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Stratigraphic and Structural Studies in the Breadalbane–Currawang Area, Gunning and Goulburn 1:100 000 Sheet Areas: Report on Investigations 1985–1986. Record 1992/12

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ABSTRACT

This record summarises results of field work undertaken in 1985 and 1986 in the Breadalbane -- Currawang area as part of project 2A.08: Volcanic-hosted massive sulphide deposits in southeastern Australia. The area contains a thick sequence of Ordovician metasediments disconformably overlain by a 3 km thick conformable intertonguing sequence of Siluro-Devonian volcanics and minor sediments. Three Siluro-Devonian formations are recognised: the Woodlawn Volcanics; Currawang Basalt; and the Covan Creek Formation. Intrusive rocks include the Early Devonian Wologorong Granite and minor bodies of rhyolite and dolerite. The truncation of an Ordovician carbonaceous pelitic unit beneath Siluro-Devonian rocks indicates a relative regional eastward dip of about 5° in the Ordovician strata prior to deposition of the Siluro-Devonian volcano-sedimentary sequence. Ordovician rocks together with Siluro-Devonian strata, granite and minor rhyolite and dolerite intrusives, were deformed two major E-W compressive events: the first, accompanied by lower to upper greenschist facies metamorphism, is probably mid Devonian in age and is correlated with the Taberaberan Orogeny, the second may be mid-Carboniferous (i.e. Kaniblan). Both deformations involved upright folding about N-trending axes.

Minor amounts of copper, zinc, lead, silver, gold and iron are the only metals produced from the area. Gold, limestone, and barite occurrences have been investigated by exploration companies, mostly in the case of the latter, for possible associated base metals. Nearly all of the base metal mineralisation represents deformed volcanogenic-hