STRUCTURAL HISTORY OF THE ARTHUR LINEAMENT, NORTHWEST TASMANIA: AN ANALYSIS OF CRITICAL OUTCROPS.

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ABSTRACT
The Arthur Lineament of northwestern Tasmania is a Cambrian (510 ± 10 Ma) high strain metamorphic belt. In the south it is composed of meta-sedimentary and mafic meta-igneous lithologies of the “eastern” Ahberg Group, Bowry Formation and a high strain part of the Oonah Formation. Regionally, the lineament separates the Rocky Cape Group correlates and “western” Ahberg Group to its west from the relatively low strain parts of the Oonah Formation, and the correlated Burnie Formation, to its east (Turner 1989). Early folding and thrusting caused emplacement of the allochthonous Bowry Formation, which is interpreted to occur as a fault-bound slice, towards the eastern margin of the parautochthonous “eastern” Ahberg Group meta-sediments. The early stages of formation of the Arthur Lineament involved two folding events. The first deformation (CaD1) produced a schistose axial planar fabric and isoclinal folds synchronous with thrusting. The second deformation (CaD2) produced a coarser schistosity and tight to isoclinal folds. South-plunging, north-south stretching lineations, top to the south shear sense indicators, and south-verging, downward facing folds in the Arthur Lineament suggest south-directed transport. CaF1 and CaF2 were rotated to a north-south trend in zones of high strain during the CaD2 event. CaD3, later in the Cambrian, folded the earlier foliations in the Arthur Lineament and produced west dipping steep thrusts, creating the linear expression of the structure.

KEY WORDS:
Arthur Lineament, Cambrian, Tyennan Orogeny, northwestern Tasmania, strain, structure.

INTRODUCTION
The Arthur Lineament, NW Tasmania is 8 km wide, 110 km long, and northeast-trending. It is a sheared belt of metamorphic rocks (Gee 1967a), of Cambrian age (Turner et al. 1998). The lineament separates the weakly deformed Neoproterozoic Rocky Cape Group correlates (shelf siliciclastics) to the northwest from the low-strain Burnie and Oonah Formations (turbidites) to the east (Figure 1). The lineament was multiply deformed during the Middle to Late Cambrian, Tyennan Orogeny (CaD1-CaD3) and has subsequently undergone several episodes of minor deformation in the Middle Devonian (DeD1, DeD2). The aim here is to use detailed structural information from parts of the Arthur Lineament to determine the nature of Cambrian tectonism in northwestern Tasmania. The Arthur Lineament has been the focus of several previous workers, at varying levels of detail. Gee (1967b) and Gee et al. (1967) carried out detailed structural mapping of the north coast of Tasmania, including the
Somerset-Doctors Rocks area. Spry (1957a) and Turner et al. (1991) carried out regional mapping in the lower Pieman River and Corinna areas, but did not attempt a detailed structural analysis. The present work is based on regional mapping of the Arthur Lineament and surrounds, but concentrating on detailed structural studies of the Somerset-Doctors Rocks region (northern study area), and the Reece Dam and spillway, Mt Donaldson-Longback and Granville Harbour to Four Mile Beach regions (southern study area) (Figures 1 and 2). The character of the lithologies and structural deformation within the Arthur Lineament, between the northern and southern study areas has not been investigated. The structural events described below are based on a synthesis of data from all these areas. The cleavage nomenclature of Passchier & Trouw (1996) is used in the descriptions below.

Rock units exposed within the southern part of the Arthur Lineament in clude the “Timbs Group”, and the Oonah Formation (Figure 2). The term “Timbs Group” was first used by Turner et al. (1991), but was not formally defined. Furthermore the “Timbs Group” is not a viable stratigraphic unit. It was interpreted to be a correlate of the Neoproterozoic Togari and Ahrberg Groups in northwest Tasmania, based on its similar stratigraphy and identical chemistry of the tholeiitic mafic sequences (Crawford 1992, Turner & Crawford 1993). However, the “Timbs Group” (Turner et al. 1991) includes the Bowry Formation. Unlike the rest of the “Timbs Group”, amphibolites within the Bowry Formation contain relict glaucophane, indicating an early blueschist metamorphic history (Turner & Bottrill 2001). This is not seen elsewhere in the “Timbs Group”. Furthermore the Bowry Formation contains a 777±7 Ma granitoid. Granitoids of this age are unknown elsewhere on mainland Tasmania. The age for the base of the Togari Group is <750 Ma (Calver & Walter 2000). The Bowry Formation amphibolites that the granitoid intrudes have been correlated with the Kanunnah Subgroup, which has a preferred age of 650-580 Ma (Crawford 1992). We conclude that the Bowry Formation cannot be a lithostratigraphic correlate of the Kanunnah Subgroup or any part of the Ahrberg Group. Turner & Bottrill (2001) discussed the problems associated with large differences in metamorphic history between the Bowry Formation and other parts of the “Timbs Group”. They concluded the Bowry Formation had a faulted margin against the rema inder of the “Timbs Group” with a metamorphic grade difference across the fault. The western section of the “Timbs Group” is interpreted here as a parautochthonous slice of the Ahrberg Group, and is referred to in this paper as the “eastern” Ahrberg Group. The autochthonous Ahrberg Group is referred to as the “western” Ahrberg Group. The Bowry Formation is referred to here as a separate unit with no specific correlates. The Bowry Formation is fault bounded within the southern Arthur Lineament, has in ter nal evidence of a different metamorphic history (Turner & Bottrill 2001) and is probably much older. There are other fault bounded units within the Arthur Lineament, in particular east of the Bowry Formation and faulted against the high strain Oonah Formation is a block of material that is similar in appearance to the “eastern” Ahrberg Group but no definite correlation can be made at this time.

The western boundary of the lineament in the north was defined by Gee (1967a) as a gradation from unmetamorphosed Rocky Cape Group outside the lineament, to slates and phyllites within it. In this area, Gee (1967a) also recognised a “mineral” isograd, defined by the appearance of albite
porphyroblasts. Turner (1989) described the southeastern boundary of the lineament, noting the transition from poorly cleaved quartzite and slaty pelite outside the lineament, to schist and phyllite that is accompanied by metamorphic differentiation within the lineament. However, as yet, no change in metamorphic grade has been recognised at the lineaments eastern boundary, possibly due to the simple mineral assemblage in the psammite-dominated packages. At the lineaments boundaries, early folds become tighter and quartz veining is more abundant. The features that define the boundary are dominated by dynamic metamorphic gradients and to emphasise this we refer to the “unmetamorphosed” rocks as low strain (slaty) zones and to the “metamorphosed” rocks as high strain (phyllitic or schistose) zones. On the north coast, the eastern margin of the lineament was recognised near Doctors Rocks and is not hidden under cover as suggested by Gee (1967a).

