noticed a distinct difference in appearance between the faces parallel to the core orientation first 2 photos and taken across the core, second 2 photos. I don't know whether you can get two thin sections out of this, or sing out if you want another sample.





7. DDH SMD136, 47.4m microdiorite with may be related to the phreatomagmatic breccia, possibly as the source of much of the milled matrix in samples 3 & 4. Any comments?

8. DDHSMD044, 608.4m (from the magnetite matrix breccia) - Does this contain actinolite?

9. DDHSMD044, 606.2m - (from the magnetite matrix breccia) Does this contain actinolite?

10. DDHSMD028, 597.9m - Does this contain actinolite? … from a more distal setting

Regards
Greg Corbett
0409306063