1980/42. Some aspects of the geology of the Mt Lindsay - Dundas areas, western Tasmania.

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Abstract

Descriptions are presented of the Oonah Formation, which belongs to the relatively unmetamorphosed group of Tasmanian Precambrian rocks, and the younger Eocambrian and Cambrian successions, the Success Creek Group, Crimson Creek Formation and Dundas Group. Relationships between the various rock units are discussed. The boundary between the Oonah Formation and Success Creek Group is a transgressive landscape unconformity. The Crimson Creek Formation conformably follows the Success Creek Group, the boundary being marked by a thin succession of haematitic rich chert, mudstone, siltstone, and conglomerate. An erosionally unconformable, but structurally conformable surface separates the Dundas Group from the underlying Crimson Creek Formation.

INTRODUCTION

This report contains a preliminary summary of results obtained from field and laboratory studies carried out on areas covered by the Renison Bell quarter sheet of the Zeehan Quadrangle, and the Wilson quarter sheet of the Corinna Quadrangle.

The original type sections of the Success Creek Group and Crimson Creek Formation of Taylor (1954) and the Dundas Group of Elliston (1954) were remapped and the extension of these stratigraphic units into the surrounding countryside was attempted with varying degrees of success. The area of Renison Limited's mine lease (65M/73) was not covered in this study.

A 1:12 500 scale compilation of the areas mapped is in preparation. This compilation is based on approximately 75 km of track and road traverses superimposed on 1:5000 scale maps, plus 1:5000 and 1:10 000 scale geological mapping of different parts of the area.

The field work was carried out during the summer field seasons of 1978-1980 and is part of a project designed to study the tectonic setting, petrology, chemistry, and mineralisation of the Tasmanian Cambrian ultramafic-mafic complexes. The subject of this report was also the basis of a paper presented at the Fourth Australian Geological Convention, Hobart (14-18 January, 1980). The abstract of this paper is included as Appendix 1.

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OONAH FORMATION - SUCCESS CREEK GROUP

Geological relationships

Proof of an unconformable relationships between the Oonah Formation rock sequences and sequences of the younger Success Creek Group can be observed along the southern bank of the Pieman River at CP616743. The transgressive onlap nature of the unconformity between these two successions

can be seen along creeks and tracks in the Misty Valley area [CP634759 - CP627788] and in creek sections south-west of the H.E.C. Lower Pieman Dam road between CP592801 and CP613795.

The unconformity has not been seen in outcrop, but rock sequences on either side of a 50 m wide scree zone in the Pieman River imply an angular landscape surface between the two successions. This surface also represents a structural and low grade metamorphic break as well as a hiatus in sedimentation.

The underlying Oonah Formation consists of two parts, a lower and an upper succession. The lower succession is dominated by indurated, monotonously interbedded, very fine- to fine-grained lithic and siliceous sandstone, with minor sequences of laminated phyllitic mudstone. The upper succession, as exposed in the Pieman River, consists of interbedded mudstone and carbonate alternating with laminated siltstone and mudstone sequences containing beds of graded, coarse-grained lithic sandstone, crystal-lithic and lithic-vitric tuff and thin brecciated lava units.

The Success Creek Group is considered to consist of five mappable sequences, each having a variable thickness. Only the lower four sequences occur in the type sections along the Pieman River (Taylor, 1954). The basal sedimentary mixtite is 50 m thick in the river section, consists dominantly of locally derived material, and overlies the Oonah Formation successions with landscape unconformity. Clasts vary in size from pebble- to cobble-grade and are set in a matrix of silt, sand and carbonate. Locally derived carbonate and mudstone clasts, as well as well rounded cobbles of quartzite and chert, occur with this unit. Lenses of silt to coarse sand grade material also occur throughout the mixtite and have an orientation sub-parallel to bedding in the overlying sandstone sequence.

The second sequence consists of interbedded, clean, shallow water sandstone, which crops out along the Pieman River around CP632751, as well as along the Murchison Highway south of Renison Bell and to the north-west of the Argent Dam. In the mine sequence at Renison this sandstone sequence is called 'Dalcoath Quartzite' (Gilfillan, 1965). The sandstone sequence grades rapidly into the third sequence, which is dominated by laminated mudstone with siltstone, minor sandstone and conglomerate units. This sequence is characterised by pervasive intraformational soft sediment deformation and later reacted incompetently during localised large scale slump movements.

