The GEOLOGY a nd PETROLOGY of the MAINWARING GROUP and ASSOCIATED ROCKS from SOUTHWEST TASMANIA

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Hobart,

November, 1968

REPORT 68/2

GEOLOGY and PETROLOGY of the MAINWARING GROUP and ASSOCIATED ROCKS

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1 GENERAL

Preliminary geophysical and geochemical surveys have indicated an area of economic interest on the coast of S.W.Tasmania, centred on Cypress Creek. This area is underlain by a belt of strongly sheared and metasomatised rocks(of probable Middle Cambrian age) which have been assigned to the Mainwaring Group.

A preliminary report (Hall and Corbett, June 1968) gives a general description of the Mainwaring Group, based on field work by a number of geologists. The present report is based on detailed petrology of all the specimens available and detailed mapping at the southern end of the belt.

A revised version of the map is presented and this differs from earlier maps in that the Mainwaring Group tapers towards the Urquhart River and disappears completely south of the Wanderer River. Petrological examination has shown that specimens from the Wanderer River originally assigned to the Mainwaring Group are quite comparable with Dundas type rocks.

There remains the possibility that the Mainwaring Group is a metasomatised lateral equivalent of Dundas type rocks and this will only be solved by further mapping round the Urquhart River.

Geological investigations so far have only produced scattered evidence of mineralisation, although the geological setting appears to be very favourable. Sulphides have been noted from the mouth of Copper Creek and in South Cypress Creek and native copper is disseminated in the volcanics of the Upper Mainwaring. Staining which probably indicates the presence of copper minerals is widespread in the southern coastal outcrops.

2 NOMENCLATURE OF CAMBRIAN ROCKS

Each Group recognised in the Cambrian of S.W.Tasmania consists of a mixture of sedimentary, volcanic and intrusive rocks, and each Group is characterised by a particular assemblage. Hence in some cases a single specimen cannot be assigned to any one Group without taking its field relations into consideration.

Correlation between ~~different~~ Cambrian rocks in different parts of the West Coast belt has always been difficult due to the limited lateral extent of many units as well as lateral variations in metamorphic intensity and structural complications.

For the most part new Group names have been given to the rocks south of Macquarie harbour. The name "Dundas Group" (type area near Zeehan) has been used for southern rocks and a correlation is probably reasonable. Fossils in a small fault block of argillites similar to the surrounding "Dundas type" argillites have been dated as Upper Middle Cambrian and this is the age given by fossils for the Dundas Group in the northern part of the west coast belt. However objections have been raised to the use of the term Dundas Group and for the present the compromise term "Dundas type" will be used in order not to lose sight of the probable correlation.

The other Groups have been given new names and tentative correlations may be made. The Lewis River Volcanics are easily defined but the status of the other Groups is not certain and at present the names should be used only for convenience in the field. The Varna Group has had little study and it is possible both the Birthday Bay and Mainwaring Groups are lateral equivalents of Dundas type rocks.

~~ASSEMBLAGES~~

~~Dundas Type~~

~~argillite, greywacke, greywacke conglomerate, turbidites~~

Assemblages

Dundas Type

argillite, turbidites	
greywacke, greywacke conglomerate	rocks fresh or extensively
basalt, andesite, dacite	chloritised, sometimes
gabbro, diorite, granodiorite	
pyroxenite, serpentinite	silicified

Birthday Bay Group

phyllites, schists	low grade metamorphism. The
slightly metamorphosed siltstones and greywackes in the upper parts	only known occurrance of
limestone	extensive limestone (30% of
diorite intrusions	total) in the Cambrian. Grades up into Dundas type rocks.

Mainwaring Group

basal phyllites and schists	strongly sheared and metasomat-
very rare calcareous siltstones	ised, with extensive introduction
volcanic siltstones, tuffs, deformed conglomerates and breccias	of epidote. Assemblage epidote-
basalt(?), andesite and dacite flows	actinolite-chlorite-plagioclase-
gabbro(?) and Diorite intrusions(?)	quartz predominates.

Varna Group

quartzite (some very rich in haematite)	age uncertain, probably Lower
dolomite	Canbrian: if so it is the only
siliceous siltstones and argillites	Group with siliceous sediments.
intrusions of Devonian granite and lamprophyre	Volcanics absent. May correlate with Crimson Creek Formation.

Lewis River Volcanics

rare siliceous sediments

tuffs and acid lavas, possibly ignimbrites

porphyry intrusives

intruded by Upper Cambrian Elliot Bey Granite:

~~acid volcanics and~~ intrusives, fresh or chloritised. Probable correlate of Mt. Reid Volcanics

3 GEOLOGICAL SETTING

The general structure of the area between Elliot Bay and the Wanderer River has been described in the earlier report.

The oldest Cambrian rocks exposed in this area are the Lewis River volcanics. This is an acid succession consisting mainly of pale, banded ~~rock~~ rocks with or without quartz or ~~plagioclase~~ feldspar phenocrysts. The rocks are identified in the field as rhyolites and tuffs but more detailed work may show that some are ignimbrites.

The acid volcanics are associated with several porphyry bodies (quartz-porphyry, quartz-biotite porphyry, quartz-feldspar porphyry) and are intruded by Upper Cambrian granites.

The contact between Lewis River Volcanics and the basal schists of the Mainwaring Group is well exposed on the coast about ¼mile south of Sassafras Creek. The contact is marked by massive quartz secretions and folding within the schists. There is about 10° divergence in strike between the flow banding in the volcanics and compositional banding in the schists, due to faulting, ~~along~~ but the contact, ~~which~~ is essentially conformable on a larger scale.

The Mainwaring Group consists of two main units - the basal siliceous schists and phyllites and the upper sequence of green volcanics. Both units are strongly sheared and variable in thickness.

The contact between the Mainwaring Group volcanics and Dundas type sediments is apparently not exposed. At Abo Creek there is a small outcrop of grey phyllite intruded by a granodiorite sill and this appears to be the lowest member of the Dundas type in the area. Green volcanics outcrop about 50 yards to the south. Distribution of Dundas and Mainwaring Group rocks is controlled by the dominent cleavage but bedding is not always ~~controlled by~~ parallel with this cleavage. A little further north at Sandy Point Dundas type slates are overturned, but a facing at ~~Green~~

Diorite Point indicates the green volcanics are right-way-up, so the contact at Abo Creek may be a fault of some magnitude.

The ~~basal~~ Dundas type slates and greywackes grade up into very striking deformed conglomerates. These conglomerates consist of white discs of fine quartz in a dark grey matrix..The discs are flattened parallel with the bedding.

More normal Dundas type greywackes and argillites are exposed in the lower reaches of the Mainwaring River and further north in the Urquhart and Wanderer Rivers.

4 GEOLOGY OF THE MAINWARING GROUP

General

In the previous report the Mainwaring Group was defined in geographic and stratigraphic terms but it is now necessary to modify the original defenition. On present knowledge the only practical defenition of the Group is based on metamorphic assemblage.

The Mainwaring Group is characterised by two distinct sequences, the lower one siliceous (and rarely calcareous) phyllites and schists overlain by green rocks in which the assemblage epidote-actinolite-quartz-plagioclase -chlorite has been imposed on an original volcanic pile. Not all members of this upper sequence contain all the characteristic minerals and in a few specimens secondary minerals are rare. A little siliceous phyllite and calcareous ~~sedi~~ siltstone is interbedded with the green ~~siltstones~~ volcanics.

Extensive shearing within the volcanics has rendered thickness measurements and even stratigraphy almost meaningless. The section through the Group between Abo Creek and Sassafras Creek is much ~~less~~ thinner than that mapped in the Mainwaring River three or four miles firther north and this

lack of persistence along strike is most apparent on a smaller scale in the areas of perfect outcrop on the coast.

All this leads to the suggestion that intensity of metamorphism varies along strike and this in turn leads to speculation about what happens to the Group north of Cypress Creek. Only two specimens from the Urquhart can reasonably be placed in the Mainwaring Group, and all the bedrock in the Wanderer belongs to the Dundas type. Until further mapping is done in the northern part of this belt the exact status of the Mainwaring group is in doubt, and it may be a lateral equivalent of the lower part of the "Dundas Group".

SECTIONS

Descriptions of sections through the Mainwaring Group mapped in the Mainwaring River and along the coast will provide the best picture of the Group as a whole.

(1) Coastal Section

Siliceous Sequence

Between Sassafras Creek and the contact with the Lewis River Volcanics to the south there are exposed about 2000ft. of metamorphosed siliceous sediments. The lowest rank rocks are glossy grey slates and phyllites and the highest are coarse knotted schists. There are rare pods of limestone which have been boudinaged during folding. Between Sassafras Creek and the south side of Green Point there are red phyllites.

Most of the rocks are well laminated with one cleavage parallel with the compositional layering and another at an angle to it. Minor folds are common, and generally plunge north at about 30°. Bands of kink folds are very common, particularly in the strongly cleaved phyllites.

In development of minor structures and in metamorphic grade these rocks closely resemble the Precambrian slates and phyllites which underly the Lewis River Volcanics.

To the north and east the siliceous metasediments increase rapidly in apparent thickness, reaching 5-6000 feet in Copper Creek, where grey phyllites and quartz-schists predominate. A band of greywacke conglomerate has been reported from Copper Creek and the phyllites have been reported to grade into a greywacke-argillite sequence north of the Urquhart. This sequence belongs to the Dundas type and may or may not be a lateral equivalent of the Mainwaring Group.

Green Volcanics

Between Sassafras Creek and Green Point the red phyllites rapidly grade into green and grey phyllites and quartz-schist. Green, grey and maroon volcanic siltstones and highly deformed conglomerates, all very fine-grained, laminated and strongly sheared, continue to Green Point, a thickness of about 500 feet. The top of this sequence is green tuff with pod-like epidote secretions.

At Green Point are the most remarkable outcrops in the whole group. These outcrops apparently represent a small "window" which has escaped much of the deformation suffered by the rest of the group.

A massive breccia contains flattened fragments of basic and intermediate igneous rocks from ¼inch to 2 feet across. Many of the fragments are altered to amphibolite but one unaltered quartz-andesite has been described. The matrix of the breccia is a mixture of fine epidote and calcite. The original matrix having been replaced by metasomatism following shearing.

The breccia is overlain by laminated pale green volcanic siltstones showing delicate similar folding and interbedded with minor deformed conglomerates. This is overlain by a considerable thickness of massive, porphyritic hornblende-diorite which has been considerably altered.

Northwards along strike deformation increases. Siltstones, tuffs and altered lavas (dacite as well as intermediate types) are brought together

and shearing and few types are continuous along strike. An unaltered calcareous siltstone was found in this section and there are very rare quartzite pebbles and greywacke bands in the volcanic siltstones.

Near Copper Creek the hornblende-diorite is replaced by altered diorites and possibly gabbro, underlain by tuffs and volcanic siltstones. The breccia is extremely deformed so that at first glance it appears to be mottled phyllite. One undeformed conglomerate specimen consists of intermediate lava fragments in an epidote-quartz-amphibole groundmass.

North of Diorite Point the Diorite is overlain by massive altered lava and then volcanic siltstones. Deformed conglomerates are uncommon. A combination of shearing and faulting has reduced beds to interfingering lenses.

The uppermost part of the Group consists of about 500 feet of spotted massive tuffs.

Below is an approximate section through the Mainwaring Group as exposed along the coast. The general order is correct but thicknesses are misleading since the whole Group thickens rapidly from south to north.

500ft.	tuff	top
1000	tuff, tuffaceous conglomerate volcanic siltstones, minor flows	
200	hornblende-diorite (+gabbro) intrusion(?)	
1500	volcanic breccia (less than 100ft at Green Point) tuff volcanic siltstones } 500 ft. at Green Point	
2000	phyllite and schist	bottom

(2) Mainwaring River Section

The section exposed in the Mainwaring River is about 12000 feet thick and all but 250 feet of this is the upper ,volcanic member. Outcrop in the Middle Mainwaring is poor and weathering is prevalent. Tuffs, siltstone ~~and~~ conglomerates and lavas are closely interbedded so that stratigraphic units based on the apparent dominence of one or more types are not strictly defined.

Siliceous phyllites

Only about 250 ft. of siliceous rocks are exposed just below the main junction in the Upper Mainwaring, since the base of the Group has been lost by faulting. The phyllites are generally fine and dark grey to black, with a few specimens coarse and knotted. The upper contact with green volcanics is marked by contortion and quartz veining in the phyllite and may be a fault, although the cleavage has the same strike on either side of the contact.

Green Volcanics

At the base of the volcanics is at least 2000ft of laminated tuffs and lavas with lavas predominent in the lower part. These rocks are hard and poorly cleaved, forming continuous outcrops through which ~~through~~ ~~which~~ the river has cut a deep gorge. This part of the succession is repeated by faulting in the Upper Mainwaring where it directly overlies the Lewis River acid volcanics.

Downstream from the gorge outcrop is sporadic, consisting of altered lavas, tuff and deformed conglomerates. There is a single gabbro sill. One mile below the gorge the dominently igneous succession gives way to volcanic siltstones.

The upper part of the Group consists mainly of fine tuffs and volcanic siltstone with minor lavas and conglomerate. A relatively undeformed breccia like that at Green Point occurs about 1000ft from the top of the Group.

~~Dundas argillite~~

Dundas type argillite

2000ft tuff and siltstones, minor conglomerate

4000 tuff, volcanic siltstone and conglomerate, minor lavas

4000 Lava, tuff, conglomerate

2000 laminated tuffs and lavas

250 phyllite, knotted schist

↓ base of Mainwaring Group

5 [redacted]

5 PETROLOGY OF THE MAINWARING GROUP

In describing specimens attributed to the Mainwaring Group an unusual step has been taken in describing all specimens available, not only those which have been sectioned. This is in order to give the fullest possible coverage to this highly diverse and complex group.

In naming the rocks every attempt ~~every attempt~~ has been made to provide a name indicative of the origin of the specimen. In some cases this has been impossible due to complete replacement of the original minerals and destruction of original textures by shearing and re-crystallisation. In these cases non-genetic terms such as "amphibolite" and "epidote-schist" have to be used. In many more cases a genetic name has been given even though the evidence for origin is slight.

The term "diorite" has been used for medium-grained igneous rocks which are intermediate in composition. However in many cases most mineral are secondary and metasomatism may have produced an intermediate composition in rocks originally more basic. Many of these igneous rocks are assumed to be lavas, since they form narrow bands conformable with the pyroclastics but few of them retain textures diagnostic of lavas.

Most of the lava flows have been extensively altered to plagioclase-amphibole-epidote-chlorite assemblages and the best clues to their original nature are ~~found~~ provided by relatively unaltered fragments found in some of the breccias. A variety of lava types have been described from the breccias, including dacite, quartz-andesite, porphyritic andesite (very like that occurring in the Dundas assemblages) and diorites containing hornblende or actinolite. Although these fragments may be quite fresh the sedimentary matrix of the breccias has been replaced by epidote with lesser carbonate and amphibole. The breccias are of very local derivation, all their clastic material being lava fragments.

The fine-grained rocks, such as volcanic siltstones and tuffs are generally extensively altered and their origins are usually uncertain. Tuffs may often be identified only by their fragmental texture. The deformed "conglomerates"are composed of flattened lenses of very fine material and are always altered, although tuff bands may sometimes be recognised in them.

No fresh basic rocks have been described but three hand specimens (from south of Copper Creek, Diorite Point and the Hainwaring River) have coarse gabbroic textures. The original minerals are no longer present.

Criteria used in naming hand specimens are listed at the end of this section and these names should be used ~~for the sak~~ whenever possible in further field work.

Shearing

No fixed relationship has been found between metasomatism and shearing. For the most part the two probably occurred together, with enitial shearing preceeding metasomatism and crystallisation of secondary minerals continuing after shearing had ceased. Generally chlorite and actinolite appear to have crystallised during shearing, with chlorite continuing after shearing. Most of the epidote and quartz crystallised after shearing. The position of plagioclase is uncertain, and some of it is probably primary. Veins of quartz, epidote and chlorite post-date the main shearing. These relationships are generalisations and exceptions to all of them have been described. Normal ~~seri~~ sausseritisation of feldspar and chloritisation of amphibole probably proceed independently of the metasomatism and this complicates the textures.

Identification of Hand Specimens

Rocks from the coast and The Mainwaring River have been divided into seven types recogniseable in hand specimen and in each case the name is based on thin section descriptions. This list does not include unaltered specimens which may be identified by normal methods, but such rocks are rare in this environment.

1 phyllite, schist - grey, fine-grained, strong cleavage. Contain quartz and muscovite, +/- chlorite. Siliceous, non-volcanic sediments at the base of the Mainwaring Group.

2 volcanic siltstone - pale grey-green, very fine-grained, strong cleavage. Texture slightly feathery and the rock is very soft, sometimes laminated. Contains quartz, plagioclase chlorite and epidote, also little clay and muscovite.

3 tuff - medium green, fine-grained but individual grains visible, generally cleaved. Fragmental, often feathery texture. Consists of quartz, plagioclase, sometimes pyroxene and rock fragments, all wrapped by chlorite. May be finely interbanded with siltstone.

4 volcanic conglomerate - green, grey, maroon and yellow-green lenses flattened in the cleavage, which is strong to very strong. Also lenses of secondary epidote and chlorite. Appearance characteristic even when it is so sheared that it looks like a mottled phyllite.

5 epidote-schist - non-genetic term for highly altered rocks. Fine grey-green groundmass with sheets and streaks of chlorite and knots of epidote. Cleavage moderate.

6 diorite, altered lava - light or dark green, medium-grained with mottled texture and patches and streaks of chlorite. Usually not cleaved but minerals may be streaked out. Plagioclase and amphibole abundant.

7 gabbro - Dark green and mottled with relatively coarse, interlocking dark and light green crystals. Usually not cleaved.

6 PETROLOGY OF INDIVIDUAL SPECIMENS

SPECIMEN LOCALITIES

Wanderer River	71/52-65	Dundas Type	
Urquhart River	78/29, 78/31-33		
	78/43	Mainwaring Group	
	78/240-242	Dundas Type	
Mainwaring River			
Upper Mainwaring	78/35-40	Lewis River Volcanics	
	78/207-212	Mainwaring Group	
Middle Mainwaring	78/41	"	"
	78/69-77	"	"
	78/181-206	"	"
South Cypress Creek	78/214-223*	"	"
	78/249-254*		
Coast (NtoS)			
S of S.Cypress Ck.	78/224*	"	"
Abo Ck. to Diorite Pt.	78/147-149	"	"
Diorite Point	78/146,146'	"	"
Diorite Pt. to Copper Ck.	78/229-237*	"	"
	78/246*		
	78/143-145	"	"
Copper Creek	78/48,49*	"	"
	78/243-245*and 78/247, 48*		
Copper Ck. to Green Pt.	78/125-142	"	"
	78/225-229		
Green Point	78/110-124	"	"
Green Pt. to S contact	78/88-91*	"	"
	78/105-109	"	"
Copper Creek (inland)	78/60-68*	"	"
	78/237-239*	"	"
	78/255,256*	"	"
Sassafras Creek (inland)	78/104	"	"

* specimens not available

PETROLOGY of SPECIMENS from the WANDERER RIVER

GENERAL

Although the river has been mapped over at least the first eight miles of its course from the coast, the sample ~~into~~ sites are widely separated. Samples were taken at the mouth of the river, then at approximately one, three and five miles from the coast, with three to five specimens collected in each area.

A large number of rock types are represented, including slate and greywackes, intrusive and extrusive igneous rocks ranging from basic to acid (calc-alkaline) in composition and pyroclastics(associated with the basic and intermediate lavas.)

The sediments are derived from a mixed Cambrian-Precambrian terrain, but contain little volcanic material. Fragments from basic or ultrabasic rocks have not been positively identified. All the greywackes are unaltered or only slightly chloritised and they are typical Dundas type sediments.

The igneous rocks cannot be definately placed in any particular grpup, but it is significant that most are fairly fresh, with a little chloritisation as the only type of alteration. These igneous rocks make up a basalt-andesite suite within the sediments, consisting of restricted flows ~~and~~ with associated pyroclastics and minor acid intrusives.

Mapping ~~a considerable~~- indicates a considerable thickness of rocks described as green tuffs and laminated siltstones which would be typical of the Mainwaring grpup. However it is considered ~~highly~~ significant that none of the specimens examined show either the shearing or the metamorphic assemblage epidote-actinolite-chlorite-plagioclase which is characteristic of the Mainwaring Group.

So long as the Mainwaring Group is defined on its metamorphism it cannot be considered to extend as far north as the Wanderer River. On

present knowledge of the structure it is possible the Mainwaring Group is a lateral, metasomatised equivalent of the Dundas type rocks in the Wanderer.

WANDERER RIVER SPECIMENS

Cat.No.	FieldNo.	Specimen	Rock type	miles from river mouth
71/52	(208)	T.S.	Silicified andesite? (chert + plagioclase)	3
71/53	(209)	TS B6296	porphyritic gabbro or basalt	5
71/54	(210)	hand spec.	andesite	1¼
71/55	(211)	TS	greywacke	0
71/56	(21)	TS	slate	0
71/57	(213)	TS	fine greywacke	0
71/58	(214)	TS B6297	porphyritic basalt	5
71/59	(215)	TS B6298	sheared tuff or greywacke	5
71/60	(216)	TS B6299	greywacke	3
71/61	(217)	TS B6100	banded pyroxene aplite	3
71/62	(218)	hand spec.	greywacke	1
71/63	(219)	TS B6101	tuff	1
71/64	(220)	TS B6102	chloritised granodiorite	1¼
71/65	(221)	hand spec.	andesite	1¼

71/52 TS "Chert" silicified igneous rock? 3miles from river mouth Card 47

The rock is dark grey, dense and banded. The cut surface shows small dark and clear patches in a lighter groundmass. The light patches consist of ragged, undulose secondary quartz and plagioclase (oligoclase) crystals about 0.05mm. long. The dark areas are very fine plagioclase and quartz with abundant tiny elongate grains of chlorite and clinozoisite(?). There are also rare large grains of carbonate, chlorite and oxidised magnetite. Grains of plagioclase (possibly andesine) 0.2mm. accross contain inclusions of sericite, chlorite and groundmass material and these may be the only original crystals in the rock. The fine plagioclase is distinguishable from groundmass quartz only by its twinning and both are probably secondary.

The rock may have been igneous but has been completely silicified with the destruction of all original textures.

71/53 TS B6296 porphyritic Gabbro about 5 miles from river mouth Card 212

This Section

The original rock consisted of idioblastic pyroxene phenocrysts up to 1.5mm. long, set in a groundmass of interlocking, subhedral plagioclase laths and fine, granular pyroxene.

The pyroxene is unaltered apart from a little replacement by chlorite and amphibole in the centres of a few crystals. It is colourless, with large extinction angles on the prismatic cleavage and a moderate 2V (+ve.). It is probably augite. Many of the large grains show perfect crystal forms, with twinning and cocnentric zoning quite common. Some phenocrysts form clusters of interfering crystals.

The plagioclase forms shadowy laths up to 0.3mm. long. It is considerably altered, with cloudy chlorite and sericite inclusions and

patches of fine, stained epidote. No determination of composition is possible.

The most spectacular secondary mineral is quartz, which forms large, often idioblastic crystals in the groundmass. These long, pointed crystals are almost always separated from the rest of the rock by fringes of brownish chlorite or chert. The crystals sometimes show faint streaks which may be pyramidal growth lines. Other quartz crystals are quite irregular and merge into patches of fine silica.

Quartz and chlorite are late secondary minerals, probably later than the sericite, epidote and green chlorite replacing plagioclase.

71/54 Andesite ½ mile up first N-tending tributary, ¼ mile from river mouth.

Hand Specimen only

The rock is dark greenish-grey and generally very fine-grained, with dark green phenocrysts (hornblende plus chlorite?) up to 4mm. across. There are a few large feldspar phenocrysts.

71/55 Greywacke mouth of Wanderer River Card 29

The rock is clean and little chloritised, with quartz, plagioclase and rock fragments up to 3mm. long. The clastic grains are wrapped by films of muscovite and chlorite. Single mineral grains include clear, corroded quartz, fresh plagioclase (often with cross-hatched twinning), clorite, muscovite, biotite and iron oxide. Rock fragments derived from Cambrian sources include vein quartz, secondary quartz and chert, chloritised glass (?) and chloritised plagioclase rock. Precambrian fragments are rare- a few stained quartzites, rare mica schists, rounded fragments of slate and shale.

There is slight preferred orientation of elongate grains parallel with the irregular cleavage.

71/56 Slate mouth of the Wanderer River Card 43

Hand Specimen

This is a grey, banded slate, very fine grained with small micaceous flecks on the uncut surfaces. Colour banding is distinct but discontinuous, suggesting deposition on eroded surfaces. There is a strong cleavage parallel to the banding and a weak one at about 30° to it.

Thin Section

This is a fine, strongly foliated rock in which rounded, elongate quartz grains (to 0.1mm.) and less common fresh plagioclase (oligoclase), plagioclase-chlorite aggregates and flakes of green chlorite and muscovite are wrapped by aligned flakes of muscovite and biotite in an abundant matrix of chlorite and sericite. Grains and thin strings of pyrite are scattered throughout.

The banding seen in the hand specimen is due to grainsize variations and matrix abundance (55% in the coarse bands, 70% in the fine ones) which in turn affects the degree of weathering and iron-staining.

Few conclusions can be drawn about the provenance of such a fine-grained rock. Quartz grains are strained and micas abundant, suggesting Precambrian source rocks, but there are no really distinctive fragments.

71/57 fine Greywacke mouth of the Wanderer River Card 30

Hand Specimen

The rock is fine and dense, with poor cleavage and slickensides on one surface. Specks of white mica and a few dark grains are visible on the weathered surface, but none of these exceed 0.5mm. diameter.

Thin Section.

The rock is rather fine-grained, with banding and slight preferred orientation of grains. It contains about equal quantities of quartz, rock

fragments and matrix (chlorite and brown, stained muscovite) with lesser plagioclase and some muscovite, biotite and iron oxide.

The quartz grains are moderately rounded and often corroded on their margins, Some grains are deformed. Deformed quartzites with equant or elongated grains and mica schists are probably derived from Precambrian rocks.

A few fragments of chert are present and there is one quartz spherule and these grains appear to have come from a volcanic terrain, probably Cambrian.

As in 71/55, there are sericitised plagioclase grains and fresh, grains with cross-hatched twinning. Fresh plagioclase is not common in 71/57 and the total plagioclase is about 10%. Oligoclase is the most calcic plagioclase determined.

There are a large number of rounded rock fragments composed largely or completely of chlorite, and these are derived from altered Cambrian igneous rocks. Other fragments are rich in talc(or possibly muscovite) and chlorite and are also originally igneous. Several fragments appear to be altered glass, but this is uncertain.

The matrix is abundant. Many clastic grains have fringes of pale green chlorite and chlorite marginally replaces quartz a nd plagioclase in many cases. Between clastic grains there is a dark matrix, dominently chloritic but also containing muscovite, decomposed plagioclase and limonite.

This rock differs from other greywackes described in being fine-grained, with more abundant matrix.

71/58 TS B6297 Basalt about 5 miles from the mouth of the river Card 210

Hand Specimen

The specimen is deeply weathered, with a small core of fresh grey-green rock. It is richly porphyritic, with dark green and white mottled phenocrysts 1-6mm across in a fine groundmass. The rock is quite massive.

Thin Section

Large clusters and single crystals of clinopyroxene are scattered in a groundmass of fine, interlocking plagioclase, with interstitial chlorite, granular quartz and pyroxene. Quartz and chlorite may be primary minerals.

The plagioclase is quite fresh with a few small chlorite inclusions. Laths of plagioclase reach 0.6mm. in length and are the dominent crystal form. The composition is sodic andesine.

The groundmass is in equilibrium with the phenocrysts, and small plagioclase crystals penetrate the edges of pyroxene, but generally the fine material tends to flow round the large grains. Pyroxene crystals are often fractured, and may be bleached at the edges and slightly chloritised. The pyroxene is colourless augite.

