UR1976_44

1976/44. Volcanic stratigraphy and Cambro-Ordovician relationships in the South Darwin Peak-Mt Sorell area: A preliminary report.

K.D. Corbett

Abstract

A cross-section of the Mt Read Volcanic Belt is exposed from the Clark Valley across the South Darwin Plateau to Ten Mile Hill. Three major units are present:

(1) A sequence of quartz-feldspar-phyric rocks, including some flow-banded and autobrecciated lavas, with associated slate-siltstone units, which occurs in the Clark Valley.

(2) A sequence of pink to green, fine-grained, feldspar-phyric rhyolites, intruded by the Darwin Granite, occupying South Darwin Plateau and its western flanks.

(3) An eastern sequence of volcaniclastic conglomerate and sandstone together with tuff and quartz-feldspar porphyry which unconformably overlies the Darwin Granite along the eastern flank of the plateau.

Part of the latter sequence has previously been mapped as 'Jukes Conglomerate'. The occurrence of disoriented cleaved fragments of the underlying volcanic rocks in the eastern sequence suggests the unconformity represents a significant tectonic event and a period of extensive erosion to expose the sub-volcanic granite.

Siliceous sandstone and fine conglomerate of the Owen Conglomerate correlate unconformably overlaps the eastern sequence at South Darwin Peak, and rests directly on the central rhyolite sequence just west of the peak. On Mt Sorell, the Owen correlate is at least 1200 m thick and overlies a major unit of volcaniclastic conglomerate.

1976/44. Volcanic stratigraphy and Cambro-Ordovician relationships in the South Darwin Peak-Mt Sorell area: A preliminary report.

K.D. Corbett

Detailed mapping of parts of the South Darwin Peak-Clark River area was carried out by the author in the period December 1974-February 1975 as part of a regional study of the Mt Read Volcanics. Access to the area is via a 4-wheel drive track which leaves the Crotty Road at Ten Mile Hill and traverses the southern part of the South Darwin Plateau (fig. 1). A walking track cut by the Electrolytic Zinc Company leads down the western flank of the plateau to the Clark Valley. Parts of Mt Sorell and the Clark Valley were mapped from a tent camp on the Clark River. The mapping was essentially designed to indicate the general nature of the various sequences, and if possible to determine the stratigraphic relationships between sequences. Much further work remains to be done, but the preliminary results are made available to assist with correlations throughout the volcanic belt.

The stratigraphic succession in the area may be summarised as follows:

Quaternary. Bouldery moraine, outwash gravel and scree deposits of the western Clark Valley.

Cambro-Ordovician

(1) Owen Conglomerate correlate - siliceous sandstone and conglomerate of South Darwin Peak, Ten Mile Hill and Mt Sorell.

Unconformity - disconformity.

(2) Volcaniclastic conglomerate of Mt Sorell east flank.
(3) Eastern sequence of volcaniclastic conglomerate, sandstone, tuff and quartz-porphyry.

Unconformity.

Cambrian-?Late Proterozoic

(4) Central 'rhyolite' sequence with Darwin Granite.
(5) Clark Valley quartz porphyry-slate sequence.

The relationship between units (4) and (5) is not yet clear, but could be interfingering. The relationship between Units (2) and (3) is also not known, but they are probably lateral equivalents. The term 'rhyolite' is used for the fine-grained, pink to pale-coloured rocks, usually containing feldspar phenocrysts, which characterise the central sequence. Volcanic rocks with quartz (and usually feldspar) phenocrysts are generally referred to as quartz-porphyries, although some may be of pyroclastic origin.

CLARK VALLEY QUARTZ PORPHYRY-SLATE SEQUENCE

Volcanic rocks with phenocrysts of quartz and feldspar occur extensively on the western and northern sides of the Clark Valley. The rocks tend to be massive and structureless, although compositional and flow-type banding occurs in a few outcrops and generally dips steeply west (75°-88°) or is vertical. Southwesterly-dipping flow banding was recorded at the northern end of the valley. Part of a major slate-siltstone unit is exposed on the central western side of the valley beneath the extensive scree-moraine cover, and slate float and fragments of slate within volcanics were noted towards the northeast end of the valley.

There appears to be some interfingering of quartz-porphyritic rocks

and fine-grained rocks of rhyolite type along the eastern side of the valley. The contact area in the north-east corner of the valley appears to be marked by a slate unit, with quartz-phyric agglomerate to the west and fine-grained rhyolite and basalt to the east. No facing directions have been found, and hence the internal stratigraphy of the sequence is not known.

In the *central Clark River*, massive, cleaved, pale green quartz-feldspar porphyry abuts the western slate horizon. A specimen from the junction with a major NNW tributary (75-223*) contains large embayed and broken quartz phenocrysts and rare small feldspar phenocrysts in a murky, poorly crystallised, microcrystalline groundmass of quartz, feldspar, sericite and opaque dust. The sericite forms an anastomosing web along the cleavage, and there are pressure beards behind some of the phenocrysts. The feldspar phenocrysts are partly replaced by carbonate and sericite, and commonly show bent twin lamellae. The marked porphyritic texture, reaction rims around phenocrysts, and lack of clastic groundmass textures suggest the rock is a lava or intrusive.

Brecciated and banded quartz porphyry occurs just upstream of the above tributary. A finely banded variety (75-224) contains embayed quartz phenocrysts and less common feldspar phenocrysts and glomerophenocrysts in a finely microcrystalline quartz-feldspar-sericite groundmass rich in carbonate. The banding appears to be mainly due to irregular lines of carbonate. Just east of this a pink vitric-crystal tuff contains small feldspars and lesser quartz fragments and rock fragments in an abundant fine glassy sericitic matrix.