The topmost sequence in the Pieman River consists of thinly bedded siliceous siltstone with mudstone partings and minor sandstone and calcareous siltstone units. This sequence is a walkable continuation of the 'Renison Bell Shale' (Gilfillan, 1965) of the Renison mine sequence. In the Pieman River the top of the Success Creek Group has been faulted out. In the Renison mine sequence the siliceous siltstone sequence is conformably followed by a carbonate unit, then by interbedded haematitic chert and mudstone units with minor lithic wacke and conglomerate (Newnham, 1976). This haematitic sequence was first described by Condor in 1918 when he referred to it as 'red rock'. A correlate of this sequence occurs in the Mt Lindsay area and is well exposed in cuttings along the Lower Pieman Dam road around the 24.9 km mark [CP615798]. In this area the sequence dominated by haematite is approximately 13 m thick and contains minor fine conglomerate and pebbly lithic wacke as well as chert and mudstone.

Between the 'red rock' and the 'Renison Bell Shale' correlate in the Mt Lindsay area is a 60 m thick sequence of interbedded, laminated siliceous siltstone, black or haematitic mudstone, dolomitic carbonate, black oolitic

chert and recrystallised brecciated chert units. The laminated siltstone shows soft sediment deformation.

There is sufficient evidence in the non-sandstone sequences of the Success Creek Group to show that these sedimentary rocks were deposited within a relatively unstable environment, initially shallow water, that was probably subsiding at the time. Such occurrences as mixtite (mudflow conglomerate), combining material from at least two different sources, intraformational soft sediment deformation, and localised mass movement blocks occur within the succession.

Structural comparisons

Structurally, rocks of the Oonah Formation contain isoclinal folds with a well developed axial surface cleavage. These isoclinal folds have been refolded by a later phase of deformation which produced a random distribution of the isoclinal fold axes. Phyllitic mudstone within the Oonah Formation contains a cleavage associated with the isoclinal folding which was subsequently crenulated by the later phase that refolded the isoclinal folds. In the fold hinge zones of still later folds, both of these cleavages have been subjected to later crenulation when large scale folding produced the dome-shaped anticlinorial structure which dominates the Oonah Formation in the Zeehan - Mt Lindsay - Granville Harbour area. Later, Devonian folding superimposed up to two additional cleavages upon the Oonah Formation.

The structural hiatus between the Oonah Formation and the overlying structurally similar Success Creek Group, Crimson Creek Formation, and Dundas Group, is demonstrated by the fact that the only cleavage so far found in the latter three successions are consistent with the Devonian deformation. This deformation produced open folds with shallowly plunging hinge lines and associated steep cleavages. The dominant cleavage recorded in the three Eocambrian - Cambrian successions is consistent with the north-westerly trending fold phase of Devonian deformation, whilst the second cleavage, observed in some outcrops, is explained as belonging to the earlier northerly trending fold phase of Devonian deformation.

Metamorphic grade

The difference in metamorphic grade on either side of the unconformity is slight. Within rocks of the Oonah Formation, the matrix fraction of the sandstone units has recrystallised and commonly occurs as muscovitic beards in the cleavage direction around and between the clastic grains. Some overgrowth between clastic grains has occurred, but the basic clastic texture of the sandstone predominates and the term quartzite cannot be applied. In the rock sequences above the unconformity, only partial recrystallisation of the matrix component has occurred and this is parallel to the dominant cleavage. Overgrowth between the clastic grains has not been observed in the Eocambrian-Cambrian sedimentary rocks outside the contact metamorphic aureole of the Meredith Granite.

SUCCESS CREEK GROUP - CRIMSON CREEK FORMATION

Geological relationships

The boundary between these two successions in their type area on the Pieman River is now known to be a fault. The fault is a north-westerly continuation of the Federal - Bassett structure of the Renison area. In the Renison mine area (Newnham, 1976) and regionally in the Mt Lindsay area,

the Success Creek Group is conformably overlain by the Crimson Creek Formation. When looked at in detail, the boundary zone in the Mt Lindsay area shows many tectonic features.

Along the Crimson Creek - Pieman River - Huskisson River type section (Taylor, 1954), the Crimson Creek Formation consists mainly of laminated siltstone and mudstone with volcaniclastic lithic wacke. The proportion of volcaniclastic material in the succession increases northwards from south of the Pieman River into the Mt Lindsay area, where the first interbedded basaltic units have been found.

In the Mt Lindsay area, the Crimson Creek Formation consists of volcaniclastic lithic wacke and minor tuff horizons, monotonously interbedded laminated siltstone and mudstone, tholeiitic basalt flows, and carbonate horizons. The clastic units show most of the characteristics of typical turbidite flows, but the presence of tuff horizons, thin interbedded non-pillowed lava flows, and carbonate beds leave the question of water depth undetermined.

