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Petrological and Mineragraphic examination of twenty drill core samples from hole MRDD01 in the Mt. Ramsay Project area, EL42/2002, Tasmania.

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SUMMARY

Twenty drill core samples are from drill hole MRDD01 in the Mt. Ramsay Project area, EL42/2002, Tasmania. This drill hole is located in the Eocambrian Crimson Creek Formation and targets a well defined EM conductor.

A summary of the rock types and mineralogy of samples in the present suite is appended in the Summary Table.

Rock Types

Rock types represented are dominated by post deformational hydrothermal (metasomatic) breccias that contain mainly angular fragments of brittle fractured very fine grained host rocks. These rocks vary from crackle breccias (brittle fractured host rock and fragment- supported breccia with little matrix) through jigsaw breccias (fragment- supported closed framework breccia) to open framework matrix-supported breccias.

Relict textures in lithic fragments and host rocks are poorly preserved, mainly due to exceptionally fine grain size. Many are heavily clouded with dusty sphene/leucoxene suggesting a (Ti-rich) volcanic component. Possible flow banding and albite microlites are poorly preserved in felsic ?volcanic fragments of sample 266.20m. Lithic fragments in sample 305.9m are contact-metamorphosed microporphyritic felsic ?dyke rock. In sample 266.45m, fine grained igneous (?subvolcanic) lithic fragments enclose poorly preserved crystal sites suggesting previous ?feldspar microphenocrysts. Fine layering is characteristic in sample 393.10m which may have a felsic ?subvolcanic protolith. In sample 285.80m, breccia fragments of exceptionally fine grained 'chert' contain dusty ilmenite, again suggesting an igneous influence.

Lithic fragments in the open framework breccia are poorly sorted fine grained feldspathic volcanic sediments (?volcaniclastic rocks or greywacke) in samples 300.1m, 341.20m, 359.35m, 360.85m, 383.55m, 384.64m, 396.40m, 397.83m,

and 398.21m. The sample at 360.85m contains fragments of very fine grained feldspathic sediment intercalated with ?chert or once-glassy acidic ?volcanic rock. Very fine grained feldspathic clasts in fragments of sample 384.64m retain recognisable trachytic texture.

Sample 385.86m is an open framework breccia containing fragments of poorly preserved siltstone with some compositional layering. The latter is also characteristic in fragments of sample 388.40m.

At 406.56m, host rock fragments are interlayered exceptionally fine grained pelite (?shale) and finely layered feldspathic siltstone.

Cherty fragments also occur in an open framework breccia at 407.95m.

Contact Metamorphism, Metasomatism and Mineralisation

Alteration of lithic fragments in breccia, and their reaction rims adjacent to brittle fracture-located veins, is to very fine grained assemblages that challenge accurate microscopic identification. Many fragments are clouded by ubiquitous secondary sphene/leucoxene granules and patchy prehnite with minor carbonate. Several samples could contain cherty quartz-topaz assemblages, but these may be determined accurately only by x-ray diffraction or electron microprobe analysis.

Rare patches of subgraphic quartz and K-feldspar in pyrrhotite-mineralised vein and breccia matrix assemblages indicate a proximal granitic source (sample 300.10m). Some patchy interstitial K-feldspar is high temperature sanidine ± quartz in samples at 266.20m, 266.45m, 305.90m, 355.60m, 360.85m, 396.40m, 397.83m, 398.21m and 406.56m. This assemblage also suggests a high temperature of formation and granitic igneous affinity.

Many mineralised vein and breccia matrix assemblages contain abundant patchy high-temperature contact metamorphic diopsidic clinopyroxene (samples 266.20m, 355.60m, 360.85m, 384.64m, 385.86m, 393.10m, 406.56m, and 407.95m). The diopsidic clinopyroxene mainly is present as aggregates of unoriented stout subhedral prisms, commonly set in, and intergrown with acicular fibrous and subradial tremolite. The latter is the most abundant phase in the vein-like breccia matrix and narrow brittle fracture-located veinlets in most samples. Other coexisting phases are patchy sphene (titanite), traces of chlorite, carbonate, albite, K-feldspar, prehnite and tourmaline.