At the junction with a linear creek from the south-east, this pink tuff is faulted against grey, feldspar-rich tuff (75-227) with what appear to be abundant shards in the matrix. This rock is probably an ignimbrite, and is closely associated with a dense, pink- fine-grained rock (75-226) containing abundant well-formed small spherulites in groundmass, large altered feldspar phenocrysts and fairly numerous small quartz phenocrysts. Material similar to that forming the spherulites has crystallised around small quartz crystals in a few cases. Both the latter rock types have affinities with the central rhyolite sequence.

A traverse around the *northern Clark Valley*, at the foot of Slate Spur, revealed massive pale green quartz-porphyry to the west, followed by well-exposed flow-banded and autobrecciated quartz-porphyry lavas in the central part. The brecciated variety has angular fragments ranging in size from over 20 cm down to less than one centimetre. In thin section (75-228) the rock consists of fragments of fine-banded quartz-porphyry surrounded by slightly finer grained groundmass material. The groundmass appears to irregularly invade and corrode some fragments. Unaltered feldspar phenocrysts are also common. Banding in the fragments is due to parallel wisps of very pale green-brown sericite-chlorite, and commonly wraps around phenocrysts. The small size of the fragments (some less than one millimetre) is suprising in a lava.

The sequence in the *eastern part of the valley* was investigated mainly in the north-east corner where the Clark River crosses the valley to the east side. Here the quartz-porphyry sequence passes into a mixed sequence of quartz-bearing and rhyolite-like rocks. The westernmost member is a pale pink fine-grained rock with scattered feldspars. In thin section (75-229) this rock comprises large feldspar phenocrysts and glomerophenocrysts in a finely microcrystalline groundmass rich in small spherulites, and is essentially identical to rocks of the central belt around Mt Jukes.

---

*Specimen numbers refer to the Department of Mines collection: Localities of specimens are shown on Figure 1.

East of this is a flow-banded, pale green rock with abundant feldspar and lesser quartz phenocrysts, followed by a pale green, fine-grained feldspar-rich rock which in thin section (75-230) comprises small to large feldspar phenocrysts and glomerophenocrysts in an abundant fine murky groundmass of quartz, feldspar and fine sericite and chlorite. The groundmass has a finely clastic appearance, with small angular shapes resembling fine shards in places. The rock is similar to some of the feldspar-porphyries of the central rhyolite sequence. A few metres east of this is a rock rich in quartz and feldspar phenocrysts in a fine glassy groundmass which in thin section (75-231) is finely recrystallised but shows glassy flow structure and wispy, welded shard-like shapes suggesting an ash-flow origin. Some of the large feldspars have the core area almost completely replaced by murky chlorite-sericite but have a clear rim. Autobrecciated quartz-porphyry lava occurs just east of this, near the probable contact with the central rhyolite sequence. The contact area in the Clark River is apparently marked by a slate horizon, numerous blocks of which occur on the east bank. The quartz-bearing sequence appears abruptly at a bend in the river as it swings out into the valley, and includes coarse laharic agglomerate containing contorted slate fragments. Upstream and east of this are typical fine-grained greenish rhyolites. The contact or zone of interfingering apparently lies west of the baseline track through the Electrolytic Zinc Company's camp, since only rhyolite type rocks were recorded along this track. The contact zone at the south-east end of the mapped area appears to be gradational over about 100 m.

The main *slate* unit was examined in a small tributary west of the Clark River on the western side of the valley, but may crop out in the river further south. Black slate and laminated silty sandstone crop out over a cross-strike width of at least 100 m, so that the thickness of the unit is at least of this order. The western margin is obscured by scree. The bedding and cleavage dip very steeply west.

CENTRAL RHYOLITE SEQUENCE AND DARWIN GRANITE

Very little detailed mapping of this sequence has been done, except in the eastern Clark Valley, on 'Humpty Dumpty', and along the eastern margin of the South Darwin Plateau where the Darwin Granite crops out. The granite has not been examined in detail, and no attempt has been made to map its boundaries.

In the *north-east Clark Valley*, the first rock exposed east of the mapped contact is a grey, fine-grained, fractured rock on the west bank of the Clark River. In thin section (75-232) this rock consists almost wholly of fine groundmass material cut by thin quartz-chlorite veins. Much of the groundmass consists of spherulites or 'snowflakes' outlined by concentrations of dusty micaceous minerals and showing uniform extinction. Such textures are common in rhyolites from the central belt. A massive, green, fine-grained rock at the mouth of an east tributary here (75-233) also consists mainly of quartzo-feldspathic groundmass, with a few feldspar and quartz phenocrysts.

A fine-grained green rock (75-234) collected from 60 m up this east tributary is a *basalt*, and consists of fine feldspar laths partly intergrown with hornblende, pyroxene, chlorite and very low birefringence clear mineral (feldspathoid or zeolite?). Boulders of fresh basalt are common in the Clark River, suggesting there could be fairly extensive outcrops of the rock in the north-east part of the headwater area.

In the central eastern side of the valley, on the E.Z. Co. walking track, the rocks are mainly pink to green fine-grained types. Specimen 75-235 contains small to large phenocrysts of feldspar and scattered small phenocrysts of quartz in a groundmass rich in very fine spherulite-like structures

outlined by cracks. This rock has characters allied to both the quartz-porphyries and the central belt rhyolites.