The laminated siltstone and mudstone units may be calcareous, vary in grain size from clay to silt grade, and commonly contain multiple truncated cross-laminations. These finer units usually display a good anastomosing cleavage. The carbonate horizons rarely crop out, but weathered units can occasionally be seen. Lithic wacke beds vary in thickness from 200 mm up to 1.5 m, are fine- to coarse-grained, usually graded, contain rip-up mudstone fragments up to 100 mm in length, basal scour and flame structures, as well as the occasional soft sediment deformation zone in the upper part of a turbiditic unit. The tuff horizons can be lithic crystal or crystal lithic, are well compacted and derived from acid to basic volcanic sources.

The Lower Pieman Dam road gives access to a section through 3000 m of the Crimson Creek Formation succession. In the upper part of this formation, as exposed between the 26 and 27 km marks, tuff horizons are dominantly medium-grained, contain fragments of tholeiitic and dacitic lavas and crystal fragments of fresh volcanic pyroxene, as well as volcanogenic quartz and feldspar grains. In the lower parts of the succession, as exposed between the 25 and 26 km marks, the volcaniclastic lithic wacke units are fine- to medium-grained and tuff horizons are infrequent. Thin tholeiitic basalt flows occur in this part of the succession.

Structural features

Over 300 bedding readings have been obtained from rocks of the Crimson Creek Formation from a strip of country running from Renison Bell to Mt Lindsay. At over half of these stations a sedimentary facing was obtained, which, without exception, faced east. Apart from minor drag folds near fault zones, no tectonic folds were observed within rocks of the Crimson Creek Formation. The dominant cleavage within this formation is consistent with an axial surface cleavage formed during the north-westerly trending Devonian deformation fold phase.

CRIMSON CREEK - DUNDAS GROUP

Geological relationships

All contacts so far observed by the writer between rocks of the Crimson Creek Formation and Dundas Group successions are faults. Remapping the type area of the Dundas Group (Elliston, 1954) shows that it consists dominantly of two distinct successions that may have been separated by a break in sedimentation. The lower part is sparsely fossiliferous and con-

sists of laminated siltstone and mudstone alternating with either mudflow conglomerate interdigitated with basic volcanic rocks or turbiditic chert-conglomerate sequences. The top of the lower part appears to be shallow water siltstone and mudstone that contain beds with multiple sand-starved ripple marks, interbedded with acid volcanic tuff. The units within the lower succession vary rapidly in thickness and appear to be localised basin infillings on eroded Crimson Creek Formation basement. Using the terminology of Elliston (1954), the lower succession consists of all rock units up to and including the lower part of the 'Brewery Junction Formation'.

The upper succession of the Dundas Group is a fossiliferous turbidite sequence, extending from the middle of the 'Brewery Junction Formation' as mapped in the type area, up to and including the 'Misery Conglomerate'. The only known contact between these two successions is a fault that runs through the old township of Dundas. The upper succession has fossils belonging to the earliest Late Cambrian (J.B. Jago, pers.comm.) in the lowermost part of the succession, as exposed in the Dundas Rivulet.

No formation of the original Dundas Group (Elliston, 1954) can be successfully walked outside the Dundas area. Any correlation with the Dundas Group can only reliably be made on biostratigraphic evidence, as very similar lithological units to those found in the upper part of the Dundas Group have been found elsewhere in much older successions.

One biostratigraphic correlate of the upper succession of the Dundas Group, the Huskisson Group of Taylor (1954), is exposed along the Lower Pieman Dam road between the 34.8 and 34.3 km marks and consists of a succession of laminated and thinly-bedded siltstone, sandstone and fine conglomerate. The sandstone and conglomerate units are usually graded, with the conglomerate units lensoidal. Some sandstone units show ripple-marks.

From evidence so far obtained it is suggested that the Crimson Creek Formation is of Eocambrian age and that the Early Cambrian and early Middle Cambrian times represented a period of erosion before the onset of Dundas Group sedimentation in the middle Middle Cambrian.

Structural features

Structurally, rocks of the Dundas Group contain up to two cleavages. The dominant cleavage is parallel to the axial surface of the north-westerly trending Devonian fold phase, while the second cleavage occurs randomly throughout the Dundas area and is consistent with the earlier northerly trending fold phase of Devonian deformation.

ULTRAMAFIC - MAFIC COMPLEXES

The largest area of ultramafic - mafic rocks in the area under discussion is part of the Wilson River Complex. The main mass is a strike-ridge of massive and thickly interlayered serpentinised dunite and pyroxene-bearing dunite. Areas of layered dunite, pyroxene-dunite, orthopyroxenite, and minor clinopyroxene-bearing peridotite occur at both the northern and southern extremities of the complex.

To the south of Renison Bell occurs the Serpentine Hill Complex. This is well described by Rubenach (1974), and consists of finely interlayered orthopyroxenite, and harzburgite with minor dunite, norite, lherzolite and wehrlite. Interstitial plagioclase occurs in some layers.

At Dundas there are several residual kernels of layered harzburgite and pyroxenite in a dominantly weathered serpentinite mass. The residual layering and textures within these kernels is similar to the sequences at Serpentine Hill.

Layering styles, textures and mineralogy of the ultramafic rocks from these complexes are consistent with a cumulative origin. Most of the complexes have a zone of tectonic deformation, but these are not always basal zones nor always in the same zone in different complexes. In some complexes the tectonite zone transgresses layered sequences. Although the ultramafic complexes show high temperature deformation characteristics, the emplacement of the complexes into their present positions within the sedimentary sequences was accompanied only by local minor deformation. No imbricate thrust structures have been recognised within the sedimentary sequences into which the ultramafic rocks have been emplaced.

Detritus derived from these ultramafic bodies occurs in basal conglomerate of the lower succession of the Dundas Group. These are exposed in the Ring River and on Confidence Saddle.

REGIONAL STRUCTURE

The dominant structure affecting the region is the north-westerly plunging Huskisson Syncline. All pre-Silurian successions are steeply dipping and are overturned over a large part of the area. Structural profiles compiled from traverse information show that with the exception of minor tight local folds producing contrary sedimentary facings, all sedimentary facings from the hinge of the syncline, east to the faulted boundary of the sedimentary rock successions with Mt Read type volcanic rocks, face to the west. All sedimentary facings obtained from those successions west of the syncline hinge to the Oonah Formation face east.

Folding was followed by a major phase of faulting during which part of the underlying ultramafic-mafic complexes were re-emplaced through their sedimentary cover to give the present geometric relationships shown by the different rock sequences.

SUMMARY

The earliest Eocambrian - Cambrian deposits, the Success Creek Group, unconformably overlies the Precambrian Oonah Formation. Rock units within the Success Creek Group indicate an unstable basin of deposition with material being derived from both local and distant sources. The conformable relationships between the partially unstable sequences of the Success Creek Group and the turbiditic sequences of the Crimson Creek Formation, suggests a gradual deepening of the basin of deposition.

The ultramafic-mafic complexes were formed in crustal magma chambers as layered cumulate bodies at high temperature and low pressure from high-magnesia andesitic magmas. The timing of the original deformation at high temperature, during which emplacement of the ultramafic rocks to higher levels in the crust occurred, is unknown. Whatever the tectonic setting in the Middle Cambrian, rocks from both the Crimson Creek Formation and ultramafic complexes were eroded and intermixed with material from other sources to form the basal Dundas Group conglomerate sequences. These sequences appear to have been formed in irregular local depressions.

Tectonically, the area of deposition of the Success Creek Group, Crimson Creek Formation and Dundas Group sequences appears to have been relatively

quiet from the time of the Penguin Orogeny, which affected the Oonah Formation, until the Devonian, when the only deformation so far observed within the Eocambrian - Cambrian successions was produced. This Devonian deformation consists of open large scale folds with shallowly plunging hinge lines and an associated steep cleavage. Folding was followed by large scale block faulting with throws of over 1500 m between some of the Eocambrian and Silurian sedimentary rock sequences. After faulting there was an episode of granitic magma emplacement that stabilised the area in its present configuration.

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APPENDIX 1

Early deposits in a Lower Palaeozoic trough of western Tasmania

Shallow water sandstone sequences, with locally derived mixtite, of the Success Creek Group infilled a basin in comparatively unmetamorphosed lithic sandstone, mudstone and carbonate with tuff units and lava flows belonging to the Oonah Formation. The sedimentary rocks of the Success Creek Group overlie the basement with landscape unconformity. This unconformity represents a structural hiatus.

The rocks of the Success Creek Group fall into two types - the basal part of mixtite and sandstone, and an overlying succession of laminated siltstone and mudstone with varying amounts of interbedded conglomerate and sandstone. The upper part of this succession consists of carbonate units and coarse-grained sandstone lenses interbedded with mudstone.

Within the interbedded laminated siltstone and mudstone sequence there is an horizon exhibiting numerous structures developed during soft-sediment disruption. This horizon behaved in an incompetent manner when later tectonic movement produced overprinting of soft-sediment structures by tectonic deformation. Evidence available from within this horizon indicates that the sedimentary sequence was developed on an unstable shelf.

The tectonic activity responsible for the rapid deepening of the basin probably coincided with the onset of vulcanism which is recorded as a turbidite sequence of immature volcaniclastic lithic wacke interbedded with laminated siltstone and mudstone belonging to the Crimson Creek Formation.