Massive fibrous subradial tremolite partly is retrograde and clearly replaces diopsidic clinopyroxene in sample 355.60m. Similarly, in sample 360.85m tremolite-actinolite forms part of the retrograde assemblage together with prehnite, 'sericite', carbonate and chlorite with interstitial sulphides.

Biotite/phlogopite flakes are selectively developed as disseminated flakes in some fine grained pelitic fragments, and form minor patches in veins and the vein-like breccia matrix in most samples.

Tourmaline is restricted to samples 285.80m, 341.20m, 385.86m and 397.83m. Most tourmaline is variegated yellow-brown to blue or blue/green, but that in sample 341.20m is strongly pleochroic dark blue/green to pink (possibly an elbaite composition). Tourmaline is a late phase with some subhedral crystal terminations into carbonate-filled patches.

Sulphide mineralisation is patchy and interstitial to vein/breccia matrix assemblages. It is dominated by almost monomineralic magnetic pyrrhotite. Minor chalcopyrite accompanies pyrrhotite in samples 266.70m 285.80m and 355.60m and confirms deposition by magmatic-related hot hydrothermal fluids. Traces of deep red-brown (iron-rich) sphalerite in 385.86m, 360.85m and 407.95m also confirm proximal high temperature hydrothermal fluid conditions.

Discussion and Comparison

The Mt. Bischoff cassiterite- sulphide skarn, about 16 km to the NNE of the Mt Ramsay Project area, is used as a comparative model for the mineralisation at Mt. Ramsay.

The Mt. Bischoff tin deposit was described by Hally and Walshe (1995). It occurs in a late Precambrian dolomite unit of the Oonah Formation (mainly quartzite and shale) intruded by a swarm of narrow near vertical feldspar porphyry dykes of Devonian age. The dykes are related to a shallow granitic ridge at depth extending northwards from the Meredith Granite. The dykes were major fluid conduits and are mineralised (pyrrhotite, pyrite, topaz, fluorite and cassiterite). Pyrrhotite is the dominant sulphide that formed during stages 1 and 2 mineral zonation (Halley and Walshe, 1995). Stage 1 was marked by serpentine, chondrodite and magnesite formation in the dolomite at 400º-460ºC. During stage 2, a retrograde event at about 320º-360ºC, quartz, talc, phlogopite and carbonate (ferroan magnesite) overprinted the earlier higher grade assemblage. Cassiterite was formed during stage 2 with pyrrhotite, secondary carbonates, fluorides and a variety of silicates. The chondrodite rocks were shown to envelope the serpentine assemblage.

Halley and Walshe (1995) showed that the cassiterite greisen was a late hydrothermal event overprinting a barren, high temperature Mg skarn, and the highest tin grades occurred close to the contacts of porphyry dykes. They also described clast supported breccias with dyke-like geometry occurring near the summit of Mt Bischoff. Porphyry clasts are altered to topaz greisen, and the breccia also contains extensive late tourmaline. Even later quartz-cassiterite veinlets crosscut the breccias.

The rock types at Mt Ramsay correlate with descriptions in Halley and Walshe (1995) of greywacke, mudstone chert and (basaltic) lavas belonging to the Crimson Creek Formation rather than quartzite, shale and dolomite of the underlying Oonah Formation. There is no clear evidence for quartz porphyry dykes similar to

those found at Mt Bischoff that contain distinctive phenocrysts of beta quartz and orthoclase.