'Humpty Dumpty' area

On 'Humpty Dumpty' the siliceous Owen Conglomerate correlate overlies a surprisingly complex sequence of fine-grained pale pink to greenish rhyolites and feldspar-porphyries, quartz-porphyries, granite and volcaniclastic rocks including breccia, conglomerate and sandstone. The volcaniclastics appear to occur as large lenses, and their relationship to the more abundant rhyolites is problematical. In one place, a coarse breccia with large blocks of rhyolite can be seen to overlie the rhyolite and quartz porphyry, and appears to form a west dipping sliver 'plastered' on the slope. It may represent a down-folded remnant of an overlying sequence. Elsewhere, however, a thicker sequence of interbedded conglomerate and sandstone dips east into the hill and is apparently interbedded with the rhyolites. There are abundant hematite veins in the rhyolite in many places. Most of the compositional banding measured dips steeply east, but there are also steep westerly dips. A major NW-trending cross-fault truncates the Owen Conglomerate correlate on the north face of 'Humpty Dumpty'.

Of nine specimens of *rhyolites* from 'Humpty Dumpty', three consist entirely of extremely fine-grained quartz-feldspar-sericite (hematite) groundmass (78-212, 213, 215). These three are from near the contact with the Owen Conglomerate, where flow banding was noted. Another is similar (75-221) except that very fine shard-like structures are visible in plain light forming a vague foliation perpendicular to the cleavage. This specimen is from the low ridge just west of 'Humpty Dumpty', and may be a fine ash-fall deposit. Specimen 75-209 is from a large outcrop with prominent flow banding on the north-west flank of the hill, and comprises scattered altered feldspar phenocrysts in a murky, rather variable groundmass of quartz-feldspar-sericite. Specimen 75-210 contains a few ragged feldspar phenocrysts in an irregularly recrystallised groundmass of sutured grains of feldspar and lesser quartz interlaced with sericite. A pale green rhyolite from near the saddle on the lower western flank (75-219) contains what appear to have been feldspar phenocrysts replaced by fine secondary pink feldspar and in some cases, chlorite, but these are difficult to distinguish from irregular veins of feldspar-quartz-chlorite. Specimen 75-220 from the low ridge west of 'Humpty Dumpty' is a feldspar-porphyry, strongly fractured and veined, with altered and fractured feldspar phenocrysts in a very fine-grained quartz-feldspar-sericite groundmass rich in hematite and magnetite(?). Specimen 75-222, also from this ridge, is a fine-grained rock with a few completely altered feldspars in a groundmass which appears to consist of a mass of shards. This rock is probably an ash flow.

The *quartz-porphyry* appears to form lens-like bodies within the normal rhyolites, and shows well developed flow banding in places. Specimen 75-207 contains numerous quartz phenocrysts up to 4 mm across, and rare completely sericitised feldspar phenocrysts, in a distinctive groundmass composed largely of small spherulites. The spherulites appear to consist of pale pink feldspar, and show radial and concentric structure in only a few cases. Most have a thin rim of pale greenish sericite. The interstitial spaces contain relatively coarse quartz grains and felted sericite-feldspar. Most of the quartz phenocrysts have a border of pinkish material, in optical continuity with the quartz, which is similar to that forming the spherulites. The rock has no apparent foliation.

Of the *volcaniclastic rocks*, 75-208 is from a conglomeratic sandstone which overlies a quartz-porphyry body along an irregular, apparently unconformable contact dipping west at 68°. The rock contains abundant rock

fragments and volcanic quartz in a matrix of brown, glassy sericitic material which in places contains distinct large shard-like bodies. Rock fragments include spherulitic and massive rhyolite, and a distinctive graphic granitic rock (Darwin Granite?). Specimen 75-211 is from a bedded conglomerate-sandstone sequence which appears to be interbedded with rhyolite and quartz-porphyry. The rock is cut by small quartz-hematite veins, and consists mainly of angular to sub-rounded rhyolite fragments and volcanic quartz grains in a sericite-rich matrix.

The *granite* on the lower western slope of 'Humpty Dumpty' is a pink, coarse-grained variety, and occurs as a NNW-trending dyke about 60 m wide.

South Darwin Peak area

Coarse pink granite forms the central belt in the area investigated around South Darwin Peak. The only other rock types seen are a thin band of altered pink rhyolite near the eastern margin, and two small quartz-porphyry bodies along the contact with the eastern sequence. The granite has not been examined in detail.

In a number of places along the area of the contact with the eastern sequence the granite appears to be brecciated, so that it is difficult to decide if the rock is granite bedrock or a weathered coarse clastic deposit derived from granite. This rock usually grades eastwards into granite-rich conglomerate and westward into normal granite. Elsewhere, the contact is clearly marked and abrupt.

The sliver of rhyolitic rock is 10-15 m wide and trends NNE. It consists of highly fractured, recrystallised, fine-grained material, mostly quartz, feldspar and sericite. It is possibly some kind of roof pendant or large xenolith.

EASTERN VOLCANICLASTIC AND QUARTZ PORPHYRY SEQUENCE

This sequence has been mapped in some detail between South Darwin Peak and the access road from Ten Mile Hill. The unconformable relationship with the underlying granite is clearly exposed at the southern end of the plateau north-west of South Darwin Peak, and can be confidently inferred in other areas. The high proportion of volcaniclastic rocks within the lower part of the sequence in this area has led previous workers to designate it as 'Jukes Conglomerate' (Hills, 1914, p.43; Bradley, 1954, p.216; Solomon, 1956, and 1960, p.47). However, the present mapping shows that the lower volcaniclastic rocks pass up into volcanic rocks (tuffs and lavas), that the sequence continues northwards at least as far as the South Darwin Track, and that the Owen Conglomerate correlate overlaps the sequence with almost certain unconformity. The proportion of volcaniclastic rocks appears to increase southwards.

South Darwin area

The basal part of the sequence here comprises volcaniclastic breccia-conglomerate containing abundant pink granite fragments up to 30 cm and some large blocks of green rhyolite up to 3 m long. Bedding in the conglomerate near the base dips east at 60°. The contact can be walked around the lower western flanks of South Darwin Peak, where the beds form steep cliffs, and bedding in this area dips south-east at 30-60°. The bedding is right way up as indicated by graded bedding, flame structures and small scours on sandstone beds. The lower 100 m or so of the section in this area consists mainly of massive, coarse volcaniclastic conglomerate, with only rare sandstone and possible tuff beds and some thin units of interbedded sandstone and siltstone.

The sequence is abruptly and erosionally overlain by siliceous sandstone and fine conglomerate of the Owen Conglomerate correlate on the west flank of South Darwin Peak. There is no interbedding of the two units as claimed by Hills (1914, p.43).

North-east of the peak, the sequence is exposed along the broad crest of a ridge east of the main plateau. Here the typical conglomerates and sandstones are interbedded with tuff and tuffaceous sandstone. Bedding generally dips steeply east, but shallower east dips occur towards South Darwin Peak. Specimen 75-189 is from a tuff unit on the western flank of the ridge, and comprises abundant quartz and pink feldspar phenocrysts floating in a murky, very fine groundmass rich in small angular shapes like shards. Much of the feldspar is non-twinned or simply twinned. A few small rock fragments are also present. Specimen 75-190 is from a fairly extensive unit along the western side of the northern part of the ridge. The rock is cleaved, green, fine- to medium-grained, and rich in quartz grains, and on field evidence would be either a tuff or a fine volcaniclastic rock. In thin section, angular to well rounded grains of volcanic quartz, and numerous patches of carbonate (some of which appear to be after feldspar crystals), are contained in an abundant fine quartz-feldspar-sericite groundmass showing a strong sericite foliation. Some of the quartz phenocrysts are embayed by the groundmass, but are not obviously part of rock fragments. Large glassy patches in the groundmass have wispy ends rather like pumice fragments, and an internal cellular structure. The rock appears to be a tuff, possibly an ignimbrite.

A distinctive band of pink conglomerate rich in granite clasts occurs along the northern part of the crest of this spur, and has an arkosic matrix rich in quartz and feldspar. Fragments of hematite up to 8 cm long occur in this rock. It is overlain to the east by pink crystal-vitric tuff, similar to 75-189. A small knob or lateral spur at the northern end of this ridge shows coarse tuff or tuffaceous conglomerate interbedded with green cherty shale. An irregular contact between tuff and shale is exposed here, and blocks of shale occur in the tuff, suggesting east-facing. A massive pink to green volcaniclastic rock rich in quartz, follows this to the east. This rock (78-191) consists mainly of granitic rock fragments, made up of coarsely intergrown quartz and feldspar (commonly altered), in a sparse matrix of granular quartz, feldspar, chlorite and sericite. Coarser volcaniclastic rocks follow this to the east (*e.g.* 75-192), with abundant perthitic granite fragments and also rhyolite and quartz-porphyry fragments.

Interbedded volcaniclastic conglomerate and sandstone are exposed towards the southern end of this ridge, near the foot of South Darwin Peak. The beds dip east at 45-55°, and face east, and are cut by a steep east-dipping cleavage. Conglomerate beds range up to 4 m in thickness, and vary in texture from clast-supported to matrix-supported.

Access road - Ten Mile Hill area

A more or less continuous section is exposed up the access road from Ten Mile Hill to the eastern edge of the plateau. The contact with the granite at the edge of the plateau appears to be a sub-vertical fault, trending 137°. To the south of the road, for at least one kilometre, brecciated granite near the contact is followed to the east by volcaniclastic rocks interbedded with cleaved, greenish-grey sandy rock, rich in fine quartz, feldspar and sericite, which could be tuff. About 300 m south of the road, volcaniclastic conglomerate near the granite has an irregular sharp contact with a fine-grained tuffaceous rock which in thin section (75-193) has quartz and altered feldspar crystals in a sericitic matrix which appears to be composed almost entirely of fine glass shards. Brown-stained secondary carbonate and opaque grains altered to leucoxene are common. This rock appears to be an ignimbrite.

The unit near the contact in the road section is a greenish-grey, fairly fine-grained, cleaved, fragmental rock with fairly numerous small rock fragments of granite and green rhyolite, up to 5 cm across, in an abundant greenish matrix. In thin section (75-194) embayed and broken quartz grains, very altered feldspar, and scattered small fragments of perthitic granite and quartz-feldspar-biotite rock are contained in a strongly foliated brownish-green glassy-looking matrix. Abundant small shapes in the matrix suggest it could originally have been rich in glass shards. After about 30 m this unit becomes more conglomeratic, with a gritty matrix rich in quartz. This continues for about 15 m, then becomes finer-grained and tuffaceous. A conglomeratic unit, about 10 m thick, with fragments up to 12 cm long follows. This passes gradationally into finer-grained 'tuffaceous' rock, about 10 m thick, followed by conglomerate and then by cleaved greenish tuff with wispy fragments resembling fiamme.