71/59 TS B6298 sheared Tuff about 5 miles from the mouth or river Card 209

Hand Specimen

The rock is brownish-grey with a good cleavage. Grains of various colours up to 3mm. long are flattened in the cleavage and surrounded by fine brownish material.

Thin Section

The rock is strongly cleaved and stained, consisting of rock and mineral fragments in a dark chloritic matrix. Fresh angular fragments of clinopyroxene are common and similar crystals occur as phenocrysts in many rock fragments. Single crystals of altered plagioclase are also common.

Many of the rock fragments are too chloritised to identify. The most abundant type consists of fine, very altered plagioclase aggregates, some showing flow texture and some with plagioclase or pyroxene phenocrysts. Most of the fragments have indistinct margins due to reaction with very fine-grained, brownish chlorite of the matrix.

Quartz is present only as a little secondary material associated with plagioclase in some rock fragments and the section contains no material derived from sedimentary rocks. All the fragments and crystals have their origins in basalts or andesites and the rock is either a tuff or a greywacke with a very restricted source area.

71/60 FS 36299 Greywacke about 3 miles from the river mouth
Card 208

Hand Specimen

The rock is brownish-grey with a fine, sandy texture. It is massive and hard with low permeability.

Thin Section

The rock is an uneven-grained greywacke, with rounded clastic fragments up to 0.4mm. across. Angular quartz grains are the main clastic components, with minor single crystals of plagioclase, microcline and muscovite. Rock fragments are common, with chert and siltstone the most abundant types. These grains are diffuse round the margins, probably due to reaction and recrystallisation of fine silica. Quartz-muscovite aggregates are also common.

The groundmass is not abundant, due to the wide range of grainsizes in the clastic material. It consists of stained clay and a fine recrystallised chlorite cement.

The rock is a fine greywacke sandstone derived from a granitic source. There is little material which is likely to have come from the andesite-basalt terrain described above.

71/61 TS B6100 banded Pyroxene Aplite about 3 miles from mouth
Card N1

Hand Specimen

The specimen has a most unusual appearance. It is quite massive and fine-grained, with parallel white bands about 6mm. apart in a brownish groundmass. White blotches are common extending out from the bands, which are only about 1mm. wide.

Thin Section

The rock is generally extremely fine grained, with a few isolated crystals of quartz and plagioclase up to 0.25 mm long. Most of the rock consists of very fine quartz, possibly feldspar, and whispy masses of muscovite. In this groundmass are scattered flakes of bright green chlorite and larger, irregular grains of quartz, plagioclase and rare magnetite.

The pale bands seen in the hand specimen are large masses of granular, colourless pyroxene, all the little grains within a mass having similar optical orientations. interstitial material is granular quartz.

This is probably a dyke rock, approximately aplite in composition but rather poor in feldspars and rich in pyroxene. No explanation for the pyroxene bands is apparent.

71/62 Greywacke ½ mile up N-tending tributary, ¾mile from river mouth.

Hand Specimen only

The rock is brownish-grey with a fine, sandy texture and no cleavage. A few large quartz grains (up to 2mm.) occur but most clastic grains are less than 1mm. across. The rock is very similar to 71/60.

71/63 TS B6101 Tuff ¼ mile up N-tending tributary, ¼ mile from river mouth Card 24

In hand specimen the rock looks like a medium-grained greywacke. It consists of fresh, fractured titanaugite crystals, ragged glass(?) fragments with plagioclase phenocrysts, altered plagioclase laths in highly curved vesicles filled with zeolite (stilbite) in a sparse groundmass of yellow chlorite and minor zeolite. The plagioclase is invariably altered, being either pseudomorphed by stilbite, single crystals of cloudy heulandite or muscovite plus fine granular epidote with a little albite. Pyroxenes often have a rim of stilbite, rarely alnite.

This rock was probably deposited from a fluidised system containing plagioclase and pyroxene crystals and fragments of chilled lava (glass with phenocrysts). The flow was consolidated with the crystallisation of hydrous minerals. Later plagioclase was subject to low-grade alteration but pyroxenes were not affected.

71/64 TS B6102 chloritised Granodiorite ½ mile up N tributary Card 215

Hand Specimen

The rock is dark grey-green, massive and heavy. In some parts lath-like pale crystals occur in a dark groundmass but elsewhere there are large, diffuse masses of pale green material and irregular white patches. Pyrite grains are common.

Thin Section

The texture is controlled by the strong rectangular cleavage of feldspar crystals. The feldspar is plagioclase (albite, with low relief and moderate 2V +ve.)but the 011 cleavage is unusually prominent. Quartz is the main other primary mineral.

Quartz forms fairly large, highly irregular grains interstitial to

plagioclase. The relationship between angular plagioclase and anhedral quartz can be seen in a few areas but in many more it is obscured by invading chlorite. Masses of fine quartz associated with chlorite and epidote may be secondary.

Large angular bodies of brown, opaque material are probably altered primary ilmenite, and there are unaltered, angular crystals of pyrite.

Much of the interstitial material is secondary, consisting of bright green chlorite and yellow epidote. Chlorite corrodes quartz grains and may replace plagioclase along cleavages, emphasising the feldspar crystal forms.

Some areas of the rock are very rich in ragged masses of prehnite. Individual flakes reach 0.4mm in length, but generally the crystal forms are controlled by the surrounding minerals. Fibrous intergrowth with chlorite is common. The mineral is brownish, with relief a little higher than that of quartz, and moderate birefringence. It has a moderate 2V +ve.. Cleavage is indistinct but fibrous sections are length-fast and have straight extinction.

The only definately primary constituents of the rock are albite and quartz and on this basis it must be classified as granodiorite. There are no textures to indicate the rock was a lava.

71/65 Andesite — ½ mile up N-tending tributary, ¾ mile from river mouth

Hand Specimen only

The rock is massive with a very fine, crystalline, grey groundmass and scattered phenocrysts 1-3mm. long. The phenocrysts are greenish-brown hornblende or augite or pale green to white feldspar. The rock is probably similar to 71/54.

SPECIMENS from the URQUHART RIVER

GENERAL

Eight thin sections are described covering the main part of the Urquhart River and its large southern branch.

All but two of the specimens belong to the Dundas type, and include greywackes, diorite and gabbros (or basic crystal tuffs) quite comparable with Dundas type specimens from elsewhere. Granodiorite is uncommon in the Dundas Group but examples comparable to 78/32 have been described.

78/33 and 78/43 are basalts showing the type of alteration and secondary mineral assemblages typical of Mainwaring Group rocks. These two specimens from the middle Urquhart are considered the only representatives of the Mainwaring Group in the area, although all the middle and upper reaches of the river were originally mapped as Mainwaring Group.

URQUHART RIVER SPECIMENS

78/29	TS B6105	Greywacke	G946	½ mile from river mouth
78/31	TS B6106	silicified greywacke		" "
78/32	TS B6107	Granodiorite	G1145,	1½ miles from mouth
78/33	TS B6108	altered Basalt	G1162,	3 miles " "
78/43	TS B6113	altered porphyritic Basalt	G1156,	2½ miles "
78/240	TS	sheared chloritic Gabbro or Tuff		Upper Urquhart
78/241	TS	chloritic Diorite		" "
78/242	TS	sheared Gabbro or tuff		" "

78/29 Ts B6105 Greywacke ½ mile from river mouth

Hand Specimen

The specimen is sheared, with flattened lenses of fine grey and whit material in a pale, medium-grained groundmass. There is a persistent lineation consisting of streaks of dark micaceous minerals on cleavage surfaces.

Thin Section

The rock has a strongly deformed fragmental texture, with rounded rock fragments and crystals wrapped by a fine crystalline groundmass. The specimen has indistinct bands parallel with the cleavage and the two main bands differ in composition.

The palest band consists of large, pale brown bodies (about ½mm. lon and single crystals and aggregates of quartz surrounded by very fine quar and chlorite. The chlorite has recrystallised to form fringes on large grains nad produce a flow texture in the groundmass. Many of the large grains have been rotated during shearing and do not lie in the foliation. The brown bodies are filled with fine muscovite with rims and interstitial patches of feldspar, and these bodies appear to have been plagioclase laths.

The darker, more weathered bands contain a greater concentration and variety of clastic grains, and the groundmass contains muscovite as well as quartz and chlorite. Rock fragments include chert, quartz mosaics and mica-schists as well as siltstones. Altered plagioclase is much less common in these bands than in the pale one, while quartz and muscovite are more abundant.

In most parts of the section the matrix is very abundant and in some places it exceeds the volume of clastic fragments.

The rock is a greywacke, but deformation and silicification have given it an appearance unlike other greywackes described. Altered

feldspar is unusually abundant, particularly in the pale band, which may be a tuffon textural evidence. The presence of chert, siltstone and schist fragments in the weathered band probably precludes a pyroclastic origin for the whole rock.

78/31 (227) TS B6106 silicified Greywacke ½ mile from coast

Hand Specimen

The rock is coarse grained with pink, white and black grains 1-2mm. long aligned in a pale grey matrix. Although it is quite porous, the rock is strongly cemented and very hard. There is no cleavage.

Thin Section

Angular rock and mineral fragments are scattered in an abundant silica cement. The cement is generally without foliation but in rare instances elongate quartz crystals and chlorite form pressure fringes on clastic grains. The groundmass is mostly very fine silica with a little coarser quartz and a few small mica flakes.

The clastic grains are generally siliceous - quartz grains and aggregates, quartzites and quartz schists and dark chert fragments. There are also large fragments of partly sericitised plagioclase and micaceous and chloritic siltstones.

Several rounded fragments consist of interlocking altered plagioclase grains and are derived from Cambrian lavas. The quartzites and schists come from and Older Precambrian metamorphic terrain, while the siltstones are probably from the Cambrian. The cherts may be sedimentary fragments replaced during silicification but their origin is uncertain.

Silicification is extensive and occurred after regional shearing.

78/32 TS B6107 Granodiorite 1½ miles from the coast

Hand Specimen

The rock is medium-grained with interlocking green and white crystals a few of them up to 3mm. across. The specimen is massive, without cleavage or fractures.

Thin Section

The rock consists of interlocking feldspar crystals with minor interstitial magnetite, quartz, chlorite and a little biotite.

The feldspars ~~consists of~~ are interlocking plagioclase laths with clear irregular rims of potash feldspar. Most plagioclase crystals are sericitised and contain tiny chlorite inclusions concentrated along cleavages. Inclusions make R.I. determinations dificult, but the plagioclase appears to be albite. The rims which occur on a large number of plagioclase crystals are only slightly cloudy, with high 2V -ve. and both R.I. and birefringence are lower than those of the adjacent plagioclase. This mineral is probably orthoclase but the characteristic orthoclase cleavage is seldom seen.

Quartz is a rare interstitial mineral, occurring in anhedral crystals often separated from the feldspars by rims of chlorite.

Most of the coloured silicate is bright green chlorite, which contains slivers of biotite. The structure of the chlorite indicates that at least half the original mafic material was biotite which has been replaced. Thin parallel strips of magnetite in the chlorite indicate biotite cleavages.

Within the felsic part of the rock there are a few small crystals of accessory minerals, notably apatite and epidote.

The rock is granodiorite, with the essential minerals albite, orthoclase and biotite with minor quartz and magnetite. However it is not a perfect eutectic mixture, since the orthoclase always forms rims

on plagioclase and quartz is a late mineral and much less abundant than expected.

Fgagments of a similar rock occur in a greywacke 78/31 one mile to the west.

78/33 (229) TS B6108 altered Basalt about three miles from coast

Hand Specimen

The rock is green with a fine, crystalline texture. A few dark grains reach 1mm. across but the average grainsize is much less. The rock is massive and without cleavage. ~~but~~ The cut surface shows some large shadowy masses surrounded by light green material.

Thin Section

The section contains large areas of fresh rock surrounded by very fine-grained, stained areas rich in epidote and sheared zones of fibrous amphibole.

The fresh rock is fine-grained, with thin laths of plagioclase up to 1mm. long and round granules of pyroxene and epidote, with interstitial anhedral plagioclase, chlorite, a little fine amphibole and oxidised iron ore.

The plagioclase is slightly sericitised oligoclase and appears to have been the first mineral to crystallise. Small grains of colourless clinopyroxene are also primary.

Epidote forms small grains and relatively large, twinned crystals, and appears to be secondary. Epidote, chlorite and needles of amphibole all penetrate the primary plagioclase. chlorite also forms angular patches rimmed with fine quartz, and there are many cavity fillings.

In altered parts of the rock the plagioclase is completely chloritised. The mineral assemblage is epidote-chlorite-amphibole, all fine-grained and heavily stained. Amphibole is concentrated in stained

Although there has been considerable alteration in these zones there is no sign that elongate plagioclase laths ever existed in these areas, so that granulation may have occurred early in the history of the rock, possibly during crystallisation.

Oligoclase and clinopyroxene are the only certain primary minerals, while abundant epidote, actinolite and chlorite are secondary minerals typical of altered Mainwaring group rocks. The original rock was basaltic.

78/43 (239) TS B6113 altered porphyritic Basalt 2½ miles from Coast

Hand Specimen.

The rock is green, with an uneven texture and mottled appearance. It is very fine-grained with dark green patches 1-2mm. across The rock is crossed by a network of fine, pale green lines of alteration products and is massive and uncleaved but deeply weathered.

Thin Section

The rock is generally very fine-grained with scattered aggregates of coarse plagioclase and epidote crystals. The fine material consists of scattered needles of amphibole and rare plagioclase and granular epidote and pyroxene in a groundmass of plagioclase and chlorite. It differs from 78/33 in that plagioclase is almost always confined to small, anhedral crystals rather than elongate laths.

Stained strings of fine, granular epidote are common and in some cases enclose veinlets of secondary plagioclase.

The phenocrysts are corroded crystals of plagioclase up to 1.5mm. long with chlorite replacement along the cleavages. Crystallisation of secondary minerals has been so extensive that plagioclase crystal forms are indistinct . Coarse epidote crystals are associated with the phenocrysts and in some cases several epidote crystals surround a mass of fan-shaped chlorite fibres. and these bodies may have been vesicles

This rock is similar to the non-pophyritic 78/33, but in this case the original textures are less well preserved and most of the groundmass plgioclase has been replaced by secondary minerals, as in the more altered parts of 78/33. The primary in both are oligoclase , clinopyroxene are minor iron oxides, and the original rocks were apparently vesicular basalts.