REGIONAL GEOLOGY

The early to middle Neoproterozoic of northwest Tasmania was dominated by deposition of shallow water siliciclastics and siltstone (Rocky Cape Group and correlates) in the west and turbidites (Burnie and Oonah Formations) in the east (Spry 1964). An extensional phase followed in the Late Neoproterozoic ca. 550-650 Ma (Adams et al. 1985, Calver & Walter 2000). This featured widespread intrusion of tholeiitic dolerite dykes (Rocky Cape dyke swarm), extrusion of tholeiitic basalts and deposition of associated volcanogenic sediments, carbonates and shallow marine siliciclastics (Success Creek Group-Crimson Creek Formation, Togari and Ahrberg Groups) (Brown 1989, Turner 1989, Crawford & Berry 1992). The Togari and “western” Ahrberg Groups rest on a regional-scale low angle unconformity. A more intense deformation (Wickham Orogeny) is known from King Island where there was polyphase deformation and extensive granitoid intrusion at about 760 Ma (Cox 1989, Turner et al. 1998) which may correlate with the unconformity beneath the late Neoproterozoic sequences of northwest Tasmania.

An arc-continent collision in the Early to Middle Cambrian initiated the Tyennan Orogeny (510 ± 10 Ma) (Berry & Crawford 1988, Crawford & Berry 1992, Turner et al. 1998). This resulted in the emplacement of allochthons, including mafic-ultramafic complexes in western and northern Tasmania (Crawford & Berry 1992, Turner et al. 1998). Movement indicators from the mylonitic soles of the allochthonous mafic-ultramafic complexes indicate west-directed obduction, the regional synthesis inferring an east-dipping subduction zone (Berry & Crawford 1988). The Arthur Lineament was formed during the early stages of the Tyennan Orogeny and predates a Middle Cambrian unconformity (Turner et al. 1998), but the exact process of its formation remains in doubt (Turner 1989, Berry 1994).

Subsequent deformation in the Middle Devonian as part of the Tabberabberan Orogeny (~370 Ma) resulted in further faulting and dome-and-basin style folding. This was closely followed by granitoid intrusion (332-367 Ma) (Williams et al. 1989).

REGIONAL STRUCTURAL HISTORY OF THE ARTHUR LINEAMENT
In both the northern and the southern areas of the Arthur Lineament, two intense, early fabrics are recognised. These fabrics decrease in intensity away from the lineament (Figure 3a and b). There is clear, consistent, and widespread evidence for the relative timing of the CaD₁ and CaD₂ events. The existing data (Turner et al. 1998) suggests both geometric events occur very early in the Tyennan Orogeny. They have very similar spatial distribution. We argue there is a close genetic link between these events and that they can be correlated throughout the length of the lineament.

A D₃ event was recognised in the northern Arthur Lineament. It has produced a weak, sub-vertical cleavage, with a north-northeast strike, in pelitic layers. F₃ macro-scale, open folds predate deformation interpreted to be Devonian in age. A D₃ event is also present in the southern parts of the Arthur Lineament. It also produced a variably developed, upright to west-dipping, north-northeast striking cleavage, of similar intensity to the S₃ fabric in the north of the Arthur Lineament. In the southern area the D₃ event is Late Cambrian in age, constrained by overprinting relationships at the Reece Dam spillway, where the D₃ refolds the earlier fabrics, and on the west coast, north of Granville Harbour, where the S₃ does not penetrate the overlying Ordovician sediments. In the Balfour and Trowutta areas, to the west of the Arthur Lineament, a fabric with consistent style and orientation, related to folding interpreted here to be Late Cambrian in age, is widely developed (Everard et al. 1996). On these grounds, the D₃ event in both areas is considered to be the same event.

**Deformation CaD₁ and CaD₂**

A CaD₁ (Cambrian D₁) event is evident throughout the lineament. CaD₁ produced mesoscopic to macroscopic, gently inclined to recumbent, isoclinal folds (CaF₁), and a finely spaced to schistose S₀-parallel axial planar foliation (CaS₁). To the east of the lineament, in low CaD₁ strain zones, CaS₁ is finely spaced to phyllitic and is best developed in more pelitic layers. The cleavage is typically a smooth, 0.5 mm spaced, parallel cleavage, with discrete cleavage domains and microlithons. In the southern study area, in the low strain zone 3-5 km east of the lineament, the CaS₁ foliation dips steeply to the northwest, whereas CaL₀₁ intersection lineations plunge moderately to steeply to the northeast. 1-3 km east of the lineament, where the strain levels are slightly higher (zones of phyllitic CaS₁ are dominant) the CaS₁ foliation dips moderately to the northeast, whereas CaL₀₁ intersection lineations plunge gently to moderately to the northeast. In zones of high strain within the lineament, CaS₁ is a smooth, zonal schistosity with finely spaced parallel cleavage domains (0.02 -0.2 mm wide microlithons), and discrete transitions between cleavage domains and microlithons. Within the lineament, CaS₁ is preserved in CaS₂-parallel lenses of mica and chlorite (Figure 3c). Within syn-CaD₂ albite porphyroblasts, inclusion trails (S₁) interpreted to be relict CaS₁ are preserved (Figure 3d). CaD₁ high strain zones feature intensely developed CaS₁ and are dominated by CaF₁ folds and S₀-parallel, syn-CaD₁ thrust faults. In these areas CaS₁-parallel quartz segregations are common. CaL₀₁ intersection lineations and CaL₁ stretching lineations are common and plunge moderately to the southwest.
CaD2 (Cambrian D2) structures are pervasive throughout the lineament and to the east. CaD2 produced recumbent, tight to isoclinal folds (CaF2). On the north coast, in low CaD2 strain areas to the east of the lineament, CaF2 folds plunge gently to the east and west, with axial planes dipping gently south. However, in the south, 3-7 km from the lineament, CaF2 folds plunge moderately to the northeast and CaS2 dips moderately to steeply to the east. In both of these areas the deformation produced a smooth, parallel 3-8 mm spaced axial planar cleavage in sandstones with discrete transitions between cleavage domains and microlithons (CaS2). More proximal to the lineament (1-3 km to the east of the lineament), CaS2 is a smooth 2-3 mm spaced, parallel, phyllitic cleavage with discrete transitions between cleavage domains and microlithons (Figure 3e). Regionally, CaS2 is the dominant foliation in both pelitic and psammitic layering. Within the lineament, in zones of high CaD2 strain, CaS2 is a smooth, 0.5-1.5 mm spaced, parallel schistosity with discrete cleavage domains and microlithons. It is sub-parallel to S0 and axial planar to tight to isoclinal folds. Crenulated CaS1 is preserved within CaS2 microlithons. In these high strain zones, in the south, CaF2 folds predominantly plunge gently to the south, however 1-3 km to the east of the lineament, they also plunge to the north. Axial planes dip gently to steeply to the east.

Throughout the Arthur Lineament, strain levels are high for both events, although locally the intensity of CaD1 and CaD2 vary. The CaS1 fabric is crenulated by CaS2, while syn-CaD1 thrust faults are tight to isoclinal folded by CaF2. These conditions have also resulted in the boudinage and isoclinal folding of CaD1-related quartz segregations. In areas where CaS2 is strongly developed, CaF1 and CaS1 are overprinted and difficult to find.

