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Tasmania

Mineral Resources Tasmania

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A field guide to gold deposits in northeastern Tasmania

*by R. S. Bottrill, J. Taheri and R. A. Keele**

with a contribution by M. P. McClenaghan

** Centre for Ore Deposits and Economic Studies, University of Tasmania*

This report provides an introduction to the geology of the gold deposits of northeastern Tasmania. Readers interested in more specific data on resources, structure, ore genesis or geophysics are advised to refer to the various NETGOLD reports available from Mineral Resources Tasmania. The areas covered in this report are Beaconsfield, Lefroy, Bridport, Forester, Lisle, Alberton, Mathinna and Mangana.

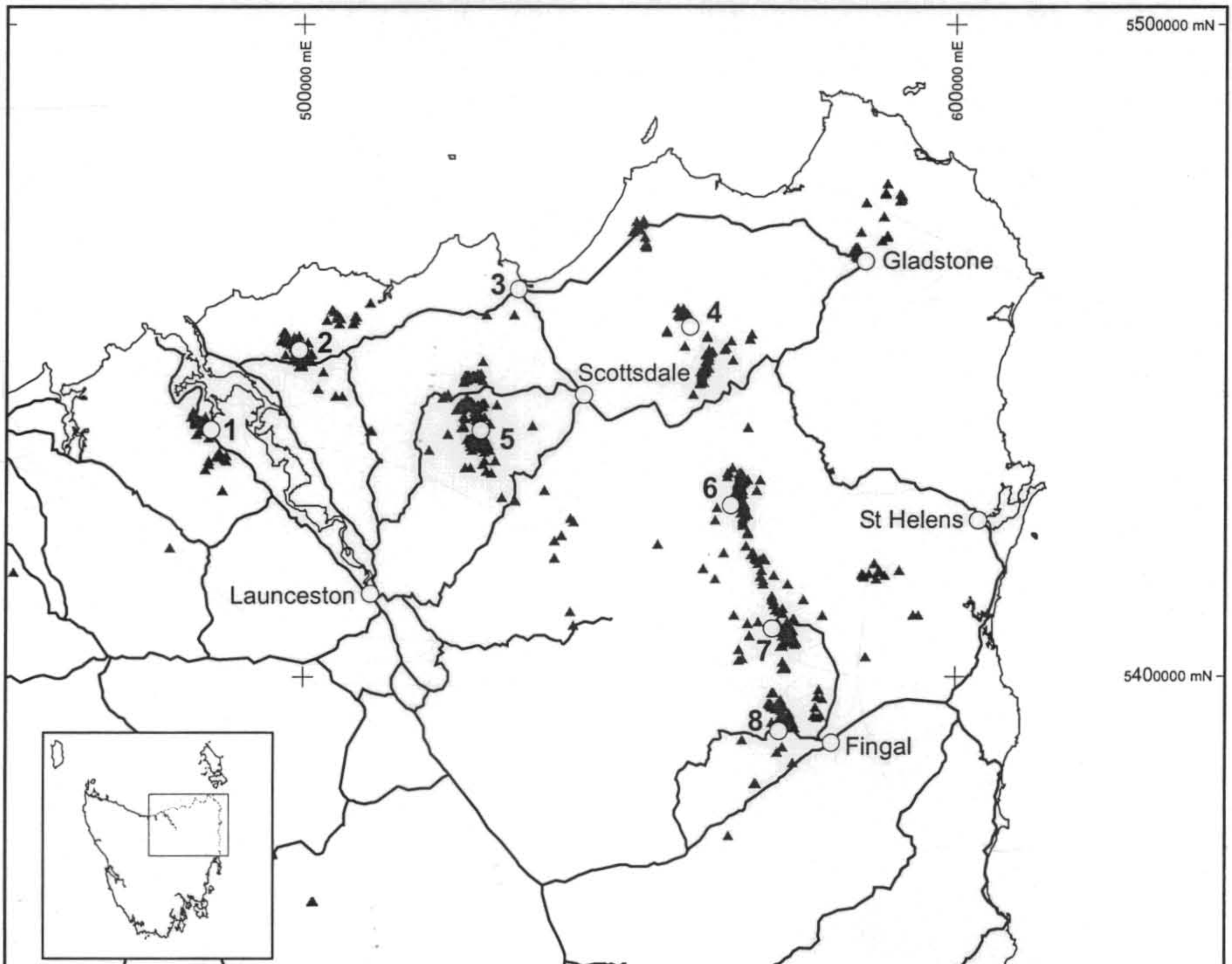

Figure 1

Northeast Tasmania, showing locations of known gold occurrences and stop locations discussed

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1: BEACONSFIELD

General

Gold was known to occur in this area in the 1840s, but the quartz reefs were not worked until about 1877, and many of the numerous workings were eventually incorporated into the Tasmania mine, the most productive gold mine in Tasmania to date. The Tasmania mine produced more gold than any single mine in Victoria (26.6 t of gold from about 1.1 million tonnes of ore up until 1914), and Beaconsfield Gold Mines Ltd have been endeavouring to re-open the mine to develop an estimated resource of about 0.7 million tonnes at 24 g/t for 16.8 t of gold (Hicks and Sheppy, 1990).

The principal reef in the area, the Tasmania reef, is developed in conglomerate and arenite of the upper Cabbage Tree Formation, of probable Early Ordovician age. These sediments have been thrust against the Precambrian Badger Head Block and the Cambrian Andersons Creek Ultramafic Complex to the west. The Cabbage Tree Formation is a probable time equivalent of the Mathinna Beds, separated by the Tamar Fracture Zone. The other reefs present in the area are also confined to the same formation.

The Tasmania reef occupies a minor fault and averages two metres in thickness, about 400 m in length, and more than 800 m in depth (this and the following data are from Hicks and Sheppy, 1990). The ends of the reef, where they approached the overlying limestone of the Gordon Group and the underlying pebble conglomerate, are highly branched and ragged. The reef is zoned, with an ankerite-rich core, a quartz-rich outer zone and a gold-sulphide enriched contact zone between these two zones. Wallrocks are locally altered with carbonates and pyrite, and partly assimilated. Sulphide minerals include pyrite, arsenopyrite, chalcopyrite and minor sphalerite, galena and tetrahedrite. Most of the gold occurs as fine inclusions (<5 μm) in pyrite. Later fracturing and brecciation of the