78/240 (494) sheared chloritised Gabbro Upper Urquhart

Hand Specimen

The rock is dark greenish-grey with dark grains up to 4mm. across in a rather sheared, medium grained, crystalline groundmass. Dark grains are flat and platey and their parallelism gives a slight cleavage. The rock is altered.

Thin Section

Fresh pyroxene crystals and large untwinned plagioclase grains are wrapped by lenticular plates of fine-grained green chlorite with grey-green birefringence. Cleavage planes filled with dark, dusty material curve round the pyroxenes and slice through the chlorite flakes.

The plagioclase is +ve. with high 2V, but twinning is rare. Where fine twinning occurs one set of twins is generally replaced by chlorite. Grains rarely show crystal faces or cleavage, though a few are elongate, and no determinations are possible. In the unaltered rock plagioclase and pyroxene formed a granular mosaic and there is no sign of ophitic texture. The feldspar is commonly cracked and partly replaced by chlorite but the usual alteration to sericite and/or epidote is not observed.

Pyroxene is pale brown with high extinction angles and is probably augite. It is often cracked and partially replaced by colourless amphibole and sometimes chlorite, but alteration is not extensive.

Chlorite is the most abundant mineral and may be late primary, or

alternatively a secomdary mineral replacing mesostasis(?) and feldspar. It crystallised before the shearing.

Oxidised iron ore forms large, opaque patches. From the angular, skeletal forms of some of the bodies it appears the original mineral was ilmenite.

Summary The original rock was an even-grained gabbro containing augite, untwinned plagioclase, ilmenite and possibly much late primary chlorite. Lenticular flakes of fine-grained chlorite crystallised before shearing, some replacing feldspar. Colourless amphibole formed at the edges and along cracks in the pyroxene, which is fractured but not extensively altered.

Approximate mode - chlorite45%, augite 30%, plagioclase 15%, iron oxide and staining material 10%.

78/241 (495) fine Diorite Upper Urquhart

Hand Specimen

The specimen is very small and deeply weathered. The cut surface shows an uneven-grained texture with white and dark grey grains 1 to2mm. long scattered in a weathered, fine grey groundmass.

Thin Section

Small pyroxene crystals are fractured and surrounded by chlorite and colourless amphibole in a groundmass of coarse, generally anhedral plagioclase. The feldspar (oligoclase) is fresh and clear, but much of it has been replaced by chlorite (which follows the plagioclase cleavages) and fine granular epidote. A few plagioclase laths are as large as 2x0.5mm. Clear rims are rare on plagioclase grains rich in inclusions.

The chlorite is green and slightly pleochroic with Berlin Blue birefringence and occurs as masses of short tufts interstitial to plagioclase and surrounding fractured pyroxene crystals, or as tiny grains in plagioclase.

The pyroxene is fine-grained and fractured, with chlorite, amphibole or weathering products occupying the cracks. It is pale brown th neutral, with high extinction angles and is identified as augite.

Ragged brownish to black, opaque grains are common and many are introduced by weathering, but some are probably altered primary iron oxides.

Summary Summary The original rock was diorite, with small augite crystals set in a base of coarse oligoclase. The feldspar has partly altered to epidote and is partly replaced by chlorite, while the pyroxene is surrounded by chlorite and a little pale amphibole.

Approximate mode - plagioclase 40%, chlorite 25%, augite 15%, epidote 10%, iron oxides 10%.

78/242 (496) sheared Gabbro or Tuff Upper Urquhart

Hand Specimen

The specimen is medium grey and heavily weathered. The cut surface has a cleaved, streaky appearance with pale and dark grey slivers roughly aligned in a mottled grey-green groundmass.

Thin Section

The rock is very strongly sheared, with thick bands of iron oxides along shear planes, and this emphasises the fragmentary texture. Fresh pyroxene grains, partly replaced by colourless, fibrous amphibole, are extensively fractured, the fracturing being associated with the cleavage of the whole rock. The pyroxene grains are set in colourless chlorite with very low birefringence.

The interstitial material consists of coarse grains of cloudy, chloritised plagioclase, generally cleaved into elongate lenses, and large lenses of pale green, fibrous chlorite with Berlin Blue and yellow-brown birefringence. The chlorite contains very fine amphibole needles. The

chlorite also wraps and encloses perfect six-sided epidote crystals which occur singly and as clumps and are apparently late primary minerals.

Small quartz grains are scattered through the most altered parts of the rock and some from inclusions in altered plagioclase. However quartz is not abundant.

Large masses of dusty, opaque material may be remnants of iron oxide bodies, but this is uncertain. They are frequently rimmed with chlorite with short fibres at right angles to the boundary, and thus may be an early textural element.

Conclusions - The rock is apparently a gabbro. Its texture is highly fragmental and this is at least partly due to strong shearing, which is the most recent event recognisable. However it is possible that the rock was fragmental before shearing and it may have been a basic crystal tuff. The plagioclase is too altered and deformed to be identified, and it is unusual in containing quartz inclusions.

If the rock is igneous its history would be as follows- crystallisation of pyroxene, plagioclase and quartz; pyroxene replaced marginally by colourless amphibole (cummingtonite?) and epidote crystallised. After cooling pyroxenes were fractured, with colourless chlorite and possibly amphibole forming in the cracks. Alteration of feldspars (mainly chloritisation)and formation of large lenses of chlorite and amphibole which wrap round earlier minerals preceeded or accompanied shearing, and shearing continued after chlorite crystallisation ceased.

Approximate mode - pyroxene 25%, chlorite 25%, altered plagioclase 15%, iron oxides 15%, epidote and amphibole 10% each.

Upper Urquhart Intrusions

78/240 and 78/242 are fairly similar rocks and both are sheared and chlorotised gabbros or possibly basic pyroclastics. 78/241 is rather different in texture and is similar to "diorites" described from other areas. The feldspar (oligoclase) is fairly fresh and somewhat poikiloblastic and this is a typical diorite texture. The feldspar in the two basic rocks cannot be identified due to alteration and scarsity of twinning. It is possibly albite and these rocks may have spilitic affinities since in their other features they correspond reasonably well with some described spilites.

SPECIMENS from SOUTH CYPRESS CREEK

Sixteen specimens are recorded from South Cypress Creek but none are available for examination. The following descriptions are taken from the field specimen register.

78/214	ferruginous, resinous phyllite	
78/215	quartz plus black rock	
78/216	pyrite cubes in green tuff	
78/217	fresh green tuff	
78/218,219	" " "	
78/220	green tuff (c.f. rock at mouth of Copper Creek)	
78/221	" "	
78/222	green stretched, mottled rock	
78/223	orange-pink banded rock	
78/224	argillite with pyrite and quartz vein	coast 1ml. S of S Cypress Creek
78/249	green tuff	
78/250	greywacke with galena	
78/251	quartzite	
78/252	siltstone	
78/253	argillite	
78/254	ferruginous greywacke	

Both Dundas and Mainwaring Group rocks are expected to occur in South Cypress Creek but no precise locations have been given for the above specimens and naming does not appear to have been rigorous so that these specimens are of little use.

SPECIMENS FROM THE MAINWARING RIVER

GENERAL

A section through the Mainwaring Group as it is exposed in the Mainwaring River has been described in an earlier part of this report.

Almost all the specimens from the Mainwaring river are extensively altered, so that although most have been given genetically significant names in many cases the nature of the original rock is uncertain.

The alteration is of the Lower Greenschist facies type which characterises the Mainwaring Group. Epidote and chlorite are the most important secondary minerals and these may have been introduced metasomatically. Epidote occurs in all rocks except the non-volcanic sediments. Secondary actinolite is important in rocks of igneous origin.

The original rocks were a series of interbedded very fine, laminated siltstones (probably volcanic in origin) and fine tuffs. In several places there are "sheared volcanic conglomerates" which consist of small flattened lenses of siltstone, tuff and lavas in a silty, epidote-rich matrix. In some cases very severe shearing has produced finely cleaved rocks with thin, discontinuous bands of the rock types mentioned.

Interlayered with the pyroclastics are altered igneous rocks. These are generally intermediate with dioritic composition, though some are basic. Alteration tends to produce rocks of diorite composition and the original rocks were probably more diverse. Feldspar phenocrysts were not present in any specimens so it is unlikely the original rocks were andesites of the type common in the Dundas Group.

Gabbros are uncommon, possibly because all but the most massive are very susceptable to alteration and are not recogniseable.

SPECIMENS FROM THE MAINWARING RIVER

UPPER MAINWARING

78/35	TS B6109	Plagioclase-schist	Lewis River Volcanics
78/37	TS B6110	Dacite	
78/39	TS B6114	sheared Dacite	
78/40	TS B6112	Epidote-schist	
78/207		banded Phyllite	Mainwaring Group
78/208	TS	sheared Tuff	
78/209	TS	Diorite	
78/210		altered Diorite	
78/211	TS	sheared diorite	
78/212		altered diorite with epidote-feldspar-amphibole secretions.	

MIDDLE MAINWARING

78/141		tuff
78/69		phyllite or fine tuff
78/70		sheared volcanic siltstone
78/71		sheared Diorite
78/181	TS	very altered tuff
78/182		tuff
78/183		altered Diorite
78/184		sheared siltstone-tuff
78/185		tuff
78/186		volcanic siltstone
78/187		volcanic siltstone
78/188		altered lava
78/189		chloritised fine tuff
78/190		altered fine lava
78/191		weathered tuff

78/192		altered fine Lava (?)
78/193	TS	sheared Pyroclastic Breccia
78/194		phyllite
78/195		altered Diorite
78/196		altered Diorite
78/197		fine Tuff
78/198		knotted Epidote-schist
78/199		Tuff
78/200		altered Diorite
78/201	TS	Gabbro
78/202		altered Tuff
78/203		Diorite
78/205	TS	Epidote-amphibole-schist
78/206		knotted schist

LOCALITIES

The westernmost specimen from the Middle Mainwaring, 78/41, is taken about one mile from the mouth of the river. Specimens 78/181 to 78/201 are taken consecutively between the one-mile point and the western end of the Middle Mainwaring gorge. There are two batches of specimens, collected by several geologists. 78/202-205 are taken from the gorge, 78/206 from above the gorge and 78/207 and 208 from the junctio of the northern and eastern branches. 78/209-212 are green volcanics from the eastern branch up to ½ mile from the junction. The other specimens from the Upper Mainwaring are acid volcanics belonging to the Lewis River Volcanics. Four specimens come from the northern branch, one to two miles above the main junction.

MAINWARING RIVER ROCK DESCRIPTIONS

UPPER MAINWARING

Lewis River Volcanics

(Brief descriptions only; full descriptions in 1967 reports)

78/35 (231) TS B6109 Plagioclase-schist 2miles N of main junction

This is a medium grey, schistose rock with white porphyroblasts up to 2mm.long and elongate fine bands and lenses. Cleavage surfaces are glossy and lineated. Large plagioclase porphyroblasts are often heavily sericitised and altered to granular epidote, and some have sericite following helicitic lines or parallel tension fractures. The groundmass is foliated muscovite with lesser chlorite and fine granular quartz. Small porphyroblasts (0.2-0.4mm.)of quartz, strained quartz aggregates and fresh untwinned or cross-hatched plagioclase grains are abundant. There are also a few large, broken euhedral grains of brown hornblende with clear overgrowths, muscovite-magnetite masses and scattered small crystals of magnetite and epidote. Pennine chlorite is often associated with the porphyroblasts.

This may be a sheared igneous rock. possibly at an earlier stage of metamorphism than 78/40, but its origin is doubtful.

78/37 (233) TS B6110 Dacite 2 miles N of main junction, Nbranch.

This is a massive, light grey rock with flow banding and white phenocrysts up to 1cm. long in a microcrystalline groundmass. Angular ologoclase phenocrysts, generally turbid and often twinned are the most abundant but undulose, embayed quartz phenocrysts are common and a few phenocrysts are quartz-plagioclase aggregates. Plagioclase crystals are often zoned with distinct rims more sericitised than the rest.

Epidote crystals often form fan-shaped aggregates and are associated

with pennine and magnetite in masses which occur alone or around groups of plagioclase phenocrysts.

The groundmass is very fine quartz with minor muscovite and chlorite aligned to give a foliation which swirls round the phenocrysts. Phenocrysts often have thin sheaths of muscovite and pressure shadows of pennine.

The rock is a fresh acid porphyritic lava with very low mafic content.

78/39 (235) TS B6111 sheared Dacite N branch 1 mile above jcn.

The hand specimen shows elongate black and white phenocrysts in a fine green and grey groundmass, but no cleavages are developed. Quartz phenocrysts are broken and corroded remnants of embayed volcanic quartz, often with parallel healed fractures and internal mortar texture. Brown hornblende is fractured and displaced along its cleavages, with bleaching and parallel overgrowths of clinochlore. Originally rounded laths of andesine(?) have undergone varying degrees of alteration to very fine epidote giving stained "ghosts" of phenocrysts in many cases. Small magnetite grains are fractured and marginally oxidised.

The groundmass is very fine, elongate quartz in which green needles of chlorite and epidote grains are abundant. It wraps phenocrysts giving flow texture which probably existed before shearing. Quartz-pennine fringes on large quartz grains are common, the fine quartz being derived from the phenocrysts.

This rock is a sheared and slightly altered equivalent of 78/37.

78/40 (236) TS B6112 Epidote-schist N branch, 1 mile from junction.

The hand specimen is very fine, pale grey-green with fine lamination and good cleavage. A few weathered grains form knots which disrupt the laminae. The light-coloured bands are quartz, in very small equant grains with fused margins and undulose extinction. Fine needles of bright green chlorite are inclusions in the quartz matrix. The dark bands are stained and are composed of parallel fibrous chlorite grains and fine granules of epidote. Epidote forms numerous knots to 0.4mm. across which are wrapped by the foliation, so the texture is very similar to that in Precambrian schists except that the quartz is not elongated.