To the east of the lineament, both CaS1 and CaS2 decrease in intensity gradually, over several kilometres. In the northern and southern areas of the lineament, they are well developed (phyllitic) up to 3 km east of the lineament, and are weakly developed (slaty) up to 5 km from the lineament’s eastern margin. However, at the western boundary in the south, both foliations decrease in intensity over a much shorter distance. Within the lineament, close to its western margin, both CaS1 and CaS2 are schistose (Figure 3c). However, 300 m to the west of the lineament, CaS1 is no longer recognisable, and CaS2 is a phyllitic fabric (Figure 3f). Two kilometres from the lineaments western boundary, CaS2 is a smooth, continuous, and parallel cleavage, that is best developed in mudstone interbeds, and is crenulated by CaS3 (Figure 3g and 3h).

Deformation CaD3
The CaD3 (Cambrian D3) deformational event is not as strongly developed, and CaS3 is not as pervasive as CaS1 and CaS2. In the study area CaD3, which featured east-west compression, is most prominent to the west of the lineament in the “western” Ahrberg and Rocky Cape Groups, and in the southern parts of the “eastern” Ahrberg Group. Minor north-south trending post-CaD2 folds with an associated weakly developed spaced cleavage in pelitic layers, in the north of the study area are correlated with this event.
In the south of the study area (Corinna area) the structural overprint of the CaD₃ event is represented by gently south plunging, open to close CaF₃ folds, with gently dipping, “right way up” western limbs, and steeply east-dipping to overturned eastern limbs. The folds are moderately inclined with west-dipping axial planes that reflect an east-directed transport. West dipping thrusts were mapped in the Rocky Cape Group correlates at the Longback Ridge (341360 mE, 5398900 mN) and at Crescent Hills (344240 mE, 5402280 mN). A major, west dipping thrust is interpreted to occur in the “western” Ahrberg Group in Guthrie Ck (339980 mE, 5390980 mN). This was reported by Spry (1964) as the Delville Fault, however he did not assign a specific age to the structure. We interpret these faults to be syn-CaD₃ in age, based on their consistency of their style and orientation with the CaS₃. Spry (1964) mapped a west dipping thrust fault on the Pieman River, which intersects the Pieman River near the Donaldson River junction (the Donaldson Fault), associated with the main deformational event in that area, interpreted here to be CaD₃. Boudinage of competent beds commonly occurs on the limbs of the CaF₃ folds (eg. Figure 4f and g, 337160 mE, 539000 mN).

In the north of the study area (Somerset-Doctors Rocks area) CaD₃ was weak. Mesoscopic symmetrical CaF₃ folds have upright axial planes and shallowly dipping limbs. Associated with CaF₃ is a smooth, 2-5 mm spaced parallel cleavage with discrete transitions between cleavage domains and microlithons (CaS₃) (Figure 3g and h). The age of these folds on the northwest coast is poorly constrained, and they are tentatively assigned a CaD₃ age based on their relative timing post-CaD₂ and pre-DeD₁.

Although CaD₃ is not directly dated, a Late Cambrian age was inferred based on the folding of CaS₁ and CaS₂, and the absence of CaS₁ in the Ordovician Gordon Limestone on the west coast, north of Granville Harbour (334250 mE, 5372700 mN) (Figure 1).

Devonian deformation

Devonian age deformation, attributed to the Tabberabberan Orogeny, is widespread throughout western Tasmania and is interpreted to predate the widespread 332-367 Ma granitoid intrusion (Williams et al. 1989). In the north of the study area (Somerset-Doctors Rocks area) a mild deformational event postdates the CaD₃ event. This is tentatively correlated with the Loongana/Wilmot trend (De₁ Devonian event) of Williams et al. (1989), referred to here as DeD₁. It features sub-horizontal to gently plunging upright open folds (DeF₁), that has produced a poorly developed axial planar cleavage. The interference of the north-south trending CaF₃ and the east-west trending DeF₁ has resulted in dome and basin style folding (5-15 m wavelength). DeD₁-related faulting was not recognised in this area.

In the south of the study area (Reece Dam and Corinna areas) two deformational events corresponding to the De₁ of Williams et al. (1989) and known as the Zeehan/Gormanston trend overprint the Cambrian deformation. In this paper, the first of these is referred to as DeD₄, and the second is referred to as DeD₃. In the south of the study area, both DeD₄ and DeD₃ produced gently plunging meso- to macroscopic upright open folds (DeF₄ and DeF₃). The DeS₄ is a smooth, 5-10 mm spaced parallel
crenation cleavage locally developed in $DeF_4$ fold hinges. The $DeS_5$ is a very weak, smooth, <10 mm spaced, parallel crenulation cleavage that is also locally developed. The interference of the E-W trending $DeF_4$ and ESE-WNW trending $DeF_5$ has resulted in dome and basin style folding (10-50 m wavelength). Faulting interpreted to be contemporaneous with $DeD_4$ and $DeD_5$ is common in the southern part of the study area.

**DETAILED STRUCTURAL RELATIONSHIPS**

Spatial variation in intensity of all deformations ($CaD_1$-$CaD_3$ and $DeD_4$, $DeD_5$ and $DeD_3$) has lead to complex overprinting relationships. The aim here is to determine how the Cambrian structural elements of the Arthur Lineament were produced. Strongly deformed Burnie Formation, on the northwest coast (Somerset-Doctors Rocks area), contain a structural transition that correlates closely with the eastern margin of the Arthur Lineament in the south, and is much better exposed. The central and western portions of the Arthur Lineament are better exposed in the southern part of the study area (Reece Dam and Corinna areas). The following discussion highlights the relationships in these critical areas.

**Northern Arthur Lineament**

**STRUCTURE OF THE SOMERSET-DOCTORS ROCKS AREA**

Along the northwest coast of Tasmania in the Somerset-Doctors Rocks area there is excellent exposure of the variably deformed Burnie Formation (Figure 5a). Lithologies are composed of psammmites and psammopelites with minor basaltic lavas and associated intrusives (Cooee Dolerite). On the eastern flank of the Arthur Lineament, the westernmost outcrop of Burnie Formation provides evidence for the changing fold style and progressive increase in strain approaching the lineament. The deformation in this area is more complex than previously interpreted. The area is dominated by mesoscopic $CaF_1$ and macroscopic $CaF_2$ folds. Syn-$CaD_1$ and syn-$CaD_2$ thrusts are common (e.g. 400075 mE, 5456990 mN and 399750 mE, 5457100 mN). Subsequent deformation ($CaD_3$ and $DeD_3$) has resulted in dome- and basin style folding.

Three structural domains resulting from Cambrian-age deformation can be identified in the Somerset-Doctors Rocks area based on orientation and tightness of folds, frequency of faulting and intensity of associated fabrics. The domains are:

- Eastern low-strain Domain N1 (Somerset)
- Central low-strain Domain N2 (west of Somerset)
- Western high-strain Domain N3 (east of Doctors Rocks).
No change in mineralogy has been detected across these three domains. While historically (Gee 1967a) the textural changes described here have been associated with increasing “metamorphism” we found no evidence of a change of metamorphic grade across these zones.

Eastern low-strain Domain N1
Domain N1 is dominated by tight, west-plunging, south-verging downward-facing parasitic $CaF_2$ folds with moderately south dipping axial planes (Figures 5b and 6a), however there is clear evidence of folding and thrusting prior to the dominant $CaD_2$ deformation (Figure 7 a to d). This pre-$CaD_2$ event may correspond to $CaF_1$ and syn-$CaD_1$ thrusting seen elsewhere in the Arthur Lineament. Several $CaF_1$ folds are observed in the low-strain area but these are strongly overprinted by $CaD_2$ structures (Figure 6a and b, Figure 7a to d). The $CaS_1$ axial planar fabric is spaced (1-3 mm) in sandstone layers and slaty in phyllites. $CaS_1$ parallel boudinaged quartz segregations occur locally, in areas of more strongly developed $CaS_1$. Syn-$CaF_1$ faults (Figure 7a and b) are interpreted to have been thrusts, and show $CaF_1$ folds being dragged along the fault surfaces, suggesting southwest transport. The fault planes are parallel to the $CaS_1$ surface, and are tightly folded by $CaF_2$. Syn-$CaF_2$ faults were recognised, and are also interpreted to have been thrusts (Figure 6a to c).

Throughout Domain N1 the orientation of the $CaD_2$ related features is consistent. $CaD_2$ is the dominant event in this domain, and controls the outcrop pattern. The downward facing $CaF_2$ parasitic ‘Z’ folds have wavelengths of 5 to 20 metres and have a 3 mm spaced to phyllitic axial planar $CaS_2$ cleavage that commonly represents the dominant form surface. Axial planar fabric development varies on the different $CaF_2$ fold limbs, with overturned gently-dipping limbs displaying weaker cleavage development than the ‘right way up’ steep limbs. As a consequence of this fold-related strain variation, on $CaF_2$ the orientation of $CaL_{02}$ changes from the overturned limb to ‘right way up’ limb. $CaF_2$ are consistent in style, with moderate to steeply south dipping ‘right way up’ short limbs, and gently south dipping overturned long limbs (Figure 5b and 6a). The consistent facing of $CaF_2$ implies the entire area is on one limb of a $CaF_1$ fold and only small scale $CaF_1$ folds are present.

Overprinting the $CaD_1$ and $CaD_2$ structures in the both the low and high-strain domains are folding events correlated with $CaD_3$ to the west and south, and $DeD_1$ (Loongana/Wilmot trend) to the east. The $CaD_3$ event has open upright $CaF_1$ folds and a weakly developed spaced axial planar cleavage ($CaS_3$), only observed in the minor mudstone interbeds (Figure 6b and c, and Figure 7a). This generation has been folded by open east-west trending $DeF_1$ that has a poorly developed, spaced axial planar cleavage, that is only recognised in some pelitic layers, resulting in dome and basin interference patterns.

Central low-strain Domain N2 (west of Somerset)
At outcrop-scale, this domain is dominated by $CaD_2$ structures, although their orientations are different to those in Domain N1. The syn-$CaD_2$ strain level is similar to Domain N1, as is the $CaF_2$ vergence. The area is dominated by overturned, moderately east dipping $S_0$ and downward-facing $CaF_2$ parasitic ‘Z’ folds. Syn-$CaD_1$ fault zones truncate $S_0$. $CaL_{01}$ ($S_0/CaS_1$ intersection lineation) and $CaL_{02}$
(S0/CaS2 intersection lineation) lineations have moderate plunges trending to the northeast and southwest (Figure 5c). CaF3 are gentle folds in S0 and the earlier cleavages and CaS3 is a steeply west-dipping weak, spaced cleavage. DeD1 is weak in this domain.

Western high-strain Domain N3 (east of Doctors Rocks)
Lithologies in Domain N3 are more varied than in Domains N1 and N2, featuring psammopelitic schists, and chlorite zone metabasalts interbedded with minor volcanogenic metasediments. The metabasalts are interpreted to be the extrusive equivalent of the Cooee Dolerite, which is intruded into the Burnie Formation 6.5 km to the east (Spry 1957b, Gee 1967b).

This area is structurally more complex than the lower strain domains to the east. CaF1 and syn-CaD1 thrusts are more prevalent, as are CaF2 folds. CaF1 folds in Domain N3 are metre wavelength isoclinal folds, and display extreme thinning of sandstone layers on the limbs. CaS1 and CaS2 are finely spaced (1 mm) and phyllitic to schistose (Figure 3e). Locally, boudinaged quartz segregations are found parallel to CaS1. In contrast to Domains N1 and N2, here CaF1 and CaF2 plunge to the south-southeast, with axial planes dipping gently to moderately to the east-southeast (Figure 5d). Outcrop-scale CaF3 and DeF1 are minor.

Southern Arthur Lineament

STRUCTURE OF THE REECE DAM AND SPILLWAY AREA
Reece Dam (344900 mE, 5379020 mN) and spillway (345120 mE, 5378860 mN) are situated on the lower Pieman River, 2.5 km to the west of the Arthur Lineament’s eastern margin (Figure 8a). The engineering and excavation works, below the dam and spillway along the Pieman River and Stringer Creek, provide excellent exposure of the contact between the high strain Oonah Formation and a similarly deformed metasedimentary unit which is structurally interlayered with a tholeiitic metagabbroic unit (Turner 1992, Crawford 1992, Turner & Crawford 1993). To the west of this metasedimentary unit, and also exposed, is the faulted contact with the Bowry Formation. Turner & Crawford (1993) interpreted the metagabbro to intrude the Oonah Formation, although Crawford (1992) noted its chemical similarity to some of the amphibolites within the Bowry Formation. We interpret the metagabbro to occur within a fault bounded block of metasediments which lie between the Oonah Formation and the Bowry Formation. The metasedimentary unit is lithologically similar to units of the “eastern” Ahrberg Group, and it has undergone a similar level of deformation, although in its current position it is separated from the “eastern” Ahrberg Group by the Bowry Formation. The geology becomes more complex west of the spillway, towards the boundary of the Bowry Formation, in the vicinity of lower Stringer Creek and the Reece Dam power station (Figure 9). Mafic schist and amphibolite bodies become common, and syn-CaD1 and syn-CaD2 faults are more frequent. Furthermore, structural repetition and the interlayering of units of different metamorphic grade was observed.
The area is dominated by \( CaS_1 \), \( CaS_2 \), syn-\( CaD_1 \) and syn-\( CaD_2 \) faults, and based on consistent \( CaF_2 \) vergence, is positioned on the downward-facing, east-dipping limb of a \( CaF_2 \) fold. The orientations of \( S_0 \), \( CaS_1 \) and \( CaS_2 \) are variable due to refolding by \( CaF_3 \), \( DeF_4 \) and \( DeF_5 \). Late faults, possibly Devonian in age, also cut the early structures. The varying orientation, style and intensity of the \( CaD_1 \) and \( CaD_2 \) structures enable the area to be divided into two structural domains (Domains S1 and S2) (Figure 8b).