At Mt Ramsay, assemblages such as diopsidic clinopyroxene-tremolite ± K-feldspar are characteristic of hornblende hornfels grade contact metamorphism at temperatures of 500º-600ºC. They indicate a high temperature Mg-skarn assemblage possibly replacing an earlier carbonate-quartz assemblage. The dominant diopsidic clinopyroxene - tremolite is associated with high temperature pyrrhotite and traces of base metal sulphides (chalcopyrite and sphalerite) but lack significant cassiterite mineralisation. Abundant diopsidic clinopyroxene at Mt Ramsay indicates not only high temperature conditions but lack of significant hydrous fluids. The unusual contact metamorphic assemblages found at Mt. Bischoff such as serpentine-chondrodite (formed at slightly lower temperatures, 400º-460ºC) were not found in the present samples, possibly reflecting compositionally different host rocks at Mt Ramsay.

Very abundant tremolite at Mt Ramsay reflects a more calcic, higher temperature retrograde alteration compared with the talc-bearing rocks at Mt. Bischoff. Patchy very fine grained talc (or 'sericite') is only a minor phase in the present group of samples, unlike those in the strongly retrograded assemblages associated with cassiterite mineralisation at Mt. Bischoff. The relatively minor retrograde hydrothermal overprint (mainly tremolite replacing diopsidic clinopyroxene) also was a less pervasive event than the retrograde alteration at Mt Bischoff. Although several samples in the present group contain tourmaline there is no significant fluorite, topaz or cassiterite.

Halley and Walshe (1995) showed that the dolomitic bed in the Oonah Formation at Mt. Bischoff was critical in the Stage 1 and lower temperature Stage 2 carbonate replacement events. The sequence of replacement reactions resulted from a fluid progressively depleted in silica. They showed that the Stage 1 skarn lacks cassiterite, possibly because the temperature was too high to allow fluid saturation in cassiterite. Similarly, high temperature conditions could have suppressed cassiterite deposition at Mt Ramsay. At Mt Bischoff the retrograde Stage 2 zonal assemblage

results from carbonate reactions in the presence of meteoric-diluted magmatic fluids also precipitating abundant cassiterite by complex mechanisms. There is no significant dolomite present in the samples from drill hole MRDD01 at Mt Ramsay, although most skarn assemblages confirm a Ca, Mg - rich system.

A comparison by Halley and Walshe (1995) with other western Tasmanian deposits showed that the Renison Bell cassiterite-sulphide mineralisation occurs with quartz and talc as replacements in three dolomite horizons. Reactions are interpreted to be similar to those at Mt Bishoff. At Cleveland, however, cassiterite-sulphide lenses are interbedded with chert and occur above a quartz-wolframite-molybdenite stockwork, but they are also interpreted as replacements of limestone.

Reference.

Halley S.W and Walshe J.L. 1995. A re-examination of the mt Bischoff Cassiterite Sulfide Skarn, Western Tasmania. Economic Geology Vol. 90, pp. 1676-1693.