There is an abrupt change to purplish pink quartz-feldspar porphyry at the foot of the first slope east of the plateau. This rock occurs along the crest of the ridge for several hundred metres. In thin sections (75-195, 196) it consists of abundant small to large feldspar phenocrysts and less common quartz phenocrysts, as well as feldspar-chlorite-magnetite bodies and rare chlorite phenocrysts, in a very finely microcrystalline groundmass which appears to consist mainly of feldspar. Many of the feldspar phenocrysts are strongly corroded. The cross-strike thickness of this unit is about 200 m. It is probably a lava, since pieces of it occur in a fragmental rock just to the east.

This is followed by feldspar-rich rock (75-197) with abundant large feldspar phenocrysts and less common quartz phenocrysts in a murky groundmass of quartz, feldspar, sericite and opaque dust. The phenocrysts characteristically have a rim of slightly pleochroic chlorite-sericite along two or more sides, and many have cracks filled with similar material in roughly parallel orientation, forming a weak foliation. Whether the rock is a lava or a recrystallised crystal-vitric tuff is difficult to say.

Down the eastern slope of this ridge, the rocks are pale green to pink quartz-feldspar-phyric rocks, with fragmental zones in places. Specimen 75-199 is a quartz-feldspar porphyry with a very finely microcrystalline groundmass, resembling a lava. Zones of this rock type appear to alternate with more cleaved, fragmental zones in which small rock fragments (including granite) are apparent. Specimen 75-200 is from a natural outcrop about halfway down this slope, and is a quartz-feldspar porphyry in which irregular patches of the groundmass have recrystallised or devitrified to a slightly coarser texture than others. Some of the coarser patches are shaped like elongated amygdales and have a concentration of fine chlorite towards the core area and a fine-scale spherulitic texture in parts. The rock is either a lava or a devitrified welded tuff. Specimen 75-201 has numerous ragged feldspars and corroded quartz phenocrysts in a groundmass showing fine-scale snowflake texture. Most of the quartz phenocrysts have a broad rim of optically continuous groundmass material like a large snowflake. Although there is no evidence of shard structure, this rock could also be a devitrified welded tuff. Specimen 75-202 is from near the base of the slope, and has ragged feldspar and quartz crystals and a few small rock fragments (mainly quartz-porphyry) in a variable fine groundmass.

A small rounded spur is crossed by the track just west of Ten Mile Hill, and shows outcrops of pale green streaky tuff with small rock fragments. In thin section (75-203) the rock contains quartz and feldspar crystals and some small rock fragments (quartz-porphyry and fine rhyolite) in a strongly foliated, sericite-rich groundmass with traces of what could have been welded shard structure. The rock is probably an ash-flow.

This green tuff ends abruptly against cleaved roundstone conglomerate on the east flank of this knob. The contact is subvertical and the conglomerate unit is of the order of 15 m thick. It contains pebbles, cobbles and small boulders of a variety of rock types in a strongly-cleaved volcaniclastic matrix. Clasts include coarse and fine-grained tuff, quartzite, laminated siltstone, fine-grained green rhyolite(?) and possible siliceous fine conglomerate. The abundance of the larger clasts decreases eastwards.

The conglomerate is followed to the east (contact obscured) by massive pink quartz-feldspar porphyry similar to that on the upper ridge. In thin section (75-204) it contains numerous small to large feldspar phenocrysts, less common large embayed quartz crystals, and a few small rock fragments, in a very finely microcrystalline groundmass. Patches of the groundmass show slightly coarser devitrification texture, with spherulitic and fibrous aggregate textures apparent. Crystal-shaped patches rich in opaque grains, and filled with a fine feldspar-quartz mosaic, occur scattered through the groundmass and may be altered feldspars. The rock is probably a crystal-vitric tuff rather than a lava. To the east, near the base of the slope, it passes into strongly cleaved greenish tuff with rock fragments up to 7 cm in places. Large embayed quartz crystals are prominent in thin section (75-205), in a sericite-rich matrix showing two foliations at 30° to each other.

The outcrop in the saddle immediately west of Ten Mile Hill comprises deeply-weathered, cleaved, purplish to yellow rock with quartz and feldspar crystals and small rock fragments in a very sericitic matrix. The rock is cut by many shear planes in various directions, and there is some suggestion of a coarse breccia texture. The contact with the siliceous sandstone of the Owen Conglomerate correlate occurs on the flank of Ten Mile Hill just east of this, and appears to be faulted.

VOLCANICLASTIC CONGLOMERATE OF MT SORELL

Much of the eastern flank of Mt Sorell consists of massive purplish-grey volcaniclastic conglomerate forming smooth steep faces. The contact with the Clark Valley sequence is obscured by superficial deposits. Crude bedding is evident in a few places, and is subvertical or dips very steeply west. Bedding marked by a band of small, rounded hematite pebbles was noted in one place, dipping west at 82°. A strong vertical N-S schistosity is evident in most areas, and there is also a crude planar structure dipping 55°E. Clasts are mostly rounded and of pebble to cobble grade, with rare small boulders. Rock types include quartzite (rare), quartz-porphyry, fine-grained lava, granite, foliated green rhyolite, vein quartz, hematite, and quartz-mica schist. The clasts tend to be dispersed in an abundant grey sandy matrix rich in volcanic and granitic quartz and feldspar. The rock is cut by quartz and quartz-chlorite veins.