The fused quartz and general mineralogy suggest that this rock is formed by complete recrystallisation and possible silicification of an assemblage such as quartz-plagioclase-hornblende.

MAINWARING GROUP ROCKS of the Upper Mainwaring River

78/207 (E212) banded Phyllite junction of N and E branches

The rock is a very fine-grained, strongly cleaved phyllite with grey and white bands up to 3cm. wide. The banding is not parallel with the cleavage. There is a marked crenulation lineation on cleavage surfaces.

The rock is an altered siltstone, probably similar to the siliceous phyllites south of Sassafras Creek, underlying the green volcanics.

78/208 (E213) sheared Tuff E branch, near the junction

Hand Specimen

The rock is pale greenish grey with a strong foliation and a dull lustre on cleavage faces, which also contain a streaky lineation. The rock is composed of fine, flattened grains whose various colours give a slightly mottled appearance to broken surfaces. Sheets of iron staining are common parallel with the cleavage

~~are common parallel with the cleavage.~~

Thin Section

In thin section the rock is fine-grained with a very pronounced foliation wrapping lenticular porphyroblasts which do not exceed 0.2mm. in length.

The porphyroblasts are generally strained and deformed plagioclase (albite 0) rich in chlorite and sometimes epidote inclusions. Quartz porphyroblasts are deformed but have fewer inclusions. Epidote also forms small, elongate porphyroblasts.

The groundmass consists of flakes of yellow chlorite which appear very long and thin in the section normal to the foliation. The chlorite has Berlin Blue and tellow-green first order birefringence. Long strings of stained earthy material, probably clay, and very fine epidote, also occurs in a background of plagioclase. There is a little muscovite and epidote is common as strings of grains lying in the foliation.

The rock is ~~slightly~~ highly deformed and altered, so that the origin is uncertain. It was probably a sediment, possibly tuff, since it appears to have been rich in plagioclase. About half the groundmass is now chlorite, but much of the rest is hard to identify due to staining. It is semi-opaque and earthy, with very high relief and may be rich in secondary epidote.

78/209 (E215) Diorite east branch

Hand Specimen

The specimen is dark green, dense and hard. It contains a number of very dark green crystals in a lighter groundmass crossed by numerous pale yellow-green strings and anastamosing veinlets. The veins have no preferred oeientation and the rock is uncleaved. It is weakly magnetic.

Thin Section

The rock is remarkably fresh. It consists of patches of coarse-grained crystals well twinned andesine (determined on albite twin extinction angles and R.I. relative to adjacent quartz) in a fine groundmass of dark green actinolite and secondary minerals, with interstitial plagioclase.

The plagioclase of both groundmass and the coarse crystals is fresh although it is slightly turbid and contains some small inclusions of amphibole and chlorite.

Actinolite is abundant as short (0.1-0.2mm.) prismatic crystals, roughly aligned to give a slight schistosity. Other primary minerals are magnetite, which is common and somewhat oxidised, and boitite which occurs in a few areas as flakes, always surrounded by large bodies of green chlorite. Even if all the chlorite was derived from mica the original distribution of original biotite would have been patchy.and restricted.

Epidote and chlorite are secondary minerals, scattered throughout the groundmass as small grains or flakes and these minerals also occur as coarse crystals in a number of vein-like bodies. The main vein is associated with a shear zone with coarse epidote and chlorite crystallising on either side of a strip of sheared greenschist (amphibole and minor plagioclase). Other veins are irregular and poorly defined.

The secondary quartz is associated with coarse epidote-chlorite bodies and also invades coarse plagioclase crystals.

Summary

The rock is a slightly altered diorite consisting of patches of coarse andesine crystals in a groundmass of fine actinolite and untwinned plagioclase. Fine epidote and chlorite are scattered in the groundmass and coarser crystals form veins and segregations with secondary quartz. Some coarse chlorite patches contain biotite. Approximate mode- actinolite 30%, plag. 30% (20% as groundmass), epidote 15%, chl. 15%, mag. 6%.biot2%

78/210 (E217) altered Diorite eastern end of gorge

The rock is green and medium-grained with large diffuse masses of yellow-green epidote and small patches and streaks of dark green chlorite. The texture is obscured by alteration but is formed by interlocking elongate crystals, mostly grey-green altered feldspar. The original rock was not porphyritic.

The specimen is fresh and has a rough cleavage. It closely resembles 78/211, though the latter is more sheared.

78/211 (E216) sheared Diorite E branch, ½ mile from junction

Hand Specimen

The hand specimen is medium grey-green with a rather soapy appearance There is a fairly pronounced cleavage and irregular spots and sub-parallel streaks of dark material. Pale knots up to 1cm. across are wrapped by the foliation, but some irregular dark veins cut through it.

Thin Section

The section shows a very heavily stained, fine, foliated groundmass which wraps numerous lenticular and subidioblastic ~~phenocryste~~ porphyroblasts. The groundmass is apparently very fine chlorite or clay but staining makes it dificult to identify. In the pressure shadow areas round some porphyroblasts pale green amphibole and fine plagioclase has crystallised.

Many porphyroblasts consist of idioblastic plagioclase crystals, sometimes zoned or bent and often containing abundant epidote and muscovite inclusions, but having clear rims. Other porphyroblasts are sub-idioblastic to granular epidote crystals associated with chlorite, plagioclase and sometimes quartz. The texture indicates that epidote and plagioclase crystallised before the shearing occurred, but chlorite and amphibole recrystallised during shearing.

Fine secondary quartz is later than plagioclase, which it partially replaces, but is earlier than the shearing. Small veins containing all these minerals cut the foliation. The first plagioclase to crystallise was andesine.

The rock is probably a diorite in which secondary epidote and quartz crystallised and overgrowths on plagioclase formed before shearing took place. The original groundmass may have been plagioclase and amphibole but is now largely unregogniseable.

78/212 (E214) altered diorite with epidote-feldspar-amphibole veins

eastern branch ½ mile from junction

The specimen is dark green altered diorite, composed mainly of chlorite and amphibole with small patches of epidote and feldspar. one end of the specimen is occupied by thick, irregular veins of epidote, chalky white feldspar and needles of amphibole. Several shear zones cross these veins and pass into the rock and these shears are filled with bands of dark green cross-fibre amphibole and feldspar.

MIDDLE MAINWARING RIVER (Specimens generally taken consecutively W to E)

78/41 (237) Tuff 2¼ miles from the coast

The rock is green, with strong cleavage and layering (produced by shearing) parallel with the cleavage. Some cleavage surfaces are covered with chlorite and there are small pale grains aligned to give a lineation.

78/69 (278) Phyllite or fine tuff western end of E-W section of river.

The rock is pale grey-green, well cleaved and very soft, with slight colour banding parallel with the cleavage. Cleavage surfaces are coated with very fine white mica. Individual grains are too small to be seen with the unaided eye but the softness and texture suggest this rock may be a siliceous volcanic rather than siltstone.

78/70 (281) sheared volcanic siltstone ½ mile below first large northern tributary

The specimen is strongly sheared and consists of small, flattened green and grey lenses. It is probably similar to the sheared siltstones and conglomerates found further downstream, but the specimen is too small and weathered to be useful.

78/71 (279) sheared Diorite ½ mile below first large N tributary

The rock is grey-green with strong cleavage and glossy cleavage surfaces. Grains are extremely fine and there are a few pale patches and streaks of dark green chlorite. The rock is strongly chloritised and its original is doubtful. It does not closely resemble any of the sectioned specimens, but may be a very altered equivalent of 78/211.

78/72 (280) Tuff ½ mile below first large N tributary

The rock is medium-grained with green and white grains flattened in the foliation. The rock is very weathered but is equivalent to the fine-grained of the volcanic conglomerate 78/148 which contains igneous rock fragments only.

78/73 (282) altered Diorite ½ mile below first main N tributary

The specimen is small and weathered, ~~with green and~~ but is quite similar to several diorites described fully elsewhere. It is grey-green and very fine-grained and contains a few large pieces of dark chlorite. Cleavage is slight.

78/74 (283) altered Diorite little below first main N tributary

This specimen is quite fresh. It is green, fine-grained and slightly cleaved. It is apparently rich in epidote and there are dark patches of chlorite and possibly amphibole.

78/74 (284) Phyllite first mainn N tributary, 1¼ miles N of the Mainwaring.

The rock is loght greenish grey with well developed cleavage. It is glossy and very fine-grained, with a fine, indistinct knotted appearance which may indicate that it is a pyroclastic rather than a siliceous siltstone.

78/76 (285) altered Lava just upstream from the first large N tributary.

The rock is dark grey-green and massive, with patches of epidote and feldspar in a fine crystalline groundmass which probably contains plagioclase, amphibole and chlorite. Epidote forms large veins and secretions often associated with feldspar and chlorite. The rock may contain quartz.

78/77 (286) phyllite eastern end of gorge.

This is a grey, knotted phyllite very similar to 78/206 from the same location.

78/182 (E134) altered tuff(?) 2¼ miles from river mouth

Hand Specimen

This is a pale greenish grey, deeply weathered rock. The cut surface shows shredded pale green and pale grey material drawn out along an indistinct foliation. The rock looks very altered and consists of fine-grained secondary minerals.

Thin Section

The rock is heavily iron-stained and extensively altered. Large grains of fuzzy semi-opaque material occur parallel with the foliation, which is quite pronounced in thin section. This material is fine granular epidote and occupies about half the section. Much of the remainder of the rock is fine, pale green chlorite.

There are a number of aggregates of small, fresh plagioclase crystals and small prisms of pale green amphibole. The plagioclase is generally poorlt twinned, with a number of micaceous inclusions, but otherwise unaltered. It has a moderate 2V +ve. but no determination of composition is possible. Some aggregates contain epidote crystals.

A number of angular pseudomorphs are filled with epidote, sometimes in the form of radiating ~~crystals~~ sheaves of crystals, and these appear to have resulted from complete replacement of pyroxene(?), the pyroxene cleavages being preserved in some cases. One patch of fine secondary quartz was also observed.

Apparently all minerals present- epidote, chlorite, plagioclase and amphibole- are sedondary or at least recrystallised.

Fine grainsize and loss of almost all primary minerals make it difficult to decide on the origin of this rock. It was probably very rich in plagioclase and chlorite, with a few pyroxene grains, and seems to have been a tuff or lava, probably intermediate in composition.

78/182 (E185) Tuff

The rock is massive and rather weathered.. It is composed of small, even grains of dark grey, pale grey, pale green and white. The darkest grains are flattened chlorite aggregates. The fragmental texture suggasts this is a tuff, although it does not closely resemble other sectioned specimens.

78/183 (E186) altered Diorite

The rock is green and well cleaved, with cleavage surfaces coated with dark green lineated lineated chlorite or pale micaceous minerals. The rock is fine-grained and crystalline, and probably consists of epidote, plagioclase, chlorite and possibly amphibole. Coarse crystalline quartz ans chlorite occupy shear planes.

The original rock was probably igneous and intermediate in compositio but has been altered, with the introduction of epidote and chlorite.

78/184 (E187) sheared siltstone-tuff

The rock is pale green with strong cleavage and pale, glossy, knotted cleavage surfaces. It is made up of strongly flattened lenses of fine-grained grey, green and yellow-green rocks and the cleavage is cut by a few green porphyroblasts containing epidote and chlorite (and possibly pyroxene or amphibole.) Some of the lenses have the feathery, fragmental texture of the tuff bands described in 78/208 and the rock is a finely interbanded tuff and siltstone which has been altered and sheared to its present state.

78/185 (E188) Tuff

The rock is green with a very strong cleavage and streaming lineation on cleavage faces. The specimen is small but the texture appears to be fragmental and the rock is identified as tuff. Chlorite is the main secondary mineral.

78/186 (E189) volcanic siltstone

The rock is pale green with strong cleavage and two streaky lineations at right angles. It is very fine-grained, with shreds of dark green, fine chlorite lying in the foliation. It is a highly altered tuff or siltstone.

78/187 (E192) volcanic siltstone

The rock is pale yellowish grey with well-developed, closely spaced cleavage planes and a slight lineation due to the intersection of folded laminea on the main cleavage surfaces. The rock is very fine-grained and is probably similar in composition to the fine bands in 78/208, which consists chiefly of chlorite, epidote and clay with small plagioclase and quartz and porphyroblasts.

78/188 (E191) altered intermediate lava

The rock is green with small pale knots lying in a poorly developed cleavage. It is fine-grained with a few large, dark green phenocrysts of amphibole and/or chlorite. The rock is probably a highly altered igneous one and most closely resembles the lava layers in 78/112, but is more altered.

78/189 (E194) chloritised Tuff

The rock is pale green, very fine grained and strongly cleaved, with a fine cren ulation lineation. The cleavage surfaces are glossy but the slightly mottled texture suggests the rock is a chloritised tuff.

78/190 (E194) altered fine lava

The specimen is light grey-green and weathered. It contains phenocrysts of bright green epidote, often associated with fine quartz. Quartz and chlorite also occur as lenses flattened in the cleavage. The

groundmass is very fine-grained, and cleavage surfaces are glossy, with a streaming lineation. The "phenocrysts" are probably secondary and it is not known whether the original rock was lava or tuff.

78/191 (E195) weathered tuff

This is an extremely weathered, well cleaved rock, analagous to 78/185.

78/192 (E196) altered fine lava (?)

The rock is poorly cleaved and light grey with a coarse mottling. There are large flat patches of chlorite end "phenocrysts" of epidote. This specimen is similar to 78/190 but not so weathered and is an altered lava.

78/193 (E197) sheared Pyroclastic Breccia

Hand Specimen

The specimen is a typical " stretched volcanic conglomerate", consisting of large, ragged whisps of fine-grained, dark grey, schistose material roughly aligned in a pale green groundmass. cleavage is pronounced and is parallel with the platey fragments.

Thin Section

The section shows a number of large, sheared fragments of various types, all highly altered. The fragments are greenschists having variable grainsizes and textures, and appearing in the hand specimen as irregular apple green lenses with a mottled appearance. Mottling is due to to flakes of darker green chlorite parallel with the internal schistosity of the fragments.