SUMMARY TABLE

SAMPLE NUMBER	ROCK TYPE	PRIMARY MINERALOGY	SECONDARY MINERALOGY	VEIN MINERALOGY	SULPHIDES
MRDD01 266.20m	Angular lithic fragment-rich closed framework breccia. About 75% exceptionally fine grained felsic ?volcanic fragments (5mm-2cm). Some ?flow banding. Albite microlites, heavy sphene/leucoxene clouding. Weakly mineralised calc-silicate breccia matrix.	Ab, qtz.	Sp/lx, may contain tz.	Cpx, tr, trace interstitial Kfs (?sa), sulphides. Late veins, patches of pr. Minor cc.	?Po (magnetic).
MRDD01 266.45m	Unsorted lithic breccia (partly open framework). Fine grained angular, once-feldspathic (?feldspar microphenocrysts) ?volcanic lithic fragments (2mm-2cm) show metasomatic reaction rims against abundant breccia matrix. Mineralised massive tr-rich breccia matrix. Retrograde 'sericite' overprint.	None.	Fragments; sp/lx, ?tc/?ser, tr, pr, ?qtz, ?tz.	Breccia matrix; massive unoriented tr prisms. Trace Kfs (interstitial).Trace clay. Patchy retrograded ?cpx crystals. Patchy interstitial sulphides. Some sp veins.	Po 10%, monomineralic.
MRDD01 266.70m	Deformed hydrothermal/metasomatic open framework breccia. Sparse very fine grained degraded fragments (>3cm) set in sulphide-mineralised, tremolite-rich breccia matrix. Prehnite-'sericite' retrograde alteration.	None.	Fragments; intensely degraded. Pr, ?tc/ser, sp/lx granules, cc.	Breccia matrix. Massive fibrous amph (?tr). Sulphides interstitial to amph.	Po 30%; trace cpy.
MRDD01 285.80m	Brittle fractured, partly crackle brecciated, very fine grained ?'chert' – possibly volcanic, since abundant dusty ilmenite. Fibrous tremolite dominates vein separating massive sulphides from host rock.	None.	Fragments; fsp, ilm, bi, ?qtz, minor tr, tm.	Breccia matrix; qtz, tm (zoned yellow-brown to blue), bi/phl, tr, po, 'ser' ± ap. Veins in fragments; early granular qtz, bi/phl, po. Later amph (?tr), po ± bi/phl ± qtz ± ?zo. Zoned metasomatic patches. (Tr, bi/phl, fsp rims; granular Kfs, tr, bi/phl, po core).	Po 40%; cpy ~ 2%.

SAMPLE NUMBER	ROCK TYPE	PRIMARY MINERALOGY	SECONDARY MINERALOGY	VEIN MINERALOGY	SULPHIDES
MRDD01 300.10m	Deformed, foliated, veined, patchy pyrrhotite-mineralised open framework metasomatic breccia. Deformed altered lithic fragments are poorly sorted fine grained feldspathic volcanic arenite (?volcaniclastic). Some unsorted feldspathic volcanic clasts in arenite reach 0.6mm.	Fsp, Ti-ox, ?qtz.	Ab, sp, tr, pr, bi-phl, sulphides.	Zoned assemblages. Patchy granitic (partly graphic) qtz, ab, Kfs ± po, tr, bi/phl. Patches set in massive tr ± sp.	?Po (magnetic) ~ 20%.
MRDD01 305.90m	Brittle fractured and veined, contact metamorphosed micro-porphyritic felsic ?dyke rock. Minor sulphides. Zones of potassic (Kfs) alteration (?reaction rims on fragments lack bi/phl in phenocryst sites These contain the higher T assemblage Kfs-act).	?Fsp, Ti-ox, ?amph micro-phenocrysts.	Most rock fragments; ?Ab, qtz, Kfs, bi/phl, amph (tr-act), zr, sp.	Fracture-located veins, breccia matrix; massive act, minor patchy Kfs, qtz. Patchy interstitial sulphides. Qtz fluid/solid inclusions.	Po (magnetic), fracture-vein located, < 5%.
MRDD01 341.20m	Partly recrystallised, veined, weakly mineralised, fine to medium grained poorly sorted feldspathic arenite. Some volcanic lithic clasts.	Pl, Ti-ox, ?Kfs, ?amph.	Ab, bi/phl, act, tm, pr, sp.	Vein (zoned); Massive act; central patches tm prisms (blue/green to pink) with interstitial pr, minor chl, ap. Trace sulphides.	Trace narrow prismatic sulphide crystals (?po).
MRDD01 355.60m	Metasomatic crackle breccia. Angular/irregular very fine grained bi/phl-sp rich lithic fragments. Mineralised breccia matrix of cpx ± bi/phl ± amph.	None	Host rock. Bi/phl, patchy Kfs, minor tr, ap.	Veins. Prismatic cpx (di) crystals up to 1mm, bi/phl, wispy amph, sulphides. Patchy Kfs. Retrograde alteration of cpx to tr.	Po ~ 20%. Trace cpy.
MRDD01 359.35m	Unsorted ?hydrothermal breccia. Fragments (~ 45%) are angular to irregular shaped and reach >3.0cm. They are very fine to medium grained feldspathic sediment (?volcaniclastic) containing unsorted feldspar fragments. Some are partly foliated, may have been partly conglomeratic. Patchy/vein breccia matrix- located interstitial sulphides.	Pl, Ti-ox.	Ab, Kfs, sp/lx, 'ill/sm', pr, bi/phl, rare ?zo.	Vein/breccia matrix. Amph (tr), sp, minor patchy Kfs. Late veinlets pr ± Kfs.	Po ~ 20%.