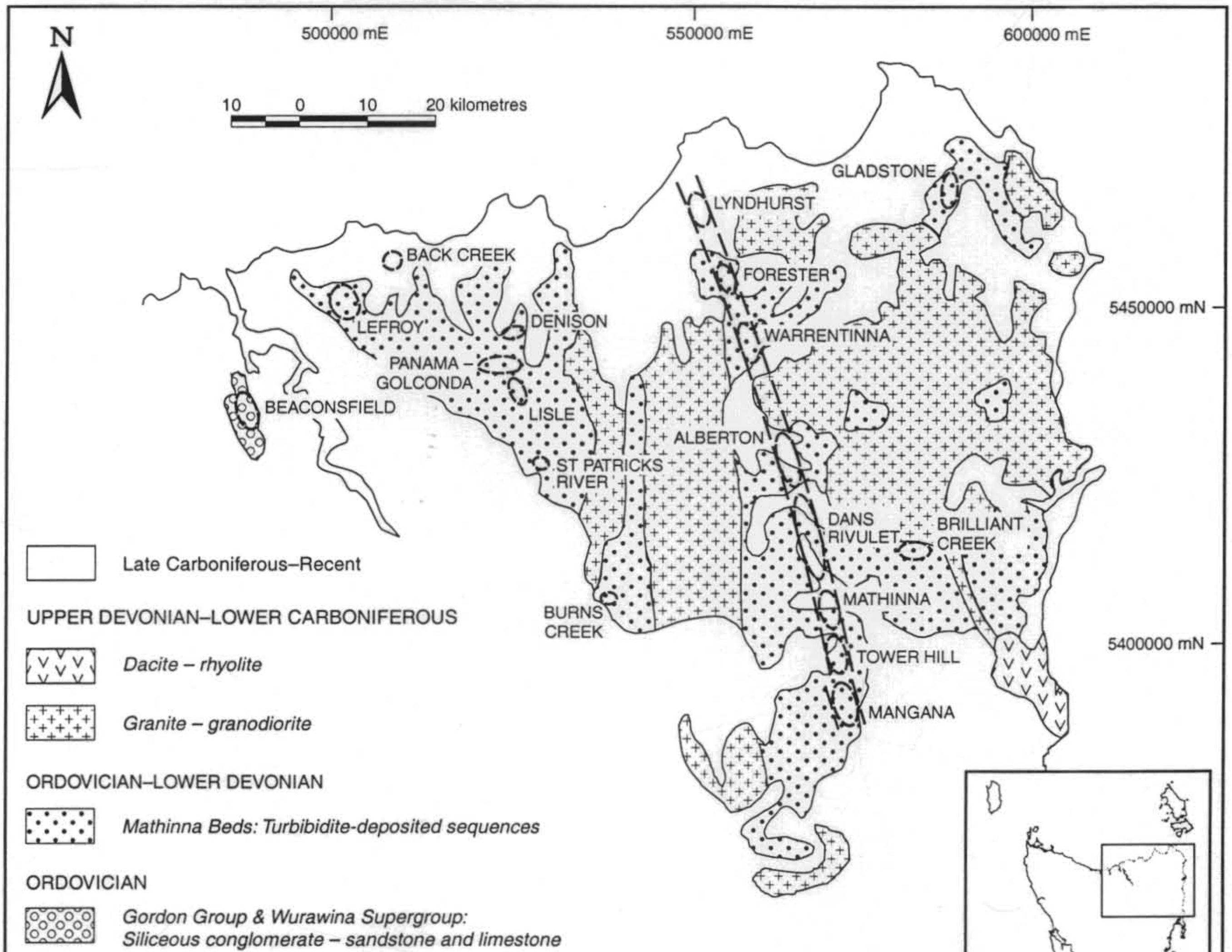

Figure 2

Goldfields and major granitoids in northeast Tasmania

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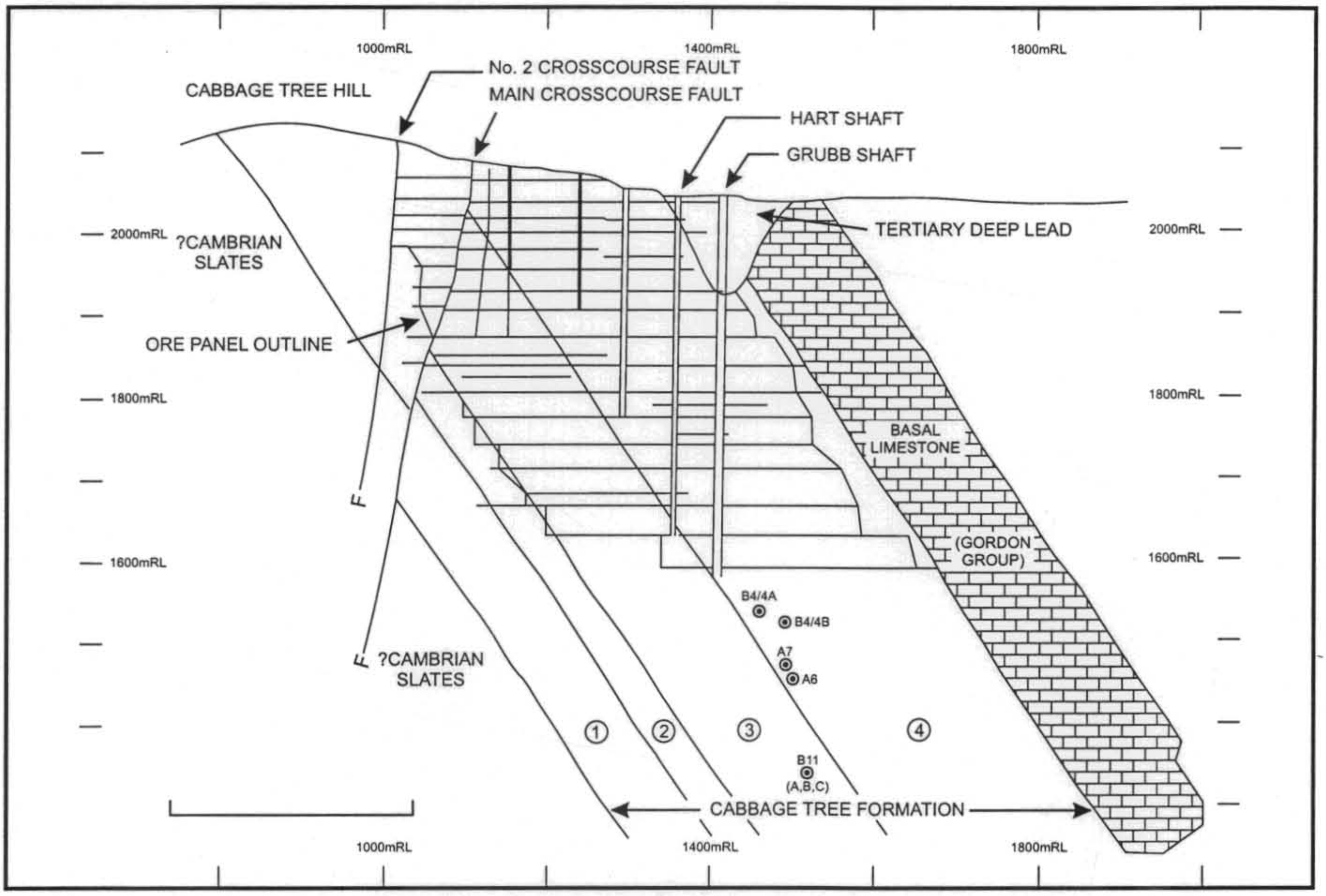

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Figure 3

Geological longitudinal section of the Tasmania mine, looking north

reef has resulted in recrystallisation, forming secondary, coarse-grained quartz, calcite, pyrite, chalcopyrite and gold (to several millimetres), as high-grade shoots parallel to bedding. There was also a recorded production of 1.1 tonnes of alluvial gold from this goldfield up to 1907, mostly from a deep Tertiary lead to the east of Cabbage Tree Hill. The gold was enriched in probable eluvial detritus on the western wall of the northern lead, and in carbonaceous false bottoms; the true bottom was probably never reached.

There are numerous old workings in this area, but most are poorly accessible and the dumps have mostly been removed. The major workings on the Tasmania reef have been re-opened by Beaconsfield Gold Mines Limited, and underground visits and viewing of drill core can sometimes be arranged with the permission of the mine manager.

2: LEFROY AREA

Introduction

Gold mining started in the Lefroy area in 1869 and had largely finished by the turn of the century. About 50 mines operated in the area on some 30 lines of reef, mostly to shallow depth. Total lode gold production from Department of Mines statistics has been estimated at 5170 kg, mostly prior to 1900, with only 230 kg recovered since that date, plus an estimated 155 kg from alluvial deposits.

Regional Geology

The basement rocks in the area are strongly cleaved siltstone, sandstone and slate of the Mathinna Beds, turbidite sequences of (?)Ordovician–Early Devonian age, generally classified with the Lachlan Fold Belt. The sequence at Lefroy trends northwest, with dips generally to the southwest at varying angles, and is multiply deformed. Stratigraphic and structural interpretation is limited by poor exposure.

The gold deposits are virtually confined to a sequence of cleaved coarse siltstone and fine sandstone which is apparently overlain to the southwest by coarse sandstone and underlain to the northeast by slate and quartzite. WSW-directed thrusting, parallelling gold lodes and veining, has been postulated as a control to the mineralisation (Powell and Baillie, 1992).

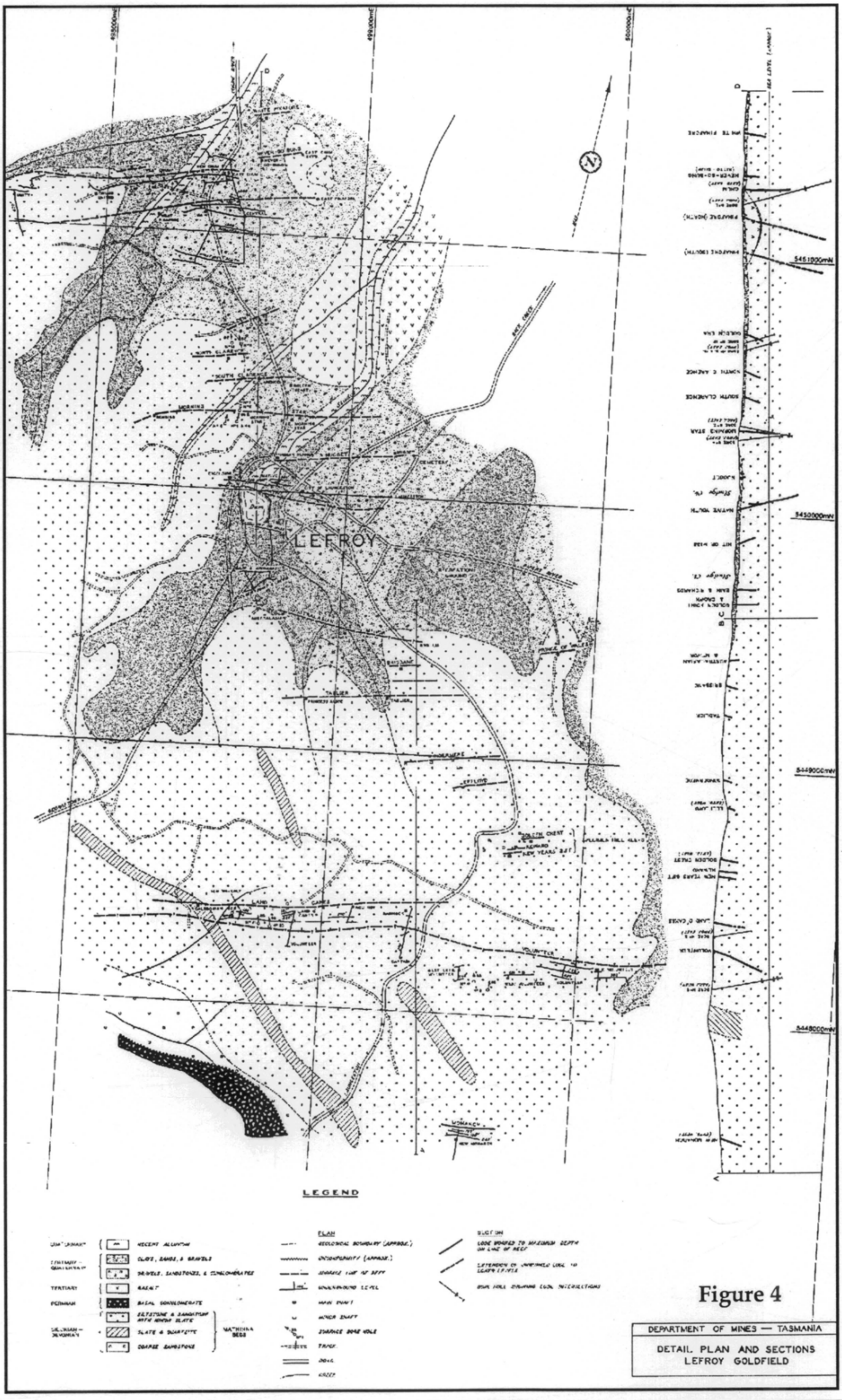
LEFROY
LEGEND
TERTIARY
PERMIAN
PLAN
SECTION
DEPARTMENT OF MINES — TASMANIA
DETAIL PLAN AND SECTIONS
LEFROY GOLDFIELD

Figure 4

Geophysical studies indicate that the goldfield is probably underlain by granodiorite at relatively shallow depth, as are many of the other goldfields west of Scottsdale.

Basal conglomerate of Permian age unconformably overlies the Mathinna Group to the southwest of Lefroy, and Tertiary Basalt and Tertiary–Quaternary gravel, conglomerate, clay and siltstone locally overlie the Mathinna Group in the Lefroy area.

Gold Mineralisation

Gold mineralisation occurs in quartz veins or reefs along fault planes which trend at 80°; the reefs mostly dip to the south, although some smaller reefs dip north. Repeated movement along the fault planes has produced slickensiding, breccia and mylonitic pug, and overprinting of quartz veins. Fault shear zones may be up to 60 m wide and reefs may occur anywhere in the zone. The fractures can be traced on the surface for about 1.5 km and have been proved to continue to a depth of at least 380 metres. The gold is limited in economic quantities, both laterally and at depth, although present in trace amounts throughout the fractures.

The gold is generally associated with vuggy quartz on the footwall and/or hanging wall of the fractures. It is found in association with stibnite and cervantite (an antimony oxide) and more rarely with pyrite, chalcopyrite and arsenopyrite. Vitreous white quartz is common, particularly in fault zones and small fractures, but is generally non-auriferous. The association of gold with sulphide minerals was most clearly shown in the Clarence mine, where free gold was extremely rare but pyrite assayed up to 673 g/t of gold. A small pocket of pyritic ore at the 800 foot (240 m) level in the New Pinafore mine was reported to have assayed 50.5 g/t of gold, and represents the only concentration of gold found below 120 m in the mines.

The predominant feature of the mining field is the consistent decline in gold values below the 90–120 m levels and, in many of the smaller mines, the marked decrease at only 30 m, although quartz may fill the lode channel. The New Pinafore and Volunteer mines were extended to a depth of 370 m and 380 m respectively but yielded very little gold although the lode channel in each case was distinct. Gold values generally declined from about 30 g/t in the upper levels to less than 3 g/t at depth. The decline in gold values was considered to be due to a process of surface enrichment, which is not proven and appears unlikely. In the New Golden Gate mine at Mathinna, for example, the original workings were abandoned at shallow depth, as with most of the early mines in the area, but were later re-opened and reached a final depth of about 600 m, with average grades of 26 g/t Au persisting. This suggests a high potential for more gold reserves at depth below other mines and 'barren' veins, although the gold distribution is obviously erratic.

A number of old river valleys or leads filled with Tertiary sediments were worked for alluvial gold up to where they pass beneath the Tertiary basalt. The sub-basaltic leads have only been briefly investigated.

Field Example: Stop 2 (Lefroy)

A road cutting on the main Bridport Road south of Lefroy (at about 498 800 mE, 5 448 300 mN) shows a typical exposure of Mathinna Beds. There is a rhythmic sequence of approximately metre-thick sandstone units separated by thin slate beds, with some open folding, kinking and faulting. Small quartz veins of various orientations are present; one of these is in the lode orientation (80°T), is limonitic and appears mineralised. The Volunteer reef and mine would be very close to this location, although the workings are presently obscured.

The Lefroy township, in the centre of the goldfield, can be reached by a turnoff one kilometre on the left before this stop, and numerous mullock heaps are visible in the vicinity. Tailings treatment is proceeding in one area.

Structure (R. Keele)

This roadside locality is from the Pipers River Recumbent Zone (Powell and Baillie, 1992). The main cleavage is sub-horizontal in attitude and the bedding dips (and faces) steeply towards the southwest; thus whilst this particular outcrop is very close to the hinge of the F_1 fold, the bedding is not actually overturned here. Note that the cleavage has a distinct sygmoidal shape, due to movement along the bedding surfaces as the fold was rotated through 90° to its present attitude. The sense of movement along the bedding surfaces suggests that the hinge suffered extension (i.e. normal) movement during this process. Note that there is a series of sub-vertically dipping, ENE-trending sulphidic quartz veins which post-date the D_1 event. These are possibly the same sets of veins that are related to mineralisation in the nearby Lefroy goldfield. These veins show evidence for a very mild re-activation along bedding surfaces after their emplacement.

3: BRIDPORT

The Mathinna Beds are intruded and locally contact metamorphosed by granitic to dioritic intrusive rocks of the Scottsdale and Blue Tier Batholiths, of probable Upper Devonian to Lower Carboniferous age. Granodiorites are more abundant in the Scottsdale Batholith and are rarely mineralised, whilst tin-bearing alkali granites are more characteristic of the Blue Tier Batholith. Some of the granodiorites are spatially associated with gold deposits and may exert a genetic control, although the relationship is not at all clear. This is most important in the Lisle-Golconda-Panama area, where gold apparently occurs in both the granodiorite and its contact metamorphic aureole, in both vein and disseminated form (see below). The granitoids are described further in Appendix 1.

Field example: Stop 3 (Bridport)

A coastal exposure (at about 532 700 mE, 5 462 000 mN) shows an atypically good exposure of a contact between granodiorite and Mathinna Beds rocks. Hornblende-rich xenoliths, grading into diorite, are locally abundant, as at Lisle. Migmatite-like structures can be viewed, and include quartzo-feldspathic veins and pods, again resembling some similar structures at Lisle. The Mathinna Beds, in general, here appear highly brecciated, sheared and replaced by granitic material. The intrusion was presumably relatively dry and volatile-poor, as evidenced by a relative lack of micaceous minerals and tourmaline. Contact metamorphic minerals are lacking in hand specimen, possibly due to the psammitic nature of the Mathinna Beds.