The greenschists are composed largely of very pale green amphibole (tremolite-actinolite) and lesser altered plagioclase full of green

inclusions. Granular green chlorite forms lenses parallel with the amphibole elongation and dark iron-stained bands are common.

A few grains of epidote and a little quartz occur in most of the lenses. One fragment has a strong knotted texture, with fibrous amphibole and chlorite wrapping masses of altered plagioclase, epidote or chlorite (which may pseudomorph pyroxene.).

The groundmass is fine, granular epidote, generally heavily stained but with clear patches of coarse epidote or single small amphibole or chlorite flakes. The groundmass is not so schistise as the greenschist fragments, due probably to the granular habit of the epidote.

All minerals are secondary so the origins are obscure. The greenschists are probably derived by low grade metamorphism of basaltic rocks and it is assumed that the original clastic groundmass has been completely replaced by epidote. The rock is a conglomerate or pyroclastic breccia.

78/194 (E198) Phyllite

The rock is pale green with a strong cleavage. It is deeply weathered, with glossy, pitted cleavage surfaces. It is very fine-grained and is best identified as a chloritic phyllite.

78/195 (E199) altered Diorite

The rock is dark green with large, pale green epidote lenses lying in the cleavage. Cleavage is well developed and there is a strong lineation due to the alignment of elongate chlorite and amphibole ~~crystals~~ crystals. The rock is an altered intermediate lava rich in amphibole.

78/196 (E200) altered Diorite

The rock is green and massive, with a pronounced streaming of mineral grains. The groundmass is rather fine-grained, but there are many irregular patches of pale green epidote and long slivers of chlorite.

with parallel alignment. The rock is fresh and probably consists largely of fine plagioclase, amphibole and epidote. It is an altered lava similar to 78/121.

78/197 (E202) fine Tuff

This ia a very weathered, weel cleaved tuff comparable to 78/185.

78/198 see page 69

78/199 (E204) Tuff

The rock is dark grey with strong cleavage which wraps lenses of pinkish quartz. There is a strong lineation caused by the parallel alignment of small pale grains (epidote). Chlorite generally forms platey masses lying in the cleavage. The granular texture suggests this rock is a tuff but the most obvious granular mineral is secondary epidote so the identification is uncertain.

78/200 (E205) altered Diorite

The rock is pale green and massive. Grains are fine and uniform. It is very rich in epidote and appears to be an altered igneous rock.

78/201 (E206) Gabbro

Hand Specimen

The rock is massive, light greenish grey and weathered. The cut surface shows a medium grained interlocking texture with pale green and dark grey grains 1-3mm. across.

Thin Section

Groups of granular pyroxene with individual crystals up to 1mm. across are set in a groundmass of stained, finely granular epidote, rare quartz, fine muscovite and chlorite and thin needles of amphibole with a background of plagioclase.

Although broken, the pyroxene is quite fresh. It is pale brown

slightly pleochroic augite or diopside. Fine cracks in the crystals are generally lined with pale green chlorite. Pyroxene grains and large chlorite flakes sometimes surround patches of columnar zeolite.

The groundmass shows relict textures which suggest it was originally rich in interlocking plagioclase laths. A few narrow strips of plagioclase are remnants of twin slices, but most of the plagioclase is a formless background to the granular secondary minerals which replace it. The feldspar is not well enough preserved for identification.

Summary

The original rock was a medium-grained gabbro with augite, plagioclase large crystals of magnetite (now oxidised) and rare quartz. Feldspar is replaced by chlorite, muscovite and epidote and there is a little very fine amphibole, but the pyroxene remains fresh. Double rows of columnar zeolite crystals may indicate vesicles but these areas are uncommon and poorly defined.

The rock was probably a basic dyke (or perhaps a flow) in the sediments and volcanics of the Mainwaring Group, but has not suffered the shearing which is pronounced in the volcanics.

78/202 (E207) altered Tuff

The rock is pale green and fine grained, with flat irregular patches of chlorite and a few pale epidote masses. The cleavage lamellae are twisted and there is a slight streaming lineation. The rock is highly altered, but may have been a tuff.

78/203 (E208) Diorite

The texture of this rock is medium-grained granular, with many large irregular masses of epidote and chlorite. The rock is massive and it rather similar to 78/136, which is a diorite.

78/205 (E210) Epidote-amphibole-schist

The rock is light grey-green and fine-grained with slight foliation and poor cleavage. In section it is very fine-grained with strong foliation of amphibole fibres. Epidote forms large brownish masses often pseudomorphed by talc, and there are fine, unaltered grains in strings parallel with the foliation. Fine recrystallised quartz is interstitial. Fresh, colourless pyroxene is set in amphibole and is possibly the only primary mineral. The amphibole is unusual in its very fibrous habit, pale colour (brownish-green) and low birefrimgence.

There is no textural evidence for the rock's origin. It may be igneous and intermediate, with epidote, quartz and amphibole crystallising during shearing.

Approximate mode - amphibole 40%, epidote 24%, quartz 20%, talc 10%, pyroxene 5%, magnetite 1%.

78/206 (E211) knotted schist

The rock is dark grey with a well developed schistosity. Cleavage surfaces are glossy with white mica and are finely knotted. This schist belongs to the same series as those below the volcanics south of Sassafras Creek.

78/198 (E203) knotted epidote-schist

The rock is green and fine-grained with sheets and streaks of chlorite lying in the cleavage and knots of epidote on the cleavage surfaces. Some layers consist of coarse epidote and chlorite with little ~~chlorite~~ groundmass. It is similar to the uncleaved 78/140 which is described as a knotted epidote-chlorite-schist.

MAINWARING GROUP SPECIMENS from Coast between Abo Creek and S of Sassafras Creek

78/149	TS	Granodiorite	Abo Creek
78/148		~~sheared Lava~~ Conglomerate	N of Diorite Point
78/147	TS	sheared Lava	" " "
78/146		Quartz-Diorite	[redacted] Diorite Point
78/146'		altered Gabbro	" " "
78/145		amphibole-schist	" " "
78/144		altered Diorite	N of Copper Creek
78/143	TS	altered Porphyry (inclusion in breccia)	" " "
78/142		altered tuff(?)(epidote-talc rock)	S of Copper Creek
78/141		Tuff	between Copper Ck. and Green Pt.
78/140	TS	chlorite-epidote Knotted schist	" "
78/139		Diorite	" "
78/138		Quartzite pebble from volcanic siltstones	" "
78/137		altered Lava	" "
78/136	TS	Diorite	" "
78/135	TS	Dacite	" "
78/134		sheared Lava	" "
78/133		chlorite-quartz vein in volcanics	" "
78/132		Deformed Volcanic Conglomerate	" "
78/131		Greywacke(?)	just N of Green Point
78/130		altered Diorite inclusion in conglomerate	" "
78/129		sheared Dacite(?)	" "
78/128	TS	Calcareous Siltstone	" "
78/127		altered Lava	" "
78/126	TS	altered Volcanic Siltstone	" "
78/125	TS	altered Diorite	" "
78/124		epidote-quartz from conglomerate	Green Point

78/123		Quartz-Epidote veins in volcanics	Green Point
78/122	TS	Epidote cement from conglomerate	" "
78/121	TS	porphyritic Hornblende-Diorite	" "
78/120		Diotite	" "
78/119		sheared Diorite	" "
78/118		Amphibolite fragment from conglomerate	" "
78/117	TS	sheared Quartz-Andesite " "	" "
78/116		Lava fragment from conglomerate	" "
78/115		Volcanic Conglomerate	" "
78/114		Volcanic Conglomerate	" "
78/113		Tuff(?)	" "
78/110		Tuff	" "
78/109		Quartz-Epidote pod in volcanics	S of Green Point
78/108		Phyllite	" "
78/105		Phyllite	S of Sassafras Creek
78/104		volcanic siltstone	inland " "

PETROLOGY

All specimens were collected by the author in the course of mapping the coast. They are described in geographical order from north to south, corresponding to a section through the Mainwaring Group from top to bottom.

78/149 (E97) Granodiorite Abo Creek

Hand Specimen

The specimen is taken from a 10ft. dyke intruding phyllites just above the Mainwaring Group volcanics.

The rock is light grey and rather friable with a few large green crystals in a sand-grade ~~matrix~~ groundmass. Cleavage is absent.

Thin Section

The rock is composed of subhedral crystals of plagioclase and quartz with abundant secondary epidote and chlorite.

The plagioclase generally forms short, prismatic, twinned crystals and is sodic andesine in composition. Some crystals have irregular untwinned rims of albite. In some cases a fine quartz-plagioclase intergrowth extends out from plagioclase crystals, sometimes as a linear intergrowth ~~parallel with~~ normal to the crystal faces.

The central, more basic part of the plagioclase crystals may be partially or completely replaced by epidote, producing a lath-like body of granular epidote with a rim of clear plagioclase.

Quartz is fine and interstitial to the plagioclase.

Original mafic minerals are entirely replaced by chlorite. In many cases prismatic crystal forms are retained, suggesting much of the coloured silicate was amphibole. A few pseudomorphs suggest micaceous forms, with fine iron oxide along cleavages, and the rock probably contained a little biotite before alteration. There is also a considerable

of chlorite in which no recogniseable forms are preserved, particularly in large masses associated with epidote.

Andesine, amphibole and biotite were probably the first minerals to crystallise, followed by quartz and albite. Chlorite and epidote are secondary minerals replacing primary phases. The rock is classified as a granodiorite, lacking K-feldspar, and is probably related to the intermediate igneous rocks of the Mainwaring Group.

78/148 (E96) Conglomerate north of Diorite Point

Hand Specimen

The rock is medium grey-green with a medium-grained, slightly foliated texture. Some parts of the specimen contain large, flattened fragments of dark green, yellow-green or light brown fine-grained, foliated rocks. Elsewhere the grainsize is fairly uniform, with a maximum grain length of 1mm..

Thin Section

The section includes both even-grained areas and parts containing coarse, irregular fragments.

The rock has a distinct clastic texture, consisting of rounded to angular mineral grains and aggregates from 0.5-2mm. long. Small rock fragments are plentiful in the even-grained material but there are also some fragments several cm. across.

Mineral fragments include single crystals and aggregates of quartz, plagioclase and chlorite. Fine to coarse-grianed aggregates of chlorite may be considered fragments of intermediate igneous rocks. Amphibole-rich fragments are abundant. Pieces of lava with very fine amphibole in the groundmass and phenocrysts of plagioclase and chlorite are common, and there are some very fine-grained fragments composed of clay and possibly epidote may have been glassy lavas.

Fragments rich in granular epidote are less common than might be expected, but epidote is abundant in the heavily stained ~~groundmass~~ cementing material. Fine secondary quartz and tiny needles of chlorite and amphibole occur in patches in the groundmass.

There are a number of small pieces of leuco-andesite and one very large, irregular fragment of this rock. Fresh plagioclase phenocrysts are aligned in a groundmass of plagioclase, fine amphibole, chlorite and granular iron oxide with strong pilotaxitic texture. The only alteration that has occurred in large amphibole phenocrysts which have been extensively chloritised. There are several areas where the andesite has been invaded by large masses of epidote and minor quartz. The plagioclase is andesine and the amphibole is pale actinolite rather than the iron-rich actinolite or hornblende in many of the diorite fragments.

Another large lava fragment consists of interlocking, short, brown hornblende crystals with chlorite, iron oxide and interstitial plagioclase. Some plagioclase crystals form phenocrysts but they are corroded and rich in apatite, chlorite and amphibole inclusions. This type of fragment is common in the even-grained part of the rock.

All fragments in this rock are igneous, and most are andesite or diorite, with plagioclase-amphibole assemblages predominating. Quartz occurs as chert and as secondary cement. Epidote is found in the cement and in some rock fragments. The rock is a conglomerate, possibly formed by explosive volcanism, and has been mildly affected by metasomatism, which is confined chiefly to the groundmass.

78/147 (E95) sheared Lava north side of Diorite Point

The rock is fresh and crystalline with a coarsely mottled texture. It probably contains amphibole, chlorite and plagioclase but epidote is not evident in the hand specimen. Small cubes of pyrite stand out on the weathered surface. The specimen is sheared, with plates of feldspar developed in the shear planes, but cleavage is poor. This rock is comparable to the unsheared diorite 78/136.

78/146 (E94) Quartz-Diorite south side of Diorite Point

The rock is altered but not sheared. The texture is granular, with white grains of feldspar and quartz 1mm. across in a finer background of chlorite and amphibolr. The crushed specimen shows a high proportion of felsic minerals and alteration is not extensive. The rock is similar to the Quartz-andesite fragment 78/117, although the latter is coarser and less weathered.

78/146' (E94) altered Gabbro south side of Diorite Point

The rock is massive with coarse interlocking dark green and white crystals merging into chloritic sections where the specimens is heavily altered. The freshest parts consist of coarse feldspar and hornblende or pyroxene which appears to be partly replaced by chlorite. Epidote may be present in small quantities replacing feldspar but is not prominent.

78/145 (E93) amphi ole schist south of Diorite Point

Hand Specimens

(i) This rock is fresh and coarsely crystalline, consisting of dark green bands up to 1cm. thick interleaved with sheets of pale, sheared feldspar 1mm. thick. The amphibole-rich layers contain some feldspar and chlorite and there are a few small knots of epidote which disrupt the foliation. This rock is completely recrystallised and there is no trace of the original texture

(ii)The specimen which was sectioned is soft and pale green, It is fine grained with fine colour banding and a well developed cleavage parallel with the banding. The rock is called amphibole schist because all traces of the original texture have been lost, but on the appearance of the hand specimen alone it would be called a volcanic siltstone.

Thin Section

The rock is extremely fine-grained with a few flakes up to 0.6mm. long. It is composed of approximately equal amounts of amphibole, chlorite and epidote. The foliation is expressed as elongation of chlorite and amphibole crystals.

The interstitial colourless silicate is quartz and there is apparently no plagioclase. Several quartz veinlets cross the section.

The amphibole, chlorite and epidote are the same as those found in other rocks of the Group, and 78/145 is probably a metasomatised sediment, but there is little evidence for the original composition.