SAMPLE NUMBER	ROCK TYPE	PRIMARY MINERALOGY	SECONDARY MINERALOGY	VEIN MINERALOGY	SULPHIDES
MRDD01 360.85m	Brittle fractured, partly brecciated very fine to fine grained sediment containing unsorted angular feldspar cleavage fragments. Weak grain size layering. Some fragments intercalated with very fine grained ?chert or once-glassy acidic volcanic.	Pl, Ti-ox.	Ab, ?Kfs, sp/lx, patchy bi/phl.	Narrow, brittle fracture-located veinlets; Kfs, sp, all, ?qtz. Vein; prismatic cpx (di) and retrograde cc, amph (tr-act), pr, 'ser', cc, chl. Interstitial sulphides.	Patchy vein-located sulphides. Trace deep red-brown sph ± ???po. Possibly not magnetic.
MRDD01 383.55m	Partly fractured, veined, altered and partly recrystallised, very fine to coarse grained feldspathic volcanic lithic arenite (?volcaniclastic rock). Some micro-phenocrysts are albitised plag. prisms 0.3 mm long. Clasts of trachyte.	Pl, Ti-ox, ?ap.	Ab, pr, sp/lx, bi/phl.	Amph (?tr), ± ab ± sulphides.	Fracture-located sulphides (< 5%) are not magnetic.
MRDD01 384.64m	Breccia showing multiple episodes of brecciation. Bleached angular lithic fragments (up to ~ 7 cm) of prehnite-sphene clouded, fine grained feldspathic volcanic lithic (trachyte clasts) arenite. ~ 60%, lithic fragments in breccia.	Pl, Ti-ox.	Ab, pr, sp/lx.	Breccia matrix/vein. Cpx (di) prisms, amph (tr). Pl (some zoned). Trace chl. Interstitial sulphides.	> po (magnetic) interstitial.
MRDD01 385.86m	Open framework hydrothermal breccia. ~ 20% very degraded angular lithic fragments (< 1 cm). Many rotated. Poor relict textures and compositional layering in fragments. Mineralised abundant breccia matrix. Po-mineralised pr-amph-rich breccia matrix.`	?Ti-ox.	Sp, pr, ?zo, chl.	Very abundant prismatic cpx cp(di), pale green amph (tr-act) patchy tm, xp, cc, chl, pr, interstitial sulphides.	?Po (magnetic) ~ 15%. Minor red-brown (Fe-rich) sph.
MRDD01 388.40m	Exceptionally fine grained finely compositionally layered sphene, amph (tr) ± patchy bi/phl and clouded fsp-altered host rock. Brittle fracture-located veinlets are amph ± bi-pl + trace patchy sulphides.	None. Sediment, some deformed fractured mineralised layering.	Sp granules, patchy amph (tr), minor bi/phl clouded fsp.	Tr veinlets, patchy bi/phl interstitial sulphides. Trace Kfs.	Trace dusty dissem. sulphides mark disrupted ?layering.