**Eastern spillway – Domain S1**

Domain S1 is defined as the short limb and hinge-zone of a late (\( CaD_3 \) or \( DeD_5 \)) upright southeast-plunging ‘Z’ fold with a wavelength of 150 metres. The domain features pervasive development of \( CaS_1 \) and \( CaS_2 \), which have consistent vergence relationships with \( S_0 \). \( CaF_2 \) are small-scale (5-15 cm wavelength) folds that verge to the southeast. The folds feature moderately southeast-dipping overturned long limbs, steeply southeast dipping upright short limbs. \( CaS_2 \) is finely spaced (1-2 mm) and phyllitic to schistose. The \( CaF_2 \) folds refold the very finely spaced (1 mm) phyllitic to schistose \( CaS_1 \) cleavage.

\( CaS_1 \)– and \( CaS_2 \)– parallel faulting and shearing is common. The metagabbro described by Crawford (1992) and Turner & Crawford (1993) outcrops in Domain S1 as boudins that have intense cleavage developed around their margins due to competency contrast between the metagabbro and the surrounding quartz-mica-albite-carbonate schist. In contrast, the cores of the boudins are unfoliated.

\( DeF_4 \) folds are minor, weakly developed, small-scale (1 metre wavelength) folds and rarely produce an axial planar fabric. Open \( DeF_5 \) folds overprint \( DeF_4 \) and produce dome-and-basin interference patterns. \( DeS_5 \) is a sub-vertical spaced cleavage.

**Western spillway – Domain S2**

Domain S2 is the moderately dipping long limb of the late (\( CaD_3 \) or \( DeD_5 \)) upright southeast-plunging fold (Figure 8b). \( CaS_1 \) and \( CaS_2 \) are pervasively developed. \( CaS_1 \) is a finely spaced schistosity (0.5 mm), and produces a \( CaL_{01} \) intersection lineation. \( CaS_2 \) is also schistose (1-2 mm spacing), and produces a \( CaL_{02} \) intersection lineation.

In this domain \( DeF_4 \) folds are not evident. \( DeS_5 \) is a locally developed spaced (5-10 mm) cleavage. There are minor examples of \( DeS_4 \)-parallel extensional quartz veins, which occur in the hinge zones of the \( DeF_5 \) folds. The syn-\( CaD_1 \) and syn-\( CaD_2 \) faults display a consistent reverse sense of movement and predominantly dip to the east (Figure 8b). They lack fault gouge or breccia.

As on the north coast in the Somerset-Doctors Rocks area, in the southern study area, 0 to 7 km to the east of the lineament \( CaS_1 \) and \( CaS_2 \) cleavages are evident, and become increasingly well developed closer to the lineament. Although \( CaF_2 \) folding is evident in this zone, it has not reached its maximum intensity. Between 0 and 3 km to the west of the Arthur Lineament’s eastern boundary (ie. inside the
lineament), the structural style is dominated by $CaF_1$ and $CaF_2$ folding. In this zone, syn-$CaD_1$ and $CaD_2$ faulting are infrequent, and do not cause major disruption to the stratigraphic sequence. However, the structural style at Reece Dam and spillway and proximal to the Bowry Formation to the west, is markedly different, with faulting associated with $CaD_1$ and $CaD_2$ becoming dominant. The increase in the frequency of early faulting (syn-$CaD_1$ and syn-$CaD_2$) at the spillway and dam (Figure 8 and 9) is representative of the style of deformation within the most strongly deformed parts of the Arthur Lineament. Individual syn-$CaD_1$ and syn-$CaD_2$-related fault bounded slices are typically 5 to 10 m thick, with strongly foliated to sheared margins demonstrating well developed S-C fabrics. The boundary zone on the east of the Bowry Formation is dominated by small-scale faults (Figure 9). The faults have stacked slices of different composition and different metamorphic grade, including graphitic phyllite, pelitic and psammopelitic schist, chlorite and mafic schist, amphibolite and minor quartz-feldspar schist (344900 mE, 5379075 mN). The complex fault relationships are critical to the understanding of this strongly deformed zone of the Arthur Lineament. These contrasting styles of deformation, fault-dominated versus fold-dominated, occur on a meso-scale (eg. Figure 8) and on a regional scale. On a regional scale, this is interpreted to have produced stacks of regionally mappable fault bounded slices of contrasting metamorphic grades, such as the allochthonous Bowry Formation.

**STRUCTURE OF THE CORINNA AREA**

$CaD_3$, featuring asymmetric south-plunging $CaF_3$, dominates the Corinna area to the west of the Arthur Lineament within the Rocky Cape Group correlates and the “western” Ahrberg Group (Figure 4a and b). $CaF_1$ are not observed, and small scale $CaF_2$ are uncommon. However, foliations associated with $CaD_1$ and $CaD_2$ were found in some pelitic layers. In the Rocky Cape Group correlates, key examples of the overprinting relationships between $CaS_1$, $CaS_2$ and $CaS_3$ are seen at (i) Sabbath Ck (339200 mE, 5394155 mN), (ii) Crescent Hills (343860 mE, 5401800 mN) and on the Longback Ridge (iii) (340600 mE, 5395280 mN). Less well preserved examples are seen in the “western” Ahrberg Group at (iv) Elizabeth Ridge (340530 mE, 5388750 mN) (Figure 4a). $CaS_1$ is identifiable in the Rocky Cape Group correlates and the “western” Ahrberg Group as a weakly developed $S_0$-parallel foliation, defined by muscovite, whereas $CaS_2$ is a weakly developed differentiated crenulation cleavage that cuts $S_0$ at a high angle. The west-dipping $CaS_2$ is a spaced (3-5 mm) cleavage. It crenulates $CaS_1$ and also cuts $S_0$ at a high angle (Figures 3g and 3h). $CaF_3$ have west-dipping axial planes, with steeply east-dipping to overturned eastern limbs and gently west-dipping, ‘right way up’ western limbs (Figure 4c, d and e). Quartzite on the overturned eastern limbs is strongly boudinaged (Figure 4f and g).