78/144 (E92) altered Diorite north of Copper Creek

The rock is massive and coarsely mottled. It consists largely of bright green epidote and dark patches of chlorite and possibly amphibole. Most of the minerals are secondary.

78/143 (E91) altered porphyry inclusion in breccia. N of Copper Creek

Hand Specimen

The rock is pale green with dark green crystals 0.5 to 5mm. across scattered in a pale, very fine groundmass. The rock is fractured but has no penetrative cleavage.

Thin Section

The groundmass contains between 50% and 75% epidote, the remainder being amphibole, quartz, minor iron oxide and a little chlorite. Veins of fine to coarse, granular quartz with minor plagioclase and needles of

amphibole are common and in most cases are older than the "phenocrysts".

The large, dark green bodies seen in the hand specimen consist of fine, fibrous amphibole intergrown with quartz. The "phenocrysts" are made up of many composite amphibole-quartz prismatic bodies, each one with a different orientation. Epidote crystals may be superimposed on the fibrous intergrowth.

The amphibole is of the type normally occurring in the altered rocks in this area. It is generally fibrous, but a few large prismatic and basal sections are seen. It is pale green and slightly pleochroic. The maximum extinction angle measured on brightly coloured sections was 20°. Birefringence extends into the second order, up to about 0.026, but many prismatic sections show low first order colours. The amphibole is probably a median member of the tremolite-actinolite series. Replacement of amphibole by chlorite along cleavages is common and usually destroys the delicate intergrowth texture.

A second type of "phenocryst" consists of coarse, granular quartz with a few bunches of amphibole needles as inclusions. There may be a partial rim of amphibole crystals and these bodies are always surrounded by a solid halo of epidote. Some bodies have a central mass of fine quartz inside a layer of coarse quartz crystals.

The porphyritic texture suggests the specimen was originally igneous but complete recrystallisation has occurred and this may have been accompanied by a change in composition. Plagioclase is present in many of the altered Mainwaring Group rocks but is rare in 78/143, and this may be an indication of the original composition, i.e. the rock may have been rich in quartz and poor in alkalis.

78/142 (E90) altered tuff (epidote-talc rock) S of Copper Creek

The rock is pale green and massive. The fine texture is produced by interlocking soft, fibrous minerals, chiefly talc. Bright green spidote crystals are scattered through the rock and concentrated with chlorite on several irregular surfaces. Copper staining is marked.

78/141 (E89) Tuff S of Copper Creek

The rock is massive with a granular texture blurred by crystallisation of secondary minerals. The original grains are white, dark grey and green and are generally less than 0.5mm. across. Chlorite and feldspar are important components. Secondary epidote crystals 1-2mm. across are abundant and much of the fine chlorite may also be secondary.

78/140 (E88) Chlorite-epidote knotted schist S of Copper Creek

Hand Specimen

The specimen is soft with a poorly developed cleavage. The cut surface shows a green foliated groundmass wrapping coarse light green crystals. Part of the specimen is rich in pale granulated material with an indistinct foliation.

Thin Section

The groundmass is strongly foliated, consisting of chlorite which wraps small lenses of quartz and lesser plagioclase. The rock is banded with groundmass bands of varying grainsizes and varying quartz and iron oxide content.

Large lenticular bodies are wrapped by the foliation. These porphyroblasts consist of rounded of drawn out and fragmented aggregates of coarse epidote crystals, generally associated with fine granular quartz and plagioclase. Foliated chlorite forms "tails" in the pressure shadow areas and coasse chlorite may be associated with epidote and quartz.

This is an unusual situation in which epidote crystallised before the foliation developed. This is best explaned if epidote replaces original phenocrysts in situ, and this is likely since epidote is rare in the groundmass.

Much of this rock consists of quartz and chlorite, with amphibole absent and epidote in phenocrysts only, so that it differs from the usual amphibole-epidote-plagioclase assemblage. As in many other rocks of this group there is little evidence for original composition. The porphyroblasts may indicate an original porphyritic igneous rock.

The three specimens 78/140 to 78/142 are taken from a single large body about 100 yards south from Copper Creek. The body was thought to be a diorite intrusion when the area was mapped, but although 78/140 and 78/142 are of doubtful origin, 78/141 is reasonably identified as a tuff. Alteration and metasomatism tend to ~~produce similar rocks~~ reduce all rocks in the area to similar compositions, regardless of their original nature.

78/140 Diorite (ES7) S of Copper Creek

The rock is massive with interlocking grains 0.5-2mm. long. It is quite comparable with 78/136, which is slightly sheared.

78/138 Quartzite (ES6) half way between Copper Creek and ~~Diorite~~ Green Point

The specimen is part of a six-inch pebble enclosed in volcanic siltstones, and such inclusions are very rare.

78/137 altered Lava (ES5) N of ~~Diorite~~ GREEN Point

The rock is dark green and massive with interlocking crystals. It is extensively altered with the introduction of granular epidote and large patches of chlorite.. The original rock contained feldspar, amphibole and possibly quartz and has similarities with 78/136 (diorite)

and 78/135 (dacite), both of which are less altered.

78/136 Biorite (E84) N of Green Point

Hand Specimen

The rock is light greenish grey with an indistinct mottling. Some grains reach several mm. acerose but are not clearly defined. Cleavage is poor but there is a slight streaming lineation. The cut surface is porous although the rock is unweathered.

Thin Section

The rock consists of a mixture of coloured silicate crystals in a background of plagioclase.

The plagioclase forms subhedral crystals with many tiny inclusions of chlorite, some fine epidote and a few needles of apatite and amphibole. Twinned crystals are rare and are generally deformed so that no definate identification can be made, but the plagioclase appears to be sodic andesine. Those grains showing crystal forms are usually surrounded by irregular, fine grained plagioclase rims and these may be secondary.

A number of coloured silicates are present. The first to crystallise was probably pyroxene, which occurs as isolated crystals partly replaced by chlorite. The pyroxene is a colourless clinopyroxene,- augite ot diopside.

Amphibole crystallised around pyroxene grains and formed large prismatic crystals. It is the most abundant primary mafic mineral. Some crystals are brownish and pleochroic hornblende but much of the amphibole is pale green tremolite. Extinction angles up to 23° were measured on the prismatic cleavage. A secondary pale green amphibole, tremolite or anthophyllite, forms a few needles in the plagioclase.

Both pyroxene and amphibole have been partially chloritised but it is doubtful if all the large chlorite masses in the rock are formed by

replacement - some may be a late primary phase. The chlorite is green or brownish with anomalous brown, grey or blue first order birefringence.

A light brown, slightly pleochroic mica forms wavey strips of crystals in some parts of the rock, but is not widespread. It appears to be bleached biotite but no interference figures could be obtained. It is a late primary mineral.

Skeletal forms of oxidised iron ore indicate replacement of primary ilmenite. The crystals are large, often exceeding 1mm. across, but are sparsely scattered.

Epidote is abundant as small granules and coarse crystals and aggregates transgressing all the other minerals. Clinopyroxene and biotite (?) occur in small quantities but quartz is absent. The rock has been extensively chloritised and epidotised.

78/135 Dacite (ES3) N of Green Point

Hand Specimen

This is a medium-grained, mottled rock. Cleavage is absent but there is a pronounced preferred orientation, expressed as a ~~streaking-out~~ streaming of minerals on the cut surface. Although the rock is hard an unweathered it is quite porous.

Thin Section

The rock consists of shattered phenocrysts and sericitised plagioclase in a strongly foliated groundmass of plagioclase,, chlorite, granular epidote and quartz. Large masses of chlorite form ragged ~~patches~~ lenses parallel with the foliation while chlorite patches edged with fine epidote tend to cut across the foliation.

Quartz phenocrysts reach about 1mm. in diameter and may have originally been embayed, but now have indistinct margins due to reaction with the groundmass. The crystlas are corroded and fractured and the apatite

inclusions are sometimes bent. Large quartz grains and feldspar crystals have fringes of fine elongate quartz and chlorite crystals lying in the foliation.

Plagioclase crystals seldom exceed 0.5mm. in length and are generally cloudy, with many small elongate chlorite inclusions. Some of the groundmass is probably coarse plagioclase crystals but is so rich in granular epidote and small chlorite flakes that it generally appears fine-grained.

A number of large iron oxide grains have been fractured, oxidised and drawn out into lenses and these are surrounded by quartz-chlorite fringes.

Epidote forms small granules in the groundmass and aggregates of larger crystals. It is usually associated with chlorite and in some cases rows of epidote crystals appear to be mounted on thin strips of chlorite. Pressure fronges of fine quartz and chlorite do not form on epidote grains, which appear to have crystallised after shearing. Associated chlorite masses are parallel with the foliation and this may have the appearance of fringes.

Summary

The rock is a porphyritic acid lava or possibly an ignimbrite which has been chloritised and strongly sheared. Epidote was introduced after the shearing.

78/134 sheared Lava (E 82)

The rock is dark green and crystalline with very strong mineral alignment but no cleavage. It contains feldspar, amphibole and chlorite and is very similar to 78/147 and both are only slightly less altered than 78/145.

78/133 Veins of massive chlorite plus quartz from volcanics (E81)

~~78/132 stretched volcanic conglomerate~~

78/132 (E80)
stretched volcanic Conglomerate

This conglomerate is highly deformed so that it has the appearance of a finely banded, lineated phyllite, the laminae disrupted by knots of epidote and chlorite. Some of the layers and lenses are composed of dark lava or amphibolite, others are green or grey siltstones. No tuff band are seen in this specimen but they probably occur in the adjacent rocks. Discontinuous bands of pale, fine epidote are common. 78/132 is rather similar to 78/128 but lacks the grey-maroon phyllite bands which are common in the latter. 78/132 probably contains more volcanic material than 78/128

78/131 Greywacke(?) (E78)

The specimen is very dark grey-green with a fine sandy texture and slight cleavage. It is more siliceous than the greeen siltstomes typical of the Mainwaring Group and the very dark colour may be due to the presence of biotite as well as chlorite. The origin is uncertain but the rock appears to be a siliceous sediment.

78/130 altered Diorite (inclusion in Conglomerate) (E77)

The rock is green and fine-grained with coarse patches of secondary chlorite and epidote. This specimen is weathered but otherwise similar to 78/125, and altered diorite inclusion in conglomerate from the same area

78/129 sheared Dacite(?) (E76)

The rock is dark grey-green and cleaved. Many cleavage faces are covered with sheets of fine chlorite, but the bands between these sheets are coarse-grained, with large porphyroblasts of quartz and feldspar. The dark colour is largely due to chlorite and the rock is probably siliceous, with little epidote. It may be a sedimnet and not a lava.

78/128 Calcareous siltstone (E75) N of Green Point

Hand Specimen

The rock is very strongly foliated, with a strong penetrative lineation in the form of tiny ribs. Laminae are various shades of grey, dark and pale green and tend to be lenticular, with the short axis about 1mm. and the median axis 1-3cm. long. This suggests the rock may have originally contained different coloured, sub-spherical bodies which have undergone flattening. Dilute HCl reacts vigorously on the cut surface.

Thin Section

The section is cut approximately normal to the foliation and about 25° from the lineation.

The rock consists of scistose lenses and bands of fine-grained calcareous sediments. Grainsize and composition vary slightly from one band th the next. Some lenses are rich in chlorite, being composed of about equal quantities of chlorite and carbonate with a little quartz, feldspar and mica, and these lenses are relatively coarse-grained. Other lenses are composed of very fine carbonate, plagioclase, muscovite and quartz and a few lenses contain muscovite and iron oxide only.

Iron is common as fine strings along the cleavage and much of it may be introduced by weathering. Although some large angular grains are wrapped by the foliation and are clearly original constituents of the rock. Small patches of fine quartz, quartz and muscovite or quartz and iron oxide are also wrapped by the foliation.

Carbonate commonly occurs as long plates (up to 0.5mm. long) lying in the foliation plane. These grains have recrystallised, probably at the time of shearing, but the very fine grains in some layers suggest the carbonate was present in the original sediments and remobilisation has been slight.

Summary The rock appears to be a metasomatised conglomerate in hand specimen but is actually composed of unaltered calcareous siltstone fragments. Shearing has been intense so that the original layers have been broken into lenses, but the epidote so abundant in surrounding rocks is absent here.

78/127 altered Lava (E74)

The rock is light grey-green with prominent feldspar knots on the weathered surface. The groundmass is pale green and fine-grained with dark streaks of chlorite. The specimen is slightly sheared but uncleaved. It is similar to the quartz diorite 78/146 from Diorite Point but is too altered for its origin to be certain.

78/126 altered volcanic siltstone (E73)

This rock is green with fine dark green bands parallel with the cleavage. It is fine-grained and well lineated. A second specimen has been sectioned. It is paler and more uniform in colour. It is very hard but lacks cleavage and lineation.

Thin Section

The rock is very fine grained, with a few prismatic crystals reaching a maximum length of 0.06mm.. It is weakly foliated.

Most of the rock consists of fine to very fine granules of epidote with interstitial clear plagioclase which sometimes shows twinning. Chlorite is common and there are prismatic amphibole crystals and a few small iron oxide grains. Needles of amphibole form inclusions in some plagioclase crystals.

The minerals are similar in abundance and composition to those in the diorite pebble 78/125 from the overlying conglomerate but quartz has not been identified in 78/126 (this may be due to fine grainsize in 78/126

This mineral assemblage - dominent epidote and plagioclase with minor chlorite and amphibole - is common to many of the Mainwaring Group rocks and has apparently been imposed on the sediments, and to a lesser extent on the igneous rocks, during a period of widespread metasomatism.

78/125 (EK) altered (epidotised) Diorite inclusion in conglomerate

Hand Specimen N of Green Point

The rock is coarse-grained with dark green crystals reaching 3mm. in diameter. It is not noticeably sheared, and the cut surface shows interlocking dark green, grey and pale yellow-green masses with poorly developed preferred orientation.

Thin Section

The section shows an uneven aggregate of a variety of crystal forms and grain sizes.

Plagioclase is the most abundant mineral, forming a background of medium-grained, sudhedral crystals. Some crystals are quite large, with many over 1mm. long. The feldspar is slightly cloudy with numerous small chlorite inclusions. Bunches of actinolite needles are common and epidote also forms rather coarse granular inclusions. R.I. and extinction angle measurements indicate sodic andesine composition for the plagioclase, but R.I. determinations may be faulty due to the effects of relatively high relief inclusions.

The coloured silicates are amphibole, chlorite and epidote. The amphibole is pale apple-green actinolite which normally forms elongete crystals in which strong prismatic cleavage gives a fibrous appearance. Needle-like secondary amphibole is common and appears to have a similar composition to the coarser crystals. A few large, twinned plates of hornblende occur and these are the large, dark green crystals seen in the hand specimen. They always have irregular, altered rims and are partially

replaced by chlorite.

Chlorite is strongly pleochroic from bright green to yellow, with yellow-brown anomalous birefringence. It is always secondary, and apparently forms by the alteration of amphibole.

Epidote is very common, ranging from fine, granular masses to single crystals 1.2mm. across. It is penetrated by plagioclase crystals and may be a primary phase.

Opaque iron oxide grains are common. These grains have central portions of unaltered magnetite surrounded by dull, oxidised material which obscures the original angular crystal forms.

Fine quartz is common as an interstitial phase - it appears to be secondary,.

Andesine, hornblende and magnetite are the only certain primary phases. The coarse, prismatic actinolite crystals may be primary but the needle-like fine amphibole is secondary. Chlorite is formed by alteration of amphibole and epidote and quartz are likely to be secondary. The present composition of the rock approximates to quartz-diorite but the original rock may have been more basic - probably hornblende diorite.

78/124 Quartz from conglomerate (E71)

78/123 Quartz-epidote Secretions (E70) Green Point

A fine-grained, dark green amphibolite(?) is host to irregular patches and veins of epidote and quartz which make up most of the specimen. There is a little chlorite associated with the epidote. This rock is part of the conglomerate complex on the landward side of Green Point.

78/122 (E69) Matrix Material from Green Point Conglomerate

Epidote-Carbonate Matrix plus Amphibolite

Hand Specimen

The rock is light green with poorly developed cleavage. It is ~~ext~~-extremely fine-grained with slight colour banding and one irregular surface(not parallel with the banding) is coated with dark green amphibolite.

Dilute HCl reacts strongly on the cut surface of the specimen.

Thin Section

Most of the section is conglomerate groundmass material. This matrix rock is very fine-grained with slight foliation and elongate crystals are rare. 50% of the rock is granular epidote and a further 35% is slightly coarser interstitial calcite. Plagioclase forms small, clear areas with a few crystals up to 0.05mm. long, and makes up about 10% of the rock. There a little chlorite and needle-like crystals of pale green amphibole, but these minerals are generally difficult to identify because of their small size. The rock is crossed by a veinlet of fine, deformed plagioclase.

On one edge of the specimen the matrix rock has an irregular contact with schistose amphibolite. For about 1mm. from the contact epidote in the matrix becomes finer and more dense than elsewhere, while carbonate is rare

Near the contact the amphibolite consists of coarse plates of green actinolite, some of it rather fibrous, and coarse interstitial chlorite. Epidote crystals up to about 0.3mm. across occur in the amphibolite, mainly near the contact. There are a number of large, rouded plagioclase crystals with quartz and rare epidote inclusions. These grains are wrapped by the prismatic minerals while the coarse epidote crystals cut straight across the foliation. Rare patches of fine silica and clear secondary plagioclase surround some of the original plagioclase grains.

The outermost layer of amphibolite seen in the section is a strip of

thin, elongate carbonate crystals, possibly crystallised from the carbonate which has been removed from the matrix rock near the contact.

78/121 (E68) Porphyritic hornblende-diorite overlying conglomerate at Green Point

Hand Specimen

The rock is light greenish-grey with scattered dark green patches several mm. long. These dark green bodies are generally flattened, with their long axes lying in the cleavage planes. Lineation and foliation are not pronounced. The rock is hard and unweathered.

Thin Section

The rock is fresh and sparsely porphyritic, with alignment of small elongate groundmass grains. The large green masses seen in the hand specimen are matted groups of prismatic hornblende crystals and chlorite with rare inclusions of quartz and epidote. These masses are wrapped by the foliated groundmass.

The groundmass consists of tiny elongate prisms of amphibole and plagioclase, with a little interstitial quartz and epidote. A few epidote masses and quartz aggregates are up to 0.7mm. long and are wrapped by the foliation.

Although epidote and chlorite are likely to be secondary the foliation is expressed in amphibole and plagioclase and is thus probably a primary texture, possibly accentuated by later shearing.

In composition the rock is a porphyritic diorite, distinguished from the andesites by the fact the phenocrysts are hornblende(and uncommon quartz) instead of plagioclase. The rock may have been intruded into the volcanic pile during shearing.

78/120 (E67) Diorite

This is a sheared and altered rock with poorly defined cleavage. The fine, crystalline groundmass contains lenses of fine epidote and large irregular chlorite bodies. 78/120 is similar to 78/121 described above, but is more sheared and altered.

78/119 (E66) sheared Diorite

The rock is strongly sheared and well cleaved, with large chlorite lenses but less epidote than the two comparable rocks 78/120 and 78/121.

78/118 (E65) Amphibole fragment from Conglomerate

The fragment is dark green, fine grained and strongly sheared, with a fine knotted appearance. The original rock was probably a basic or intermediate lava, now altered to amphibolite.

78/117 (E64) sheared Quartz-Andesite fragment Green Point

Hand Specimen

The specimen is medium greenish-grey, The weathered surface is very rough, with coarse, resistant grains several mm. long standing out from the face. Freshly broken surfaces are irregular with soft, fibrous crystals roughly aligned in the cleavage. The cut surface shows large whitish grains wrapped by a poorly developed fibrous cleavage.

Thin Section

The rock is quite fresh with only a small proportion of secondary minerals but its texture has been considerably modified by shearing. The unsheared rock would contain large plagioclase phenocrysts and smaller amphibole and magnetite crystals in a groundmass of fine feldspar, chlorite and quartz. Shearing has broken up the phenocrysts and produced a marked schistosity and granulation in the groundmass. Fine chlorite has a preferred orientation

but the cleavage is feeble since only a out 10% of the rock is chlorite.

Plagioclase is the most abundant mineral. About 50% of the rock consists of fine plagioclase phenocrysts and up to half the groundmass is feldspar. The phenocrysts are slightly sericitised and rich in small chlorite inclusions. Apatite inclusions are uncommon but some feldspars contain sheaves of needle-like secondary amphibole. Extinction on albite twins indicates albite or sodic andesine composition and R.I. determinatio favours andesine but is not conclusive because of the number of high-relie inclusions.

The groundmass plagioclase may be twinned and sericitised but some grains are clear and untwinned. Some of the groundmass is apparently formed by granulation of phenocrysts.

The groundmass contains small of pale to medium green actinolite. The more abundant chlorite is partly derived by the alteration of amphibol but some of it mat be primary. Small quantities of primary quartz and magnetite and secondary epidote, calcite and fibrous amphibole are also present.

The original rock was a porphyritic, quartz-bearing andesite with about 10% primary mafic material, mostly actinolite. The specimen is a fragment from a conglomerate and the shearing occurred after the conglomerate was deposited.

78/116 lava fragment from conglomerate (E63)

The fragment is strongly sheared with flecks of dark chlorite in a grey-green crystalline groundmass. It is probably an intermediate altered lava similar to other rocks described as diorites from nearby igneous bodies.

Note on the Green Point Breccias

The matrices of these rocks have been completely recrystallised, possible from calcareous, feldspathic material in the original sediment. Much of the matrix material may have been introduced by metasomatism . The recrystallisation occurred after the breccias were sheared, since a contact with amphibolite is sheared but there is little foliation in the matrix rock and epidote crystals in the amphibolite have not been sheared. The matrix rock increases in grainsize away from the contact.

The amphibolite was probably a diorite or basalt pebble which has been sheared and altered to its present ~~composition~~ assemblage. The later conversion of the conglomerate matrix to carbonate-epidote affected the amphibolite at least near its edges, introducing epidote and possibly carbonate.

The quartz-andesite pebble 78/117 has been strongly sheared with granulation of phenocrysts and recrystallisation in the graundmass, but the original mineral assemblage has not altered significantly. Possibly the edges of the pebble would show the effects of matrix metasomatism.

78/114, 78/115 Volcanic Conglomerates (E61, E62) Green Point

These specimens are from the relatively undeformed conglomerate found only at Green Point. It consists of flattened dark green fragments of verying sizes in a fine, pale green matrix very rich in epidote. The varying colours in the clastic fragments suggest a number of different lava types are present and fragments of various andesites, diorites and quartz diorites from the conglomerate have been described in thin section.

All the lava fragments in this specimen have been altered to amphibolite-epidote greenschist and there are a few fine-grained chlorite bodies. As in 78/148 from north of Diorite Point, all clastic fragments are of igneous origin.

Copper staining is strong on these specimens.

78/113 Tuff(?) (E60)

The rock is green and massive with fine granular texture blurred by alteration. Not much can be determined from the hand specimen, but the field relationships suggest it is a tuff. It is part of a thin, bedded sequence which overlies the main conglomerate body and includes minor conglomerates.

78/112 deformed volcanic conglomerate (E59) Green Point

Hand Specimen

The rock is strongly cleaved and consists of large flattened fragments of varying textures and colours. The groundmass is grey, fine-grained and foliated, while fragments are generally coarse, light green and mottled.

Thin Section

A variety of rock types and textures are seen in this specimen. The most common type, apparently the groundmass of the conglomerate,

is a fine-grained, strongly foliated mixture of amphibole and plagioclase with chlorite, quartz and a large amount of fine granular magnatite. These bands are quite markedly magnetic in hand specimen.

The amphibole is pale green with low second order colours and low extinction angles. It is probably tremolite actinolite. It forms very elongate prismatic crystals aligned to give a marked foliation. Chloritisation of amphibole is widespread.

The fine plagioclase is fresh and clear but there are a number of knots of course plagioclase crystals up to 0.8mm long. The foliation passes straight through some of these crystals(as lines of magnetite and amphibole)and they appear to have crystallised af er shearing. Extinction angles indicate albite or sodic andesine composition.

A second common rock type consists mainly of granular epidote and elongate plagioclase grains, with a little fresh amphibole in prisms outlining the foliation. Iron ore is sparsely distributed in these bands.

There are a number of lenses of very coarse epidote, plagioclase and chlorite and in these pressure "tails" of chlorite and fine quartz form on the plagiocoase aggregates. Other medium-grained lenses contain foliated amphibole and chlorite is more abundant than plagioclase.

None of the rock types making up lenses in this rock can be identified as all have recrystallised to similar assemblages of tremolite-actinolite, andesine(?),and chlorite with quartz, epidote and magnetite important in some cases. Recrystallisation occurred during and after shearing.

The rock was a conglomerate containing fragmants of intermediate(?) igneous rocks if the conglomerates of Green Point described above are undeformed equivalents.

78/110 Tuff (ES7)

The rock is green and slightly sheared, with poor cleavage. It is rather soft with weathered patches and a blurred fragmental texture typical of chloritised tuffs from the area.

78/109 Quartz-Epidote pod (ES6)

This fragment is part of a lens of very fine pale green material which is wrapped by volcanic siltstones and tuffs near Green Point. It is similar to the epidote cementing material of the nearby conglomerate.

78/108 Phyllite (ES5) S of Green Point

The rock is a dark grey, fine grained, siliceous phyllite with strong cleavage and slight lineation. Mica is less abundant than in most phyllites, and is very fine.

78/106 Pale phyllite (ES3)

The rock is pale grey with undulose, lustrous cleavage surfaces. Small flattened grains are seen on the surfaces, never reaching 1mm. in length. Cleavage is strongly developed, dividing the rock into lamellae less than 1mm. thick separated by very thin, dark, micaceous layers. These layers are disturbed by weak kink planes inclined at about 45° to the cleavage surfaces.

78/105 Phyllite (ES2)

This is a glossy, micaceous, pale grey phyllite with a lineation caused by lines of tiny crenulations. A coarse crenulation forms a rough lineation at an angle to the fine one.

78/104 Volcanic Siltstone (ES1)

The rock is pale green with a strong foliation but no lineation. It is fine-grained, soft and glossy with the feathery texture seen in volcanic siltstones from the Mainwaring River.

WANDERER RIVER

AMG 368650mE)
5266900mN

LARGHAM RIVER

CYPRESS CREEK

SOUTH CYPRESS CK.

MAINWARING RIVER

SANDY POINT

ABO CREEK

DIORITE POINT

COPPER CREEK

GREEN POINT

SASSAFRAS CREEK

LEWIS RIVER

LOW ROCKY POINT

AMG 377300mE, 5239050mN

ELLIOT BAY

Tms

Qal

Qgr

Elvr

Eda

Em

Emc

Eg(f)p

Eg(p)

Ega

Eca

Ec

Qa

Qds

Egr

Epqs

Epacs

B

B'

340

350

360

710

720

730

740

N

0 1 2
MILES

5 cm

QUATERNARY

- Qds — dune sand
- Qal — alluvium
- Qgr — gravel

TERTIARY

- Tms — Macquarie Beds

ORDOVICIAN

- Oc — Caroline Ck. Sandstone
- Oo — Owen Conglomerate

} JUNEE

CAMBRIAN

- undifferentiated
- Eda — argillite, siltstone
- Edg — greywacke

} DUNDAS

- Em — undifferentiated
- Emt — tuffs and lavas
- Emc — phyllite

} MAINWARING

- Elvr — acid volcanics
- Egr (p) — granite (white & pink)
- Eq.f.p — quartz-felspar-porphyry

} LEWIS

PRECAMBRIAN

- Epacs — chlorite-schist
- Epqs — quartz-schist

} ARTHUR

AMG REFERENCE POINTS ADDED

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EXPLORATION DEPARTMENT

GEOLOGY of the MAINWARING GROUP and ASSOCIATED ROCKS, S.W. TASMANIA

Drawn: E.B. Corbett	Date: 14th Nov. 1968	Centre: HOBART	
Traced: E.B.C.		Drawing No: A1-	Project No: 68/L1
Checked:			
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