SAMPLE NUMBER	ROCK TYPE	PRIMARY MINERALOGY	SECONDARY MINERALOGY	VEIN MINERALOGY	SULPHIDES
MRDD01 393.10m	Exceptionally finely recrystallised finely layered feldspar (??albite)-sphene rock (possibly a felsic volcanic rock). Some wispy deformed layering. Deformed pyrrhotite-mineralised vein breccia matrix contains prismatic diopside. Marginal zones are tremolite.	None.	Ab, sp, veins, patches and spots of pr. Rare Kfs, 'ser'.	Coarse grained cpx (di) prisms up to 4 mm long intergrown with interstitial sulphides (?po) retrograde patchy tr. Also patchy pl ± 'ser', pr. Accessory sp. 'Ser' clouds some pl.	? Po (magnetic) ~ 10%.
MRDD01 396.40m	Crackle- and jigsaw-breccia. Angular lithic fragments (1 mm – 2cm) of very fine grained finely compositionally layered Ti-rich (?volcanic) ?sediment. Some rotated fragments. Po-mineralised veinlets/breccia matrix.	None.	Sp, pr minor cc. Kfs, ?ab. Sulphides.	Tr, interstitial Kfs and sulphides centrally.	Patchy sulphides, mainly ?po (magnetic ~ 10%).
MRDD01 397.83m	Brittle-fractured, veined, extremely fine grained, partly finely layered, K-feldspar-rich, once ?tuffaceous ?sediment containing material from a strongly potassic feldspathic ?acidic volcanic source. A tremolite vein (> 1 cm wide) is strongly ?pyrrhotite-mineralised. It is separated from the host rock by 2 mm wide zone of massive fibrous tremolite.	?Kfs, Ti-ox.	Kfs, dusty sp, patchy pr.	Tr, sulphides, minor Kfs. Veinlets of Kfs, bi, tm (yellow/brown to blue/green), sulphides.	?Po (strongly magnetic ~ 15%-20%).
MRDD01 398.21m	Brittle fractured and veined, very fine grained, finely compositionally layered ?volcanic sediment. Sharp boundary against mineralised vein/breccia matrix.	Rare plag. Ti-ox.	Patchy Kfs, 'ser', dusty sp, trace bi/phl.	Fibrous tr, Kfs, (?sa) patchy interstitial sulphides.	Minor sulphides ?po. Weakly magnetic).
MRDD01 406.56m	Fractured, veined, blocky host rock fragments. Fragments are interlayered exceptionally fine grained ?pelite and dusty sphene-rich finely layered feldspathic siltstone.	Once-detrital zr, ?tm, sp.	Variable Kfs, minor bi/phl, dusty sp, minor dissem sulphides.	Fibrous tr, patchy cpx, Kfs, qtz, minor ab, sp, patchy interstitial sulphides. Veinlets; bi/phl, Kfs, pr, sulphides. Pr halo.	?Po (magnetic) 10%. Uneven distribution.

SAMPLE NUMBER	ROCK TYPE	PRIMARY MINERALOGY	SECONDARY MINERALOGY	VEIN MINERALOGY	SULPHIDES
MRDD01 407.95m	Slivers of cherty host rock fragments (up to 6 cm long x 1 cm wide) form open framework breccia. Sulphide-mineralised vein-like breccia matrix.	None.	Qtz, sp, trace cc, ap.	Patchy (some central zones), coarse prismatic cpx, fibrous radial tr, minor qtz, sp, interstitial sulphides. Patchy late pr. Veinlets are qtz, ze, sp, trace cc, pr.	?Po (magnetic) ~ 15%; trace deep red iron-rich sph.

Abbreviations: Ab = albite, act = actinolite, all = allanite, amph = amphibole, ap = apatite, bi = biotite, cc = carbonate, chl = chlorite, cpx = clinopyroxene, cpy = chalcopyrite, di = diopside, fsp = feldspar, ilm = ilmenite, Kfs = K-feldspar, lx = leucoxene, ox = oxide, phl = phlogopite, pl = plagioclase, po = pyrrhotite, pr = prehnite, qtz = quartz, sa = sanidine; 'ser' = 'sericite', sp = sphene (titanite), sph = sphalerite, tc = talc, tm = tourmaline, tr = tremolite, tz = topaz, ze = zeolite, zo = zoisite, zr = zircon.