**DISCUSSION**

Despite a distance of 60 km separating the outcrop studied in the north (Somerset-Doctors Rocks area) and south (Reece Dam and Corinna areas) of the Arthur Lineament, there is strong evidence supporting the correlation of deformational events between these areas. Evidence for the Cambrian age deformations ($CaD_1$-$CaD_3$) being widespread regional events is supported by mapping in the southern Arthur Lineament, where the fabric associated with these deformations have been mapped over a 40 x 10 km area. The $CaD_1$ and $CaD_2$ events in the Somerset-Doctors Rocks area are correlated with those
in the south of the Arthur Lineament (Reece Dam and surrounding area), based on the consistent style of CaD₁ and CaD₂ features, orientations, and the interference relationships. In both areas the CaS₁ and CaS₂ foliations increase in intensity from a spaced cleavage to a schistosity approaching the lineament from the east. Widespread interference between the strongly de developed high strain CaD₁ and CaD₂ events, followed by overprinting of the less intense third Cambrian deformation (CaD₃) and subsequent multiple Devonian age deformations (DeD₁, DeD₂, DeD₃) has resulted in complex, outcrop patterns. The orientations of the dominant, early structures are regionally consistent, but show evidence of local refolding.

In both the northern and southern areas of the Arthur Lineament, CaD₁ and CaD₂ structures change orientation from east to west. The CaD₁ event is interpreted to be a major deformatonal event, but overprinting by the intensely developed CaD₂ event obscures many of the CaD₁ structures. On the north coast, within Domains N1 and N2 recognisable CaD₁ structures are rare. Throughout Domains N1 to N3 the orientation of the CaD₁ structures is dependent on the intensity of CaD₂ and the CaF₂ fold position. Several CaD₁ thrust faults, folded by CaF₂ and transected by CaS₂, are present along the attenuated CaF₁ limbs.

The most significant change in orientation of CaL₀₁ and CaL₀₂ occurs at the boundary between Domains N2 (low strain) and N3 (high strain) (Figure 5e)(398780mE, 5457890mN). This location also corresponds with a major early shear zone, interpreted to be Cambrian in age (CaD₂). In Domain N2, on the overturned CaF₂ limbs, CaL₀₁ and CaL₀₂ plunge to the east-southeast. Close to the shear zone, the orientation of CaL₀₁ and CaL₀₂ rotates. On the predominantly high strain western side of the shear zone (Domain N3), the lineations plunge towards the south-southwest.

In the Savage River to Reece Dam region (southern study area), outside the lineament and close to its eastern margin (including parts of the high strain Oonah Formation), areas with steeply plunging CaL₀₁ and CaL₀₂ are present (areas 1 to 3, Figure 10). However, within the lineament, in the high strain Oonah Formation and the “eastern” Ahrberg Group, CaL₀₁ and CaL₀₂ have consistent shallow plunges to the south, and in minor cases, plunge shallowly to the north (areas 3 and 4, Figure 10).

Further to this, outcrop on the west coast, between Granville Harbour and Ahrberg Bay shows a similar change in structural style and CaL₀₁ and CaL₀₂ lineation direction to the Savage River-Reece Dam area. The coastal exposure of the Arthur Lineament in this area is divided into ‘northern’ and ‘southern’ areas, separated by the weakly deformed Ordovician to Silurian Duck Creek sequence (Figures 11 and 12). The two areas have distinctive differences in structural style, reflecting different strain intensities. The ‘southern’ area exposes the low strain to high strain transition zone of the eastern boundary of the Arthur Lineament, with deformed Oonah Formation and “eastern” Ahrberg Group outcropping (Figure 11). The strain level within this area is intense, producing phyllitic to schistose CaS₁ and CaS₂ foliations, however it is less intense than in the core of the Arthur Lineament, which crops out further to the north along the coastline (Figure 12). This less strongly deformed area is
dominated by $CaF_1$ and $CaF_2$ folding, with faulting relatively infrequent, although early faults become increasingly common in the northern part of this section (Figures 11a to c). $CaL_{01}$ and $CaL_{02}$ lineations plunge gently to moderately to the northwest and southeast (Figure 11d).

In contrast, the ‘northern’ area exposes the core of the Arthur Lineament, with strain levels at their most intense within the lineament (Figure 12). $CaS_1$ and $CaS_2$ are schistose, and while $CaF_1$ and $CaF_2$ folding is common, syn-$CaD_1$ and $CaD_2$ thrust faults causing repetition of units are much more frequent than in the ‘southern’ area (Figures 12a to c). In the ‘northern’ area, the $CaL_{01}$ and $CaL_{02}$ lineations on average plunge moderately to the south (Figure 12d). The increase in faulting and strain from the southern area to the northern area is accompanied by a change in orientation of $CaF_1$ and $CaF_2$, into alignment with the stretching direction.

The Devonian deformation has caused some refolding in the ‘northern’ area, resulting in a change in trend of the $CaS_1$ and $CaS_2$ foliations, to west-southwest. The shallow, east-southeast plunging axis of this later event is interpreted to have resulted in some steepening of the $CaL_{01}$ and $CaL_{02}$ lineations, however the overall effect of this event is minor.

The uniform change in orientation of $CaL_{01}$ and $CaL_{02}$ from the low strain domain to the high strain domain, in the Somerset-Doctors Rocks area and over the length of the southern study area (45 km) (Figures 10 to 12), is considered to be a result of syn-$CaD_2$ rotation due to increasing strain. Based on similarities with examples of shear-related rotation discussed by Ridley & Casey (1989) and Dewey et al. (1998), it is suggested that the change in orientation associated with $CaD_2$ described above is the result of a strongly rotational shear component with a north-south stretching direction in the high strain zone at the core of the Arthur Lineament.

The east-west trend of the $CaF_2$ hinges and fold vergence in Domain N1 can be interpreted to reflect south-directed transport, provided the overturning occurred during $CaD_2$. The alternative possibility is that the $CaF_2$ are downward facing because of a pre-existing $CaF_1$ overturned limb. We consider this unlikely based on the evidence that the rotational high strain history cannot predate $CaD_2$. Both $CaF_1$ and $CaF_2$ are rotated into the Arthur Lineament high strain zone by the same amount and at the same position. Thus the rotational strain must have formed during $CaD_2$. The regional scale of the overturned limb (more than 60 Km by 7 km) and its close spatial relationship to the Arthur Lineament argues for a close genetic link of the overturned limb to the most intense event within the lineament.

In the Reece Dam area the $CaD_2$-related features change orientation from Domain S1 to S2 (Figure 8b). Unlike the changes in orientation of the $CaD_1$ and $CaD_2$-related features between the low and high strain domains due to shear-related rotation, stereonet analysis indicates the change in orientation from Domain S1 to S2 is the result of refolding by the $CaD_3$, $DeD_4$ and $DeD_5$ events. Rotation of the eastern domain $CaS_2$ and $CaL_{02}$ about the $DeF_3$ axis ($30^\circ/130^\circ$) $50^\circ$ in an anticlockwise direction (looking down plunge), changes the $CaS_2$ orientation from $45^\circ/150^\circ$ to $55^\circ/090^\circ$ and the $CaL_{02}$ orientation from
The Corinna area to the west of the Arthur Lineament is dominated by the CaD3 event. Although this study only includes the “western” Ahrberg Group and Rocky Cape Group correlates to the west of the southern Arthur Lineament, work by Everard et al. (1996) indicates this event is also prominent in the Trowutta area to the west of the Arthur Lineament further north. In the Corinna area, the style and orientation of the CaF3 folding indicates east-west compression and a west-over-east transport direction. This suggests a change in the structural regime probably during the Late Cambrian, the significance of which is poorly understood.