The proportion of quartzite and siliceous clasts appears to increase up the slope. There is a change in lithology at a shelf or saddle area above the lower cliffs, from matrix-supported pebble-cobble conglomerate to relatively well-sorted pebble conglomerate with a coarse granular matrix. Bedding is difficult to see but dips steeply west. The rock is predominantly volcaniclastic but has a significant proportion of quartzite clasts. Overlying this, apparently abruptly, is grey siliceous granule conglomerate and coarse sandstone, with scattered volcanic pebbles, dipping west at about 50°.

The contact between the volcaniclastic rocks and the siliceous sequence was investigated closely in one small area, but no evidence for actual unconformity was found, and gradation between the two seemed possible. The proportion of volcanic clasts decreases rapidly upwards, and sandstone becomes subordinate to siliceous pebble conglomerate through this 'transition sequence'

of some 30-40 m. Grey-green silty sandstone, containing some volcaniclastic detritus, was noted within this sequence about one kilometre further south. Here again, there is a discordance in dip (from 60° to 82°) between beds above and below the transition sequence. It is possible that an unconformity between the transition beds and the massive volcaniclastics has been obscured by reworking of the upper part of the volcaniclastic material, but this requires further investigation.

OWEN CONGLOMERATE CORRELATE

Siliceous sandstone and conglomerate, correlated with the Owen Formation, occurs on South Darwin Peak, 'Humpty Dumpty', Ten Mile Hill, and Mt Sorell. Investigation has mainly been concerned with the relationship of the formation to the underlying rocks.

On *South Darwin Peak*, the sequence consists mainly of pink to purplish quartz sandstone and conglomeratic sandstone, with relatively minor pebble conglomerate. Worm tubes and coiled structures like *Lecanospira* were noted near the top of the peak. Bedding dips gently south to south-west, and appears to form a south-plunging monocline. The formation extends as a thin sliver or wedge, only 5-10 m thick, for several hundred metres down the west flank of the peak, more or less parallel to the slope (fig. 1). The contact with the underlying volcaniclastic sequence is well exposed in a number of places around this wedge, and is erosional and unconformable. The basal bed, which varies from a thin sandstone, 8 cm thick, to a local coarse conglomerate, one metre thick, fills channels and grooves cut in the underlying rock. In a number of places there are concentrations of rounded hematite pebbles at the base. Although bedding is usually difficult to see in the underlying rocks, a number of readings in this area close to the contact show east to south-east dips of 35° to 65°, while the overlying sandstone-conglomerate dips south to south-west at 17° to 40°.

On the north face of South Darwin Peak, there is apparent conformity between the purple conglomerate and sandstone of the Owen Formation, and underlying thick-bedded volcaniclastic conglomerate. A bedding reading from about 30 m below the contact indicates a south-east dip of about 40°, while the lower part of the Owen dips south-east at about 35°. Further to the north-east however, dips in the underlying rocks are moderate to steeply east, while the basal Owen beds of the east flank of the peak dip south-west at 20°. Unconformable overlap of the eastern volcanic sequence by the Owen Formation correlate seems inescapable in this area (fig. 1).

On *'Humpty Dumpty'* the Owen correlate dips south-east at about 45°, with shallower dips near the fault at the northern end. Three distinct units occur in the area mapped - a lower siliceous conglomerate, a volcaniclastic conglomerate-sandstone unit, and an upper siliceous sandstone-conglomerate unit. The lower unit comprises some 15-20 m of thick-bedded white pebble to cobble conglomerate, with boulder-size clasts in places. It has an erosional channelled base which transgresses the underlying volcanic rocks of the central rhyolite sequence. Clasts of volcanic rocks, including foliated rhyolite, quartz-porphyry and granite, are fairly common, and in places a distinctive layer of rounded hematite pebbles and granules occurs at the base. The volcaniclastic unit comprises some 10-15 m of cleaved volcaniclastic conglomerate passing up into purplish shaly sandstone. The upper unit is at least 30 m thick (top not examined), and comprises pink to purplish sandstone passing up into white thin-bedded fine conglomerate and pink sandstone. The lower part of this upper unit, where it crosses the crest of 'Humpty Dumpty', is folded and deformed in what appears to be a large slumped mass, but the deformation apparently does not persist into the overlying sandstone.

On the west flank of *Ten Mile Hill*, the contact with the eastern sequence is exposed in a bulldozed track, due east of the saddle, and appears to be a fault. Deeply weathered green to brown volcanic rock, with quartz crystals, is followed by a zone about one metre wide of limonitised breccia material containing subangular fragments of purple mudstone and quartzite and green claystone in a brown clayey matrix. This is interpreted as a fault zone. Overlying this is finely-fractured thin-bedded purple quartzite with bedding dipping east at 75°. Thin-bedded quartzite with some interbedded shaly sandstone and purplish sandy mudstone is exposed along this track, but conglomerate is lacking. Bedding attitude varies considerably, and westerly and southerly dips were recorded.

On *Mt Sorell*, a great thickness of siliceous sandstone and fine conglomerate overlies the volcaniclastic rocks of the eastern flank. Bedding dips west to south-west at 45-60°, and a minimum thickness of 1200 m is indicated. To the west, the sequence appears to be faulted against Tertiary Macquarie Harbour Beds along the western foot of the range, and a prominent fault scarp is evident in several places. The lower beds, forming the cliffs along the eastern face, are mainly grey pebble conglomerates interbedded with sandstone, in beds up to one metre thick. Beds with large cobbles and a few boulders occur along the crest of the range south of the peak, but otherwise coarse conglomerates are rare. A unit of laminated greenish-grey micaceous siltstone and silty sandstone, about 10 m thick, occurs in a small saddle west of the main crest, about 600 m above the base. Above this, the sequence consists mainly of interbedded grey fine pebble conglomerate and conglomeratic sandstone, in beds 5-40 cm thick.