The area between here and Forester, northeast of Scottsdale, is underlain by granitoids of the Scottsdale Batholith, but these are usually deeply weathered and are generally obscured by a veneer of Tertiary to Quaternary sediments and Tertiary basalt.

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4: LINTON MINE, FORESTER GOLDFIELD

Introduction

This goldfield is a relatively recent discovery (1922; most others were discovered pre-1890). Production has probably been small, but records are poor. The Linton mine has produced at least 200 ounces (6.5 kg) of gold, and the lodes are currently being reopened.

Regional Geology

In this area the Mathinna Beds is represented by a narrow wedge, about four kilometres wide, sandwiched between the Scottsdale and Blue Tier Batholiths. The bedding strikes approximately NNE in most of the area and the sediments consist of psammite (lithic arenite and quartzite), psammopelite or siltstone, and pelite (phyllite, shale or slate), with local hornfelsing close to granitoid bodies. The folding and syntectonic metamorphism (to lower greenschist facies) in the Mathinna Beds is considered to predate the intrusion of granitoids (McClenaghan *et al.*, 1982). The major mineralogy is simple; usually quartz and muscovite, with lesser chlorite, albite, graphite, heavy minerals.

The metamorphic aureoles around granitoids are commonly sharply defined, varying from about 800 m to about 5 km in width, depending upon the dip of the contact (McClenaghan *et al.*, 1982). Within these aureoles the sediments are commonly spotty and/or hornfelsed, and may contain biotite, epidote-clinozoisite, andalusite and cordierite, as well as quartz, muscovite and chlorite.

The Scottsdale Batholith in the west is subdivided into a biotite-hornblende granodiorite (Tulendeena Granodiorite) and various biotite adamellites (including the Mt Stronach Pluton and Russells Road Adamellite). The Blue Tier Batholith in the east is subdivided into several biotite ± muscovite alkali-feldspar granites and adamellites (including the Mt Paris Pluton, the Little Mt Horror Granite and the Poimena Adamellite, commonly tin bearing).

The structure of the region has not been studied in detail, but major deformation appears restricted to the Mathinna Beds, and is mostly mid-Devonian in age. Fold axes mostly strike about NNW, and thrusting is locally present. The 'gold belt' is the major structure known in the area, and is a zone about two kilometres wide, with a concentration of gold deposits, running through the Mathinna Beds from around Waterhouse, near the north coast, south for about 80 km, almost to Fingal. It is intruded in places by Devonian granitoid intrusions, buried in others by later sedimentary deposits from Permian to Recent in age, and is intruded or partly obscured by Jurassic dolerite. The strike is generally about NNW, but it bifurcates (to the NNE) near Warrentinna. This 'gold belt' is characterised by close folding, axial plane shears, strongly-cleaved slate and abundant quartz veining (of several generations). The belt and other major structures are disrupted by post-granitoid mega-kinking (Goscombe and Findlay, 1989). The structural controls on the veining and gold mineralisation are poorly understood in the Forester area.

Mineralisation styles

The primary gold in the Mt Horror area (the Forester and Warrentinna goldfields) occurs in quartz-rich veins and breccia within the Mathinna Beds. The gold lodes in this area are closely related to those in other parts of the gold belt, but are distinct from those west of Scottsdale.

The gold-bearing quartz veins are usually small and, although often very gold-rich (up to 39.5 oz/ton or 1354 g/t; Twelvetrees, 1907), are typically erratic in size and grade. The quartz is usually white and glassy, but where auriferous is dense, granular and milky to

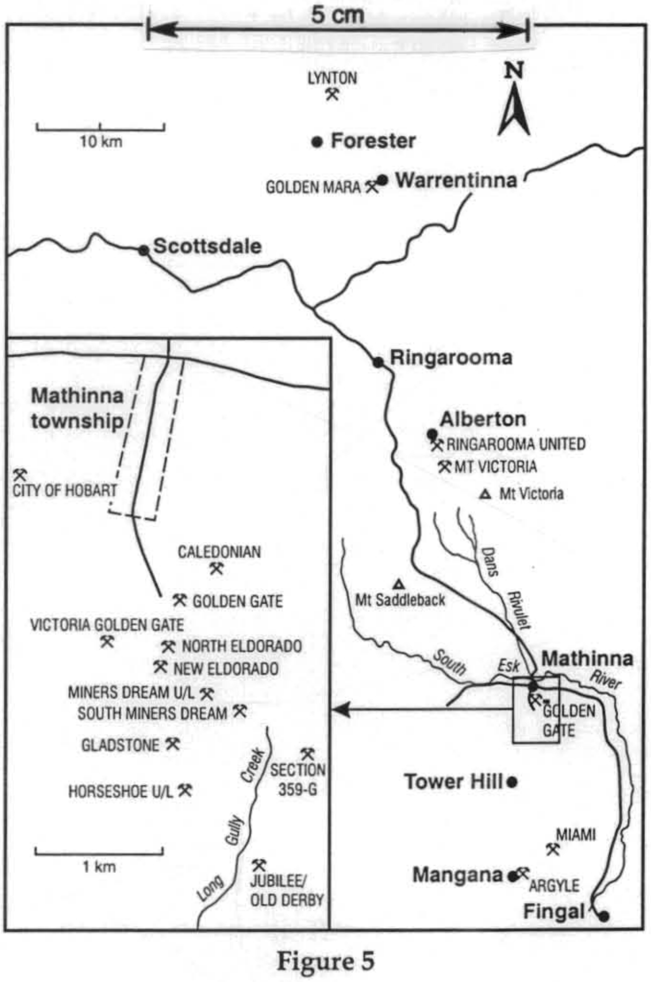

Figure 5

Location map, Forester–Fingal area

Field example: Stop 4 (Linton)

A small open cut, plus trenches and adits (at about 557 500 mE, 5 455 500 mN) provides good exposures of the three main lodes. The gold and sulphide-bearing quartz is abundant in stockpiles. The Mathinna Beds show typical folds, thrusts and lithologies.

blue-grey in colour, with minor sulphide minerals or iron oxides where weathered. The sulphides include pyrite and arsenopyrite, with lesser chalcopyrite, galena and sphalerite. Minor mica, chlorite and carbonates (ankerite and siderite) may also be present. Gold is usually fine grained and rarely macroscopically visible.

The veins vary in thickness from a few centimetres to about eight metres, and in length from about seven metres to two kilometres. The veins are commonly bedding-parallel, striking about 315-345°, and usually dipping steeply. Some veins are cross-veins and some are sub-horizontal; for example in the Linton mine and other deposits in the Forester area, the general strike is ENE. The veins are commonly extensional, in fold limbs and hinges. Multiple generations of veining are typical and variable in texture and colour. The white buck and comb quartz is usually relatively late and barren. Many lodes are breccia zones; these breccias contain clasts of early quartz and wallrocks cemented by cherty to medium-grained quartz, and are commonly gold rich. Laminated, stylolitic and ribbon veins are also commonly gold rich. The host mudstone is partly silicified and/or cataclased and may also contain up to 0.6 g/t gold.

Fluid inclusion, geochemical, petrographic and oxygen isotope studies (Taheri and Bottrill, 1994) indicate deposition of gold from metamorphic fluids in most of the gold-bearing deposits in the Mangana-Forester goldfields, with the exception of the Mt Horror arsenic prospect and the Gorge Creek tungsten prospect, both granite-related deposits.

Structure (R. Keele)

A SW-dipping thrust fault may be seen in the south wall of the main workings. This fault is truncated by the main NE-trending quartz lode in the mine, enabling an upper age limit (post-D_1) to be put on the mineralisation here. A good example of the stockwork style of quartz veins (some of which are blue to grey in colour) can be seen on the far side of the present workings; such zones may have the potential to carry low-grade mineralisation several metres wide. Note the development of 'crocodile' texture on the surfaces of the quartz veins which are exposed at the northeastern end of the workings. This curious phenomenon may be due to original growth fibres, intersecting joints/fractures, uplift, weathering, or a combination of factors.

5: LISLE AREA

Introduction

Several goldfields were discovered in this area in about 1877 and were dominated by the Lisle alluvial field, with a probable gold production of nearly ten tonnes. A small production of gold continues from Lisle.