CONCLUSION

Gee (1967a and 1977) interpreted the most intense, widespread deformation in northwestern Tasmania (CaD2 in this paper) to be the earliest event, during which the Rocky Cape Group and the Burnie Formation were transported to the southeast and deformed against the Precambrian Tyennan Nucleus. Further to this Gee (1967a) grouped CaD2 and CaD3, and concluded that this event (his D1) produced shallow plunging folds trending northeast-southwest (CaF3 in this paper) and recumbent folds (CaF2 in this paper) in conjunction with the metamorphism defining the Arthur Lineament.

We interpret the CaD1 event (not described by Gee 1967a, 1967b, and 1977) to represent major shearing producing isoclinal folds and bedding-parallel thrust faults. CaD2 produced widespread areas of low and high strain. The change in style and orientation of CaF2 from areas of low to high CaD2 strain suggests a major component of rotational strain. The rotation of CaF2 into the Arthur Lineament is interpreted to result from a north-south stretching direction along a shallowly dipping detachment, with some evidence supporting south-southwest-directed transport. This resulted in the juxtaposition of the allochthonous Bowry Formation and parautochthonous “eastern” Ahrberg Group with the “western” Ahrberg Group and Oonah Formation.

At the conclusion of the CaD2 event, the lineament is interpreted to have been a sub-horizontal feature, with the various slices being vertically stacked (Figure 13a). The interpretation of a shallowly dipping detachment is largely based on the Somerset-Doctors Rocks area. Where CaD3 is weak (Domains N1 and N3), CaD2 structures are sub-horizontal. In this area, CaS2 dips gently to the south and southeast, and CaF2 fold axes have gentle plunges, to the east and west (in Domain N1) and to the south (in Domain N3). There is no evidence for a later structure that could have rotated this foliation from an original steep dip. However where CaD3 is more strongly developed (Domain N2, and the southern Arthur Lineament), the CaD2 features are moderately to steeply dipping. The transition from a sub-horizontal structure to an east-dipping structure along most of the Arthur Lineament, probably occurred as a result of the folding and thrusting during CaD3, resulting in the present linear expression of the
structure (Figure 13b). During the Middle Devonian, further folding resulted in localised dome-and-basin style folds and additional variability in the trend of the Arthur Lineament.

The detailed structural studies within the Arthur Lineament indicate a strong north-south stretching direction on the detachments during the Cambrian. A similar stretching direction occurs in the allochthonous high strain rocks of the Ulverstone Metamorphic Complex, 20km to the east. Reed (2001) has recognised evidence for very early (syn-D1) thrusting to the southeast in the Badger Head Complex. Meffre et al. (2001) have reported Cambrian south directed transport on mylonites in the Port Davey Metamorphic Complex. All these structures have been correlated with arc-continent collision and ophiolite obduction (Berry 1994). The hornblende mylonites exposed within metres of the base of the ophiolite sheets show a west to southwest-directed transport direction when reoriented to a pre-Devonian orientation (Berry 1989). These hornblende mylonites formed at a high temperature (>700°C) based on the mineral chemistry. In contrast the structures in the Arthur Lineament formed at greenschist to low amphibolite facies conditions. We interpret the difference in these directions as representing a change in ophiolite transport direction (Figure 14) from an early vector towards the west to a south-directed transport in the later stages of the emplacement onto Tasmania.

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REFERENCES


Figure 1. Setting of the Arthur Lineament, NW Tasmania (modified after Brown et al. 1995). The Arthur Lineament consists of the high strain (metamorphosed) Burnie and Oonah Formations, the “eastern” Ahberg Group, the Bowry Formation, and other uncorrelated fault bounded units.
Figure 2. Simplified geological map of the southern Arthur Lineament (modified after Turner et al. 1991).
Figure 3. CaS₁, CaS₂, and CaS₃, within and near the Arthur Lineament. (a) weakly developed slaty CaS₂ crenulating weakly developed CaS₁, in Burnie Formation sandstone (plane polarised light), sample 147586 (399790 mE, 5457060 mN); (b) weakly developed slaty CaS₂ crenulating weakly developed CaS₁, in Oonah Formation sandstone, lens cap is 50mm diameter (353830 mE, 5380140 mN); (c) strongly developed schistose CaS₂ enveloping CaS₁, basal unit of “eastern” Ahrberg Group (cross polarised light), sample 147587 (345240 mE, 5392040 mN); (d) strongly developed schistose CaS₂ and syn-CaS₂ albite porphyroblasts with oblique CaS₁, preserved as S₁ in albite, correlate of Ahrberg Group, to the east of the Bowry Formation (cross polarised light), sample 147588 (350180 mE, 5388100 mN); (e) phyllitic metasiltstone, showing syn-CaS₂ boudinage of coarse-grained layers and possible relicts of CaS₁, oblique to the main foliation (CaS₂) Burnie Formation, Domain N3 (plane polarised light), sample 33309 (398450 mE, 5458200 mN); (f) phyllitic metasiltstone, with CaS₂ developed sub-parallel to S₀. No evidence of CaS₁ was found, “western Ahrberg Group, 300m west of boundary-fault with “eastern” Ahrberg Group (cross polarised light), sample 147589 (344530 mE, 5392100 mN); (g) finely spaced, S₀-parallel CaS₂, evident in mudstone beds and crenulated by spaced CaS₃, Rocky Cape Group correlate beds (plane polarised light), sample 147590 (343860 mE, 5401800 mN); (h) finely spaced, S₀-parallel CaS₂, crenulated by spaced CaS₃, Rocky Cape Group correlate beds.
(plane polarised light), sample 147591 (339200 mE, 5394155 mN). Symbols ‘m’ indicate white mica, ‘a’ albite, ‘q’ quartz and ‘mt’ magnetite. Samples are part of the University of Tasmania rock catalogue.