STRUCTURAL GEOLOGY AND UNCONFORMITIES

The structure of the volcanic rocks is difficult to determine because of their massive nature and the general scarcity of primary stratification surfaces and evidence for facing. Primary banding and bedding in the Clark Valley sequence generally strikes roughly N-S and is sub-vertical. Flow-banding dipping steeply south-west occurs at the northern end of the valley. The rocks are cut by a prominent sub-vertical cleavage striking NNW to N. Steep to vertical banding and bedding was recorded in the central rhyolite sequence on 'Humpty Dumpty', with strikes ranging between NE and NW. A NNW-trending cleavage also affects these rocks.

Bedding in the eastern sequence in the South Darwin Peak area strikes NE to NNE and dips moderately to steeply south-east. Easterly facings have been noted in several outcrops. Bedding is difficult to find in the road section above Ten Mile Hill, and no clear facings were seen. Bedding strikes roughly N-S and is generally sub-vertical, but westerly dips of about 60° were recorded in the central part of the sequence, and cleavage appears to be steeper than bedding at one of these localities. Macro-grading in the conglomerate unit near the eastern margin of the sequence, however, suggests east-facing. A prominent sub-vertical NNW to N cleavage affects the eastern sequence, and is also present in the volcaniclastic conglomerate sequence on Mt Sorell. A similar strong cleavage was observed in the volcaniclastic member of the Owen Conglomerate correlate on 'Humpty Dumpty', and experience from the Queenstown area strongly suggests that this prominent cleavage which affects all units is a Tabberabberan structure.

Disoriented fragments of foliated quartz-porphyry very similar to that of the Clark Valley sequence, are common in the conglomeratic beds of the eastern sequence on South Darwin Peak, together with fragments of rhyolite and granite. The foliation in the porphyry fragments is closely spaced and penetrative, and appears to wrap around the quartz phenocrysts. It appears

to be a cleavage rather than a primary flow foliation, since the latter when seen in similar porphyries in the Clark Valley tends to be marked by broader bands showing more or less prominent colour variations. If it is a cleavage, then it indicates a period of folding as well as uplift of the volcanic rocks prior to the deposition of the eastern sequence. The presence of abundant granite detritus in the sequence also indicates that there must have been very considerable erosion of the volcanic pile to unroof the Darwin Granite body. These phenomena suggest a major structural and stratigraphic hiatus rather than a normal quiescent period such as might produce a minor unconformity in the volcanic sequence. It should be noted also that the known mineralisation in the area (*e.g.* hematite-magnetite-pyrite-chalcopyrite zone at Prince Darwin, fig. 1), is confined to the central rhyolite sequence, the eastern sequence being apparently barren. Fragments of hematite and rounded hematite pebbles occur in the eastern sequence and in the Owen Conglomerate correlate.

A second unconformity can be demonstrated between the eastern sequence and the Owen Conglomerate correlate on South Darwin Peak. Bedding in the eastern sequence dips east to south-east at 35-80° (average about 60°), whereas the Owen Correlate beds dip south to south-west at low to moderate dips (20-40°), forming part of a broad, gentle, south-plunging anticline (fig. 1). There is local apparent conformity on the north-west face of the peak, where the underlying beds dip more gently south, but the contact as a whole can be clearly seen to transgress a considerable stratigraphic thickness of the eastern sequence. The fact that the Owen correlate rests directly on the central rhyolite sequence at 'Humpty Dumpty', only about 400 m west of the peak, also indicates that it transgresses the eastern sequence. The relationship on Mt Sorell between the Owen correlate and the underlying volcaniclastic conglomerate could not be clearly determined. There is some indication of transition, but bedding readings suggest some angular discordance.

REFERENCES

BRADLEY, J. 1954. The geology of the West Coast Range of Tasmania. Part I: Stratigraphy and metasomatism. *Pap.Proc.R.Soc.Tasm.* 88:193-243.

HILLS, C.L. 1914. The Jukes-Darwin mining field. *Bull.geol.Surv.Tasm.* 16.

SOLOMON, M. 1956. Darwin area, 1:31 680. (Unpublished map, Mt Lyell Co. Exploration Dep.).