The workings are spatially closely related to hornblende-biotite-magnetite-sulphide bearing granodioritic intrusions in the Mathinna Beds. The metamorphic aureoles are commonly sharply defined, varying from 800 m to about 5 km in width, depending upon the dip of the contact (McClenaghan *et al.*, 1982). Within these aureoles the sediments are commonly spotty and/or hornfelsed, and may contain biotite and cordierite, as well as recrystallised quartz, muscovite and chlorite. Some hornfels contains up to 80% iron cordierite (sekanianite). Quartz and greisen veins and granitic dykes locally occur in the aureole near the contact.

Lisle

Workings at Lisle included alluvium and eluvium in a basin-shaped depression, possibly representing an old lake bed of Tertiary age (Reid, 1926; Marshall, 1969). There were numerous patchy gold-rich horizons in the possible lacustrine sediments, and in carbonaceous horizons underlying talus, which produced relatively pure, free, angular (crystalline?) gold (Noldart, *in* Marshall, 1969). This type of gold suggested a secondary origin (i.e. *in situ* reprecipitation of dissolved gold from groundwater; Reid, 1926; Bottrill, 1986). Some gold grains are highly porous and/or colloform, while some have silver-rich cores and silver-depleted rims (Bottrill, 1991; Roach, 1991), confirming that some gold is detrital and some reprecipitated.

Auriferous quartz was relatively rare, both in alluvium and bedrock, and Twelvetrees (1909) found evidence for gold originating in the contact metamorphosed sandstone of the Mathinna Beds surrounding the basin, near the contact with Devonian granitoid intrusive rocks. Inclusions of mica, rutile and magnetite in the gold grains suggest that the gold was more likely to have been disseminated in the hornfels or granitoids than in quartz veins, while rare gold-limonite composites in placers suggest gold-bearing pyrite may have been originally present (Bottrill, 1986). Some gold was found in small quartz veins in the granitic rock underlying the alluvial sediments (Thureau, 1882; Montgomery, 1894). Recent drilling by the Department of Mines revealed very minor quartz- carbonate-pyrite alteration zones in the magnetite-pyrite bearing granodiorite, with trace gold (to 0.05 g/t; Bottrill, 1996).

Other deposits in the area

Other poorly recorded deposits worked nearby include the Lone Star, Tobacco, Cradle, and Den Creeks, and the Lebrina, Panama, Golconda and Denison goldfields

Field example — Stop 5 (Lisle)

This location (at about 527 900 mE, 5 431 100 mN) provides a view of the Lisle valley, showing its enclosed, bowl-like shape. There is a road metal quarry nearby, producing the hornfels present on this road surface, some of which is very cordierite-rich.

(Noldart, *in* Marshall, 1969). The former deposits were mostly alluvial or eluvial, and the latter vein style. The Denison goldfield consisted of a number of auriferous quartz veins in Mathinna Beds, similar to Lefroy in style, and probably overlying granodiorites (Roach, 1991).

The Panama field workings encompassed veins in both granitoids and hornfels. Reconnaissance geochemical surveys have indicated minor gold in hornfels (up to 3 g/t Au) and some very gold-rich quartz-sulphide veins (up to 210 g/t Au; Bottrill, 1996) at this site.

Stockwork-hosted gold mineralisation (to about 1 g/t Au) in arenite at Bessells Reward, near Cradle Creek, has been reported (Roach, 1991). Minor gold veins occur in the St Patricks River–Myrtle Bank area, south of Lisle, and one of these deposits contained ruby silver and gold in a porphyry dyke, suggestive of epithermal mineralisation (Reid, 1926). There is a supposed lamprophyre occurrence in the Den Ranges, perhaps related to nearby gold occurrences (Noldart, *in* Marshall, 1969).

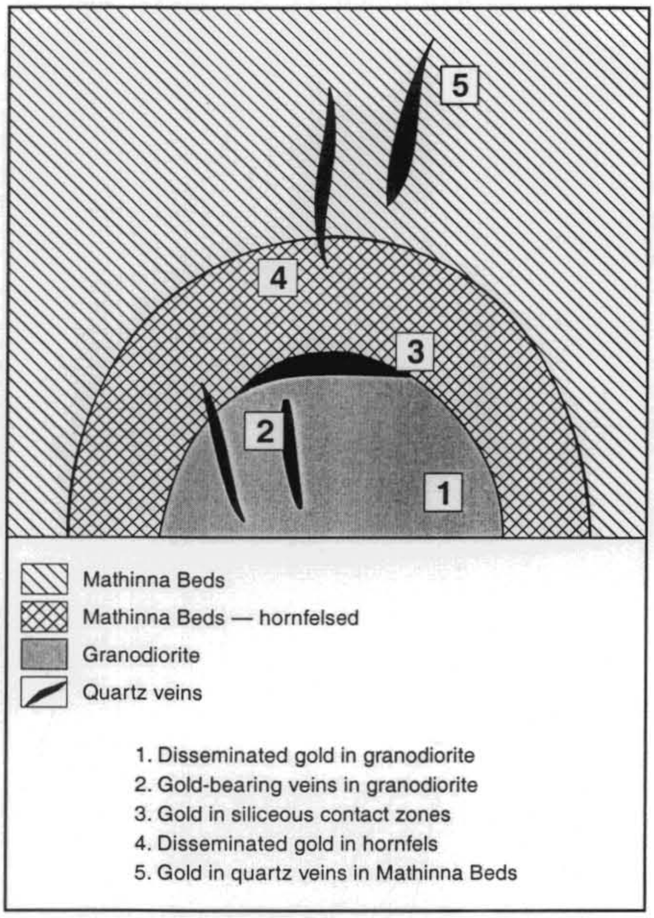

Figure 6

Possible styles of gold occurrence in the Lisle area

6: RINGAROOMA UNITED MINE, ALBERTON

General

The Alberton goldfield has a large number of old gold mines and prospects, although most have had only minor production. The Ringarooma United was one of the most significant mines in the field, and resulted from the amalgamation of several old workings on various reefs, and is one of the few to have been diamond drilled. The mine is presently being re-opened and re-drilled with a view to mining. The nearby Mercury, Long Struggle and Mt Victoria mines are also being redeveloped by the same company.

The regional geology and mineralisation are similar to that in the Linton area and the 'gold belt' is relatively continuous from here through the Dans Rivulet to near Mathinna. The structure is complex and poorly understood; quartz veins are common but characteristically short, discontinuous (faulted) and of variable orientation. This may be due to the competency of the rocks, as there is a relatively high ratio of psammite (sandstone, quartzite and siltstone) to pelite (phyllite, shale or slate) compared with some other goldfields in the northeast. The wallrocks are commonly silicified but no hornfels has been noted.

Quartz porphyry (with disseminated sulphide), basaltic dykes, probable tuff and hornblende-bearing lamprophyre are present, suggesting the presence of a deep-seated, long active major structure, tapping deep crustal fluids. The relationship of these igneous rocks to mineralisation is poorly understood, but could indicate the potential for Wood's Reef-style mineralisation.

Field example: Stop 6 (Alberton goldfield)

At the Ringarooma United mine, Alberton, there is a new waste-rock dump resulting from the recent re-opening of the adit. On the dump can be seen quartz veins and various host rocks, mostly Mathinna group siltstone and slate, plus quartz porphyry, lamprophyre and an unclassified, sericite-chlorite-pyrite altered, dacitic rock. The drill core and adit may be available for inspection with the mine owners, Mancala.

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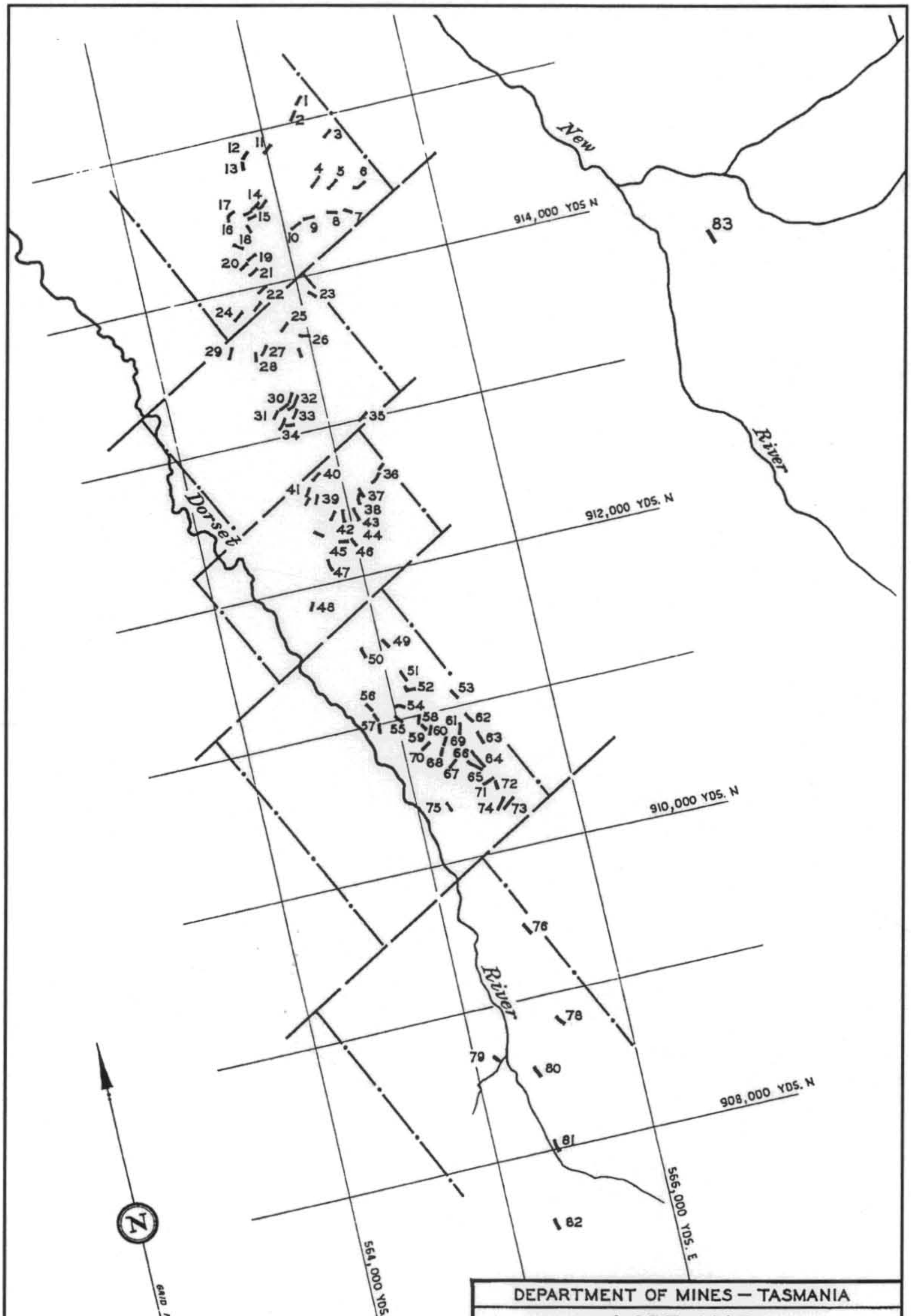

Figure 7

The distribution and strike of veins in the Alberton goldfield (after Threader, 1967)

5 cm

7: GOLDEN GATE MINE, MATHINNA

The Mathinna goldfield is a continuation of the gold belt, although the structure may be broken by a major fault to the north (Keele, 1994). The Golden Gate mine was the largest gold mine in the Mangana-Forester gold belt, with a gold production of more than 250,000 ounces (8 t) at average grades of 26 g/t Au (Table 1), and a depth of nearly 600 metres.

The geology is similar to the Linton and Alberton areas, but the sequences here may contain more black slate than at Alberton. Veining is complex and several generations are clearly visible. No hornfels or igneous rocks have been noted in the Mathinna area, and M. Roach (pers comm.) considers the sediments to be about 2-3 km thick. The presence of carbonate alteration in the wallrocks becomes prominent south of here.

The mine (at about 574 500 mE, 5 406 700 mN) contains some mullock heaps which provide interesting samples. Veining is common and several styles and generations may be distinguished, including buck, sulphidic, carbonate bearing and breccia veins (all mostly low in gold). An open cut and old shafts are visible. The tailings are very extensive and are about to be reprocessed for their gold content.

Table 1

Gold production, Mathinna and Tower Hill goldfields (Finucane, 1935)

Deposit	Ore* (tonne)	Gold* (kg)
Welcome Stranger	-	-
Enterprise	10	0.93
New Golden Gate Mine	304 158	7 197.10
Tasmanian Consols (North Golden Gate)	34 236	311.76
South Golden Gate	-	-
Caledonian	-	-
New Eldorado (prior to 1886)	508	?
	579	26.22
Horseshoe	89	1.43
Gladstone	71	1.12
Miner's Dream	208	12.29
Old Boys	242	2.14
Volunteer Mine	~9 000	72.79
Volunteer Consolidated	1 788	35.79
Yellow Boy	213	2.41
Chester and Murray	2.5	0.03
	?	2.55
City of Hobart	?	596
Pride of Hills	91	?
	15	0.23
Scott and Pickett	93	1.07?
Mountaineer	-	-
Jubilee	56	1.67
Sunbeam (Tower Hill Goldfield)	12	0.12
Total		8 265.73

* Recorded or quoted values

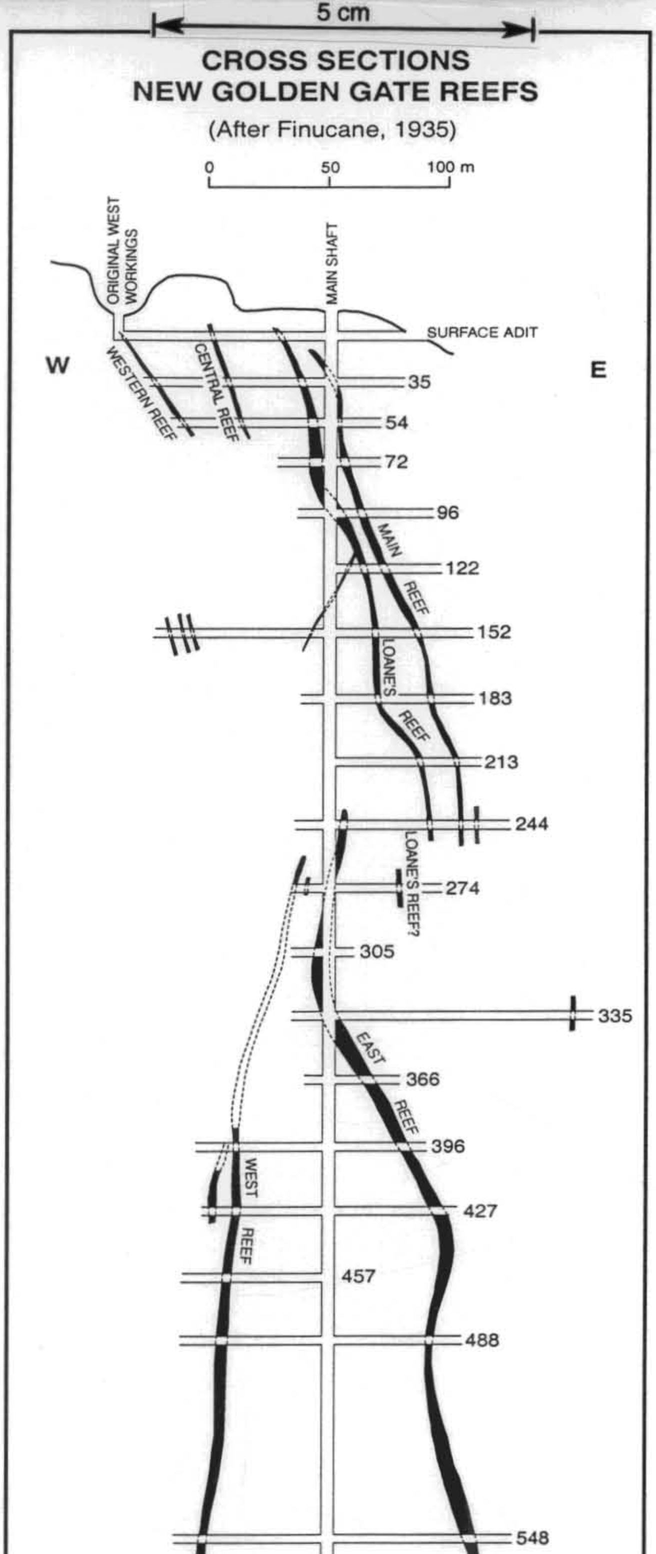

Figure 8

Field example: Stop 7 (Golden Gate)

At the Golden Gate mine, Mathinna, there is a very large tailings dump and smaller-rock dumps. On these dumps can be seen some multiple stages of quartz veins and various host rocks, mostly Mathinna group siltstone and slate. The old workings are not accessible.

8: PINCHER MINE, MANGANA

General

This goldfield was the site of the first discovery of payable gold in Tasmania. It was discovered in February 1852 by James Grant of Tullochgorum, on Richardsons Creek near Mangana ("about 150 yards below the present bridge": Twelvetrees, 1907). Most production occurred between 1852 and 1910, but has been sporadic ever since. The first lode gold mining in the area commenced at the Sovereign mine in April 1859 (Twelvetrees, 1907; Blake, 1939). Some alluvial mining continued at Majors Gully into recent years.

The total recorded production from lode deposits in the area is 208 kg (Table 2) but as early records are poor, the actual production could have been much greater. Alluvial deposits probably produced an additional 5,000 to 15,000 ounces (about 160-470 kg) of gold (Twelvetrees, 1907). Some of this alluvial gold was apparently traced to conglomerate in the Parmeener Supergroup, but no production was recorded (Twelvetrees, 1907). A large proportion of the gold was probably taken directly to the mint in Victoria by the miners. The largest mine in the area was the Golden

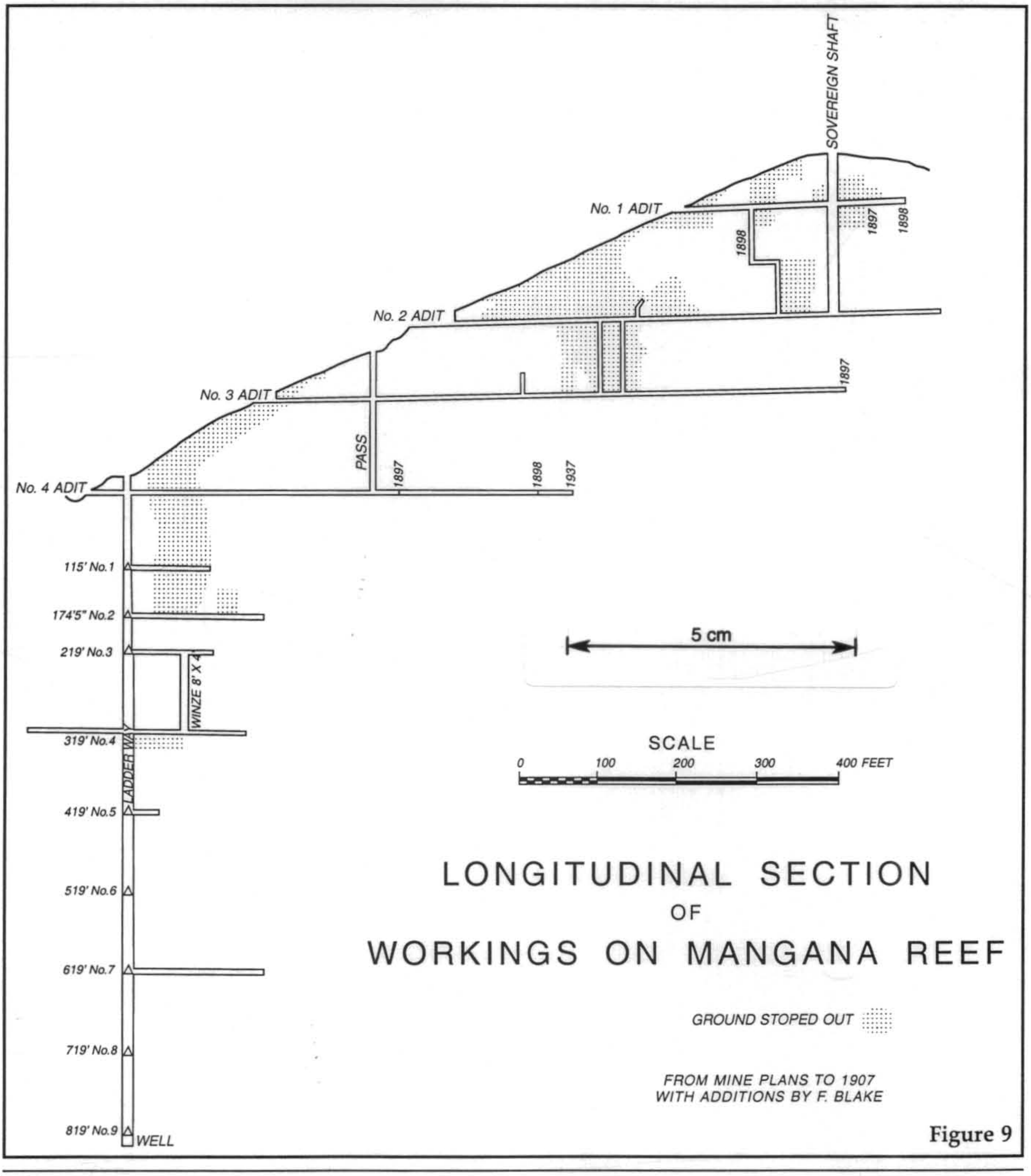

Figure 9

Table 2

Gold production, Mangana goldfield (to 1994)

Mine	Gold production (kg)	Tonnes ore	Average grade (g/t)
Abbotsford Creek	0.22	1525	0.14
Alpine	19.19	27.5	?
Buckland	35.88	1421	25.25
Cardinal	4.91	240	20.48
Fingal	9.88	9.10	
Golden Entrance	91.41	718	127.31
Golden Gully	-	0.8	?
Great Fingal	1.00	5	199.06
Mangana	24.60	3106	7.92
Miami	19.91	795	25.04
Pinchers	0.31	10	31.10
Richardsons Creek	-	40.6	-
Tower Hill Freehold	-	61.2	?
Union Jack	0.31	20	15.55
West Miami	0.23	27	8.41
Miscellaneous alluvials	~150		
Total	207.85	8057.6	25.80

Entrance, which had a recorded production of 90 kg of gold (2939 ounces) at an average grade of 125.3 g/t Au. The Pincher mine was relatively small, but typical of many in the area.

Geology

The Mangana goldfield represents the southernmost part of the gold belt, and the geology and mineralisation are similar to the Linton, Alberton and Mathinna areas. The bedding strikes approximately 340° and the sediments consist of sandstone, quartzite, siltstone and pelite (phyllite, shale or slate). No hornfels has been noted in the Mangana area, and M. Roach (unpublished data) considers the sediments to be about 2-3 km thick. The 'gold belt' strikes about NNW in general, but about northwest near Mangana. Locally abundant poikiloblastic siderite in the sediments may represent hydrothermal alteration related to mineralisation. Cleavage is usually enhanced around mineralised areas. The pelites, especially adjacent to veins, locally appear more phyllitic or schistose in this area than in the rest of the northeast.

Gold has been recovered from placer deposits in Cainozoic alluvial sediments, which have generally not been well tested. Most of the gullies running into Tower Rivulet were sufficiently auriferous to employ miners for some time (Twelvetrees, 1907). Some production continues from these today. Twelvetrees (1907) and Finucane (1932) also reported on some occurrences of alluvial gold in the Permian conglomerate at the head of some of the northern gullies, and suggested that these palaeoplacers made an important contribution to the recent alluvial gold deposits.

Field example: Stop 8 (Pincher mine)

At the Pincher Mine, Mangana, there are some shafts and short adits and a small-rock dump, with some good exposures of the gold-bearing lode and wall rocks. On these dumps can be seen quite rich ore samples (15-20 g/t Au), in laminated quartz veins. The surrounding Mathinna group siltstone and slate contains prominent carbonate spotting near the lodes. An old adit east of the creek is still accessible with care. To the north can be seen the tailings from the Majors Gully alluvial gold operations (~1985).

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APPENDIX 1

Granitoids of northeast Tasmania

by M. P. McClenaghan

The granitoid plutons of eastern Tasmania occupy an area of 2500 km^2 and form the Scottsdale, Blue Tier and Eddystone batholiths, with a number of other disconnected lesser bodies extending south to Deep Glen Bay on the Tasman Peninsula.

The batholiths are composite and consist of four main rock types; granodiorite, biotite adamellite/granite, alkali-feldspar granite, and biotite-garnet-cordierite adamellite. The age of intrusion was between about 396 and 370 Ma.

The granodiorites show little variation, being massive, medium-grained to coarse-grained, dark grey rocks commonly with abundant fine-grained dioritic enclaves. They consist of euhedral to anhedral amphibole and biotite, plagioclase and intergranular K-feldspar and quartz. Amphibole ranges in composition from actinolite in the core regions of some crystals to hornblende in the rims and in euhedral crystals. Amphibole and biotite are commonly present in intermingled clusters of crystals. Trace amounts of clinopyroxene are present in some of the granodiorite plutons in association with actinolite. Plagioclase commonly contains sericitised unzoned calcium-rich core regions (An_{80-70}) which have sharp boundaries with the clear zoned rims (An_{60-25}). Accessory minerals include apatite, zircon, sphene, allanite and ilmenite. Magnetite is present in some parts of the Pyengana Pluton which lies on the western side of the Blue Tier batholith.

The St Marys Porphyrite occurs in the south of the Blue Tier batholith and is considered to be the extrusive equivalent of a granodiorite body (Turner *et al.*, 1986). The rocks consist of plagioclase, quartz, biotite, augite, hypersthene and sanidine phenocrysts in an aphanitic groundmass. The pyroxene is pseudomorphed by amphibole at higher levels in the body and in the hypabyssal equivalent micro-granodiorite body; both orthpyroxene and clinopyroxene remnants are found in amphibole cores.

Granodiorite forms nearly half of the Scottsdale batholith whereas in the Blue Tier batholith the proportion is reduced to less than one third. A very minor body of granodiorite occurs in the Eddystone batholith and a small body is also present on the eastern side of Freycinet Peninsula.

The biotite adamellites/granites show textural variations but all consist of plagioclase, biotite, quartz and K-feldspar with accessory zircon, monazite, ilmenite and apatite. The plagioclase is generally zoned (An_{45-15}), commonly has thin rims of albite, and the K-feldspar is coarsely perthitic. K-feldspar megacrysts (20–60 mm) are a feature of these rocks and commonly contain up to five concentric zones of plagioclase inclusions (McClenaghan and Williams, 1982).

The adamellite in the Scottsdale batholith forms the northern part of the Russell Road and Hogarth Road plutons and comprises coarse-grained to very coarse-grained equigranular to sparsely porphyritic rocks with megacrysts of K-feldspar (20–50 mm). In the Mt Stronach and Kamona areas, near Scottsdale, the Russell Road pluton is pink and appears to be strongly metasomatised. In this area its composition is alkali-feldspar granite. These plutons grade in composition southwards to granodiorite where amphibole is present as well as biotite. The central part of the Hogarth Road pluton in the southern part of the body is very rich in quartz diorite xenoliths.

In the Blue Tier batholith the main adamellite bodies are the Poimena and Mt Pearson plutons. The Poimena pluton is a medium-grained to coarse-grained rock with abundant K-feldspar megacrysts (20–50 mm). Detailed mapping in the central Blue Tier area near Lottah (McClenaghan and Williams, 1982) showed the presence of several small sheet and dome-shaped intrusions of similar composition but different texture within the Poimena pluton. The Mt Pearson pluton is compositionally similar to the Poimena pluton but is very coarse grained with abundant K-feldspar megacrysts (20–60 mm).

In the Scottsdale batholith, alkali-feldspar granite is present in the northern metasomatised portion of the Russell Road pluton and in the pink metasomatised margins of the Tombstone Creek pluton which lies within the Hogarth Road pluton.

Alkali-feldspar granite also occurs in the Ben Lomond Granite which lies to the south of the Scottsdale batholith and is separated from it by the Ben Lomond plateau. The most abundant granite type is a coarse-grained, pink, porphyritic granite with K-feldspar megacrysts (Blissett, 1959). The granite consists of quartz, K-feldspar and albite with minor biotite, muscovite and accessory tourmaline and zircon. The main granite is intruded by irregular dykes of pale grey microgranite which is commonly porphyritic and greisenised with accompanying tin, tungsten and sulphide minerals (Blissett, 1959).

The Royal George Granite lies a short distance to the south of the Ben Lomond Granite and is very similar. Beattie (1967) reported topaz and fluorite as additional accessory minerals.

In the Blue Tier batholith, the two main alkali-feldspar bodies are the Lottah and Mt Paris plutons lying near the centre of the batholith. Other smaller bodies occur at Little Mt Horror and Mt Cameron. These bodies, together with the Lottah pluton, have been described as having a sheet-like form (Gee and Groves, 1971) but in the case of the Lottah pluton detailed mapping (McClenaghan and Williams, 1982) showed that a steep-sided dome is more likely.

The Lottah pluton (McClenaghan and Williams, 1982) includes equigranular and quartz and K-feldspar porphyritic granite varieties which have gradational relationships with each other. The granites consist dominantly of K-feldspar, albite and quartz, with the mica content being less than 7%. The K-feldspar is present in perthitic and non-perthitic form, with the non-perthitic feldspar commonly overgrowing euhedral K-feldspar cores. The perthitic K-feldspar is invariably more sodic than the non-perthitic K-feldspar (McClenaghan and Williams, 1982, Table 1). In the porphyritic granites the dark mica is annite or siderophyllite containing inclusions of zircon and apatite. This mica is replaced to varying degrees by zinnwaldite in the equigranular granites. Muscovite is minor and occurs as an alteration of K-feldspar or derived from the breakdown of annite. Additional accessory minerals are fluorite, cassiterite, topaz and tourmaline.

The low temperatures calculated from equilibrium feldspar compositions in this granite suggest sub-solidus mineral-fluid reactions (McClenaghan and Williams, 1982), and zones of greisenisation in the Lottah area (Groves and Taylor, 1973) indicate local metasomatic alteration of the granite.

In the smaller Eddystone batholith, the Mt William pluton is the sole alkali-feldspar body and consists of an equigranular, pink, medium-grained biotite-muscovite granite of quartz, microperthitic K-feldspar, albite, biotite and muscovite with accessory apatite.

In the Ben Lomond area the alkali-feldspar granite is associated with tin and tungsten mineralisation. In the Lottah area, in the central part of the Blue Tier batholith, the alkali-feldspar granite is associated with tin mineralisation.

Biotite-garnet-cordierite adamellite bodies only occur in the Eddystone batholith and are the Ansons Bay, Musselroe and Boobyalla plutons. The Ansons Bay pluton is similar in texture and mineralogy to the Mt Pearson pluton with the addition of garnet and cordierite. Garnet is generally an accessory phase associated with biotite and is most abundant in mafic schlieren. Cordierite is commonly pseudomorphed by sericite and secondary biotite and is rare (Cocker, 1977). Garnet and cordierite are commonly associated with biotite reaction rims to xenoliths, both of granite and Mathinna Beds (Kitto, 1982). Minor textural differences between the northern and southern part of this body (Kitto, 1982), together with chemical and isotopic differences (Cocker, 1982), suggest that the body is composite. The Boobyalla pluton is mineralogically and texturally similar to the Ansons Bay pluton but does not contain cordierite. Cordierite in the Musselroe pluton occurs as phenocrysts and garnet is rare (Cocker, 1977).

Minor intrusive bodies occurring throughout the granitoid areas include aplite, quartz-feldspar porphyry and dolerite dykes (McClenaghan, 1984). Some of the quartz-feldspar porphyry dykes are up to 250 m wide and can be traced for five kilometres (McClenaghan and Williams, 1983). Several small (<1 km in length) bodies of diorite (Hogans Road Diorite) included within or associated with strongly hornfelsed Mathinna Beds, occur as rafts in an adamellite pluton west of St Helens (McClenaghan, 1984).

The sequence of intrusion is generally in the order granodiorite, adamellite, alkali-feldspar granite. The granitoids have produced narrow (<2 km) metamorphic aureoles in the Mathinna Beds country rocks. Hornfels have granoblastic textures and are generally composed of quartz, K-feldspar, cordierite, biotite and muscovite with andalusite near contacts

(Skrzecynski, 1971). Mineral assemblages indicate albite-epidote to hornblende hornfels-facies metamorphism with possible local attainment of pyroxene hornfels-facies metamorphism at Piccaninny Point (McNeil, 1965). Migmatite zones, produced by partial assimilation of the country rock, occur in some areas, for example at Bridport (Skrzecynski, 1971).

Both I- and S-type granitoids occur in northeast Tasmania, with the Scottsdale batholith being entirely I-type and the Eddystone batholith being largely S-type. The Blue Tier batholith is largely I-type but includes adamellites (Poimena pluton) of intermediate character.

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