Figure 4. (a) simplified geology of the Corinna area (map modified after Turner et al. 1991), (b) stereographic projections showing effects of \( \text{Ca}_F_3 \) deformation; (c) cross sections illustrating structural data (with structural interpretation for sections immediately below) for the Corinna area, west of the Arthur Lineament, section [u]-[v] from 334100 mE, 5390700 mN to 339050 mE, 5390440 mN, section [w]-[x] from 340120 mE, 5388920 mN to 340620 mE, 5388750 mN, section [y]-[z] from 342590 mE, 5392170 mN to 345240 mE, 5392040 mN; (d) detailed sketch of river section in the lowermost sandstone unit of the “western” Ahrberg Group, illustrating the gently west-dipping long limb and steeply east-dipping to downward facing short limb typical of the \( \text{Ca}_F_3 \) deformation (337280 mE, 5389940 mN); (e) close up of the hinge of a \( \text{Ca}_F_3 \) fold within the detailed sketch area, sandstone beds showing well developed axial planar \( \text{CaS}_3 \) cleavage; (f) downward facing (eastern, short limb of \( \text{Ca}_F_3 \)) sandstone beds in the uppermost Rocky Cape Group correlate, showing \( \text{CaD}_3 \)–related boudinage (337160 mE, 5390000 mN); (g) sketch of (f) inset highlighting the \( \text{CaD}_3 \)–related boudinage. Legend for 4 (a) is the same as for Figure 2. Area excluded from data collection (“eastern” Ahrberg Group) is shaded. Figures 4 (d) to (g) are mirror images of photographs/sketches (taken looking south).
Figure 5. Structural overview of the Somerset-Doctors Rocks area. (a) simplified structural map of the Somerset-Doctors Rocks area with structural domain boundaries (400405 mE, 5456925 mN to 398310 mE, 5458250 mN) (modified after Gee 1977); (b) equal area stereographic projections, with block diagram illustrating the style and orientation of the dominant folding (CaF₂) for Domain N1 (downward facing parasitic CaF₂ fold) (modified after Gee 1977); (c) Equal area stereographic projections, with block diagram illustrating the style and orientation of the dominant folding (CaF₂) for Domain N2 (steepening of CaF₂ due to type 2 refolding by CaF₃); (d) equal area stereographic projections, with block diagram illustrating the style and orientation of the dominant folding (CaF₂) for Domain N3 (rotation of CaF₂ due to simple shear with component of oblique shortening); (e) detailed sketch and equal area stereographic projection, illustrating the change in orientation of the dominant lineation (CaL₀₂) at the boundary between Domains N2 and N3.
Figure 6. Cambrian deformation in Domain N1 at Somerset (400075 mE, 5456990 mN). (a) sketch of downward-facing, south verging CaF$_2$ parasitic S fold within the Cambrian age low strain domain N1, with a Cambrian age CaF$_1$ fold (small scale fold enlarged in Figure b) overprinted by CaS$_2$ evident in the bottom of the sketch. CaS$_2$ cleavage is the dominant form surface. The syn-CaD$_1$ and syn-CaD$_2$ thrusting typically occurs close to boundaries between psammitic and psammopelite sequences; (b) shows CaF$_1$ fold on lower surface of syn-CaD$_2$ shear and CaS$_2$ transecting the CaF$_1$ fold; (c) sketch of syn-CaD$_2$ thrust and CaS$_2$ overprinting CaF$_1$ fold.
Figure 7. Example at western end of Domain N1 (399750 mE, 5457100 mN) of syn-CaD₁ thrust and CaF₁, folded by CaF₂ and overprinted by CaS₂. The syn-CaD₁ and CaD₂ features are overprinted by CaD₃ (a) overview of detailed study area; (b) close-up of thrust contact, which features CaF₁ folds being dragged along the fault, suggesting southwest transport, lens cap 50 mm diameter; (c) example of CaF₁ fold, with timing relationship to CaF₂ illustrated by transecting CaS₂ cleavage; (d) sketch of CaF₁ fold, illustrating the overprinting by transecting CaS₂, which is consistent on both limbs.
Structure of the Arthur Lineament, Tasmania

Figure 8. Reece Dam and spillway, (a) location map (modified after Turner et al. 1991), with section line A-B; (b) cross section of the Reece Dam-spillway area (section A-B), with equal area stereographic projections for Domains S1 and S2 (3345300 mE, 5378875 mN to 345100 mE, 5378875 mN). Legend for 8 (a) is the same as for Figure 2.
Figure 9. Detailed geological map from Stringer Creek, near Reece Dam power station (344900 mE, 5379100 mN). The intense faulting has resulted in the stacking of slices of differing composition and metamorphic grade. Measured fault planes with movement indicators are illustrated in the stereographic projection.

Figure 10. Simplified geological map of the southern Arthur Lineament, showing generalised structural data collection areas (map modified after Turner et al. 1991). Accompanying the defined areas 1 to 4 are stereographic projections of CaL02 lineations, which show the change in orientation across the low strain-high strain boundary on the edge of the Arthur Lineament. Note the change in orientation from 1, moderately plunging to the northeast (greater than 3 km to the east of the
Structure of the Arthur Lineament, Tasmania

27

The Arthur Lineament; to 2, predominantly gently to moderately plunging to the nor th-northeast (0 to 3 km to the east of the lineament); to 3, predominantly plunging moderately to the north and south (0 to 3 km to the west of the lineament’s eastern boundary); to 4, plunging gently to the north and south, from the core of the lineament to its western boundary. Legend for map is the same as for Figure 2. White data points (●) represent CaL01, solid data points (●) represent CaL02.

Figure 11. Structural style of the southernmost edge of the Arthur Lineament, on the west coast of Tasmania, to the north of Granville Harbour (3349915 mE, 5371325 mN to 334300 mE, 5372610 mN). (a) cross section illustrating structural data for the west coast exposure of the southern Arthur Lineament; (b) interpretive cross section for the area; (c) simplified geological map of the section; (d) stereographic projections for CaL01 and CaL02 illustrating the predominantly shallow to moderate southeast plunge. Refer to Figure 2 for location.
Figure 12. Structural style of the core of the Arthur Lineament, on the west coast of Tasmania, to the north of Granville Harbour (333925 mE, 5374120 mN to 333515 mE, 5375000 mN). (a) cross section illustrating structural data for the core of the Arthur Lineament, west coast section; (b) interpretive cross section for the area; (c) simplified geological map of the section; (d) stereographic projections of CaL01 and CaL02 lineations for the area, showing their predominantly moderate plunge to the south. Refer to Figure 2 for location.
Structure of the Arthur Lineament, Tasmania

Figure 13. Schematic sections showing the formation of the southern Arthur Lineament. (a) emplacement of allochthonous and parautochthonous slices over sub-horizontal Neoproterozoic stratigraphy during the CaD₁ and CaD₂ events; (b) intense folding and faulting (CaD₃) leading to the present linear expression of the Arthur Lineament. Refer to Figure 2 for legend. Heazlewood River Complex is an allochthonous ultramafic complex. Cleveland-Waratah association consists of tholeiitic basalts, and marine sediments and is interpreted to be part of an oceanic fore-arc that was obducted onto western Tasmania in the late Early or early Middle Cambrian (Berry & Crawford 1988, Brown & Jenner 1988, Seymour & Calver 1995). West dipping faults in 13 (b) are interpreted to be syn-CaD₃, east-dipping thrust faults are late, age uncertain.
Figure 14. Schematic diagram of Tasmania during the west-directed obduction of oceanic fore-arc in the late Early or early Middle Cambrian. A. Transport direction based on hornblende mylonite at the base of the ophiolite bodies (Berry 1989). B. Transport direction inferred from the Arthur Lineament and Port Davey Metamorphic Complex.