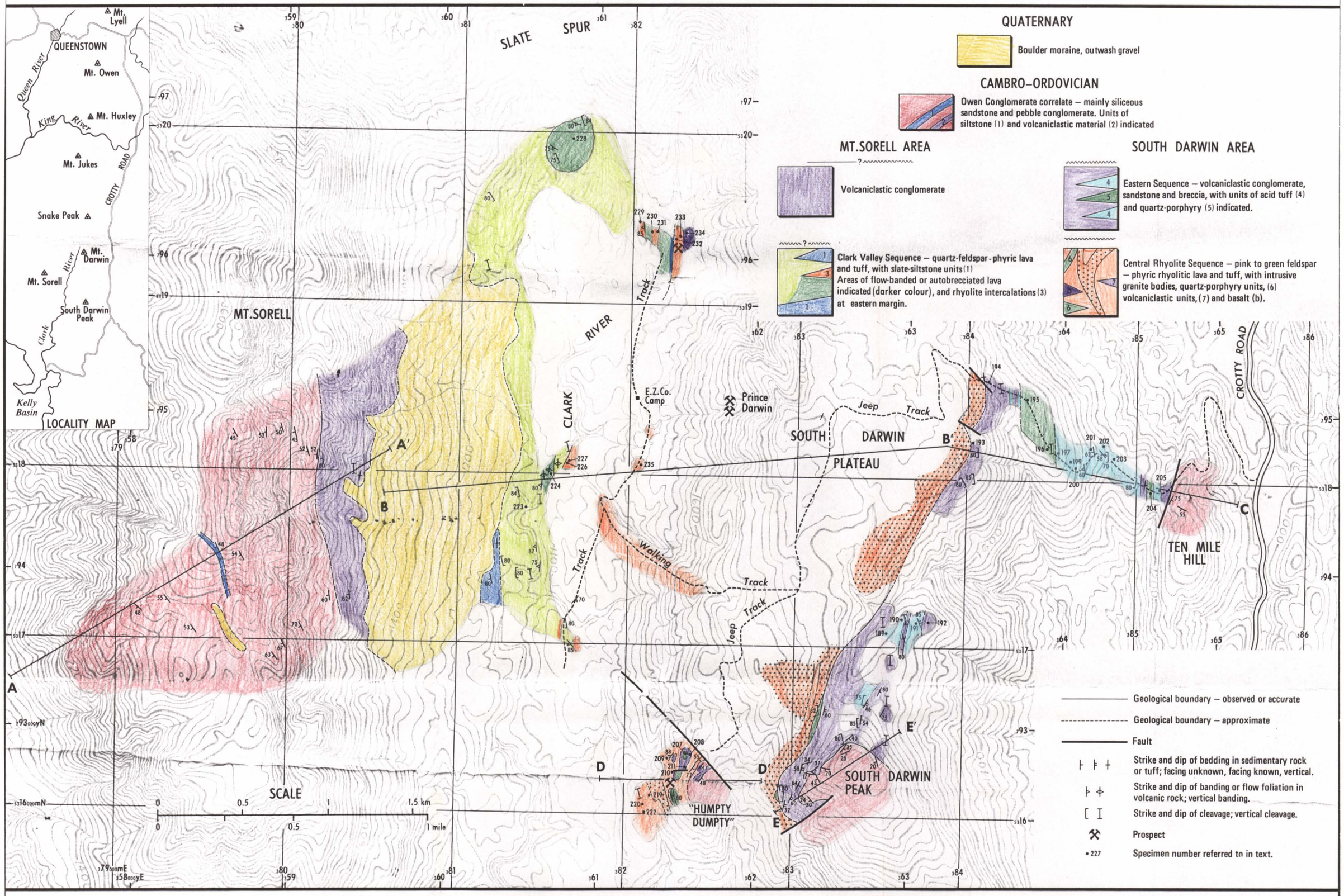
SOLOMON, M. 1960. The Dundas Group in the Queenstown area. *Pap.Proc.R.Soc. Tasm.* 94:33-50.

[5 August 1976]

13/13

GEOLOGY OF THE SOUTH DARWIN PEAK — MT SORELL AREA

K.D. CORBETT B.Sc. Ph.D.



CROSS SECTIONS A A' B B' C AND D D' E E'

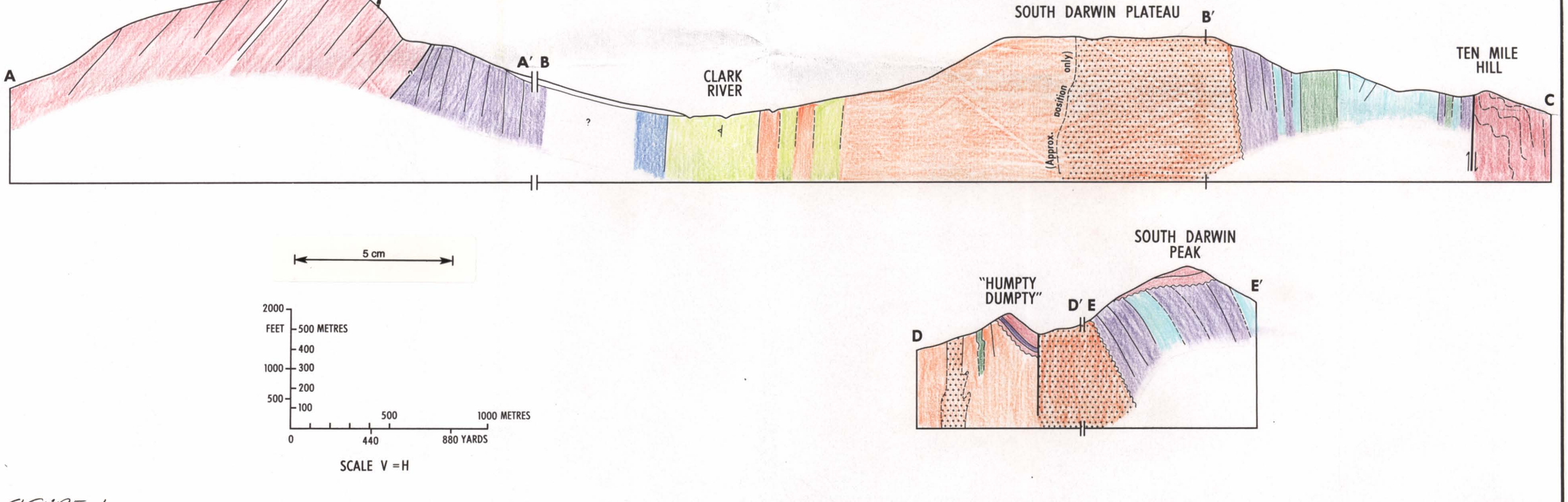


FIGURE 1.

CARTOGRAPHY: C.MEECH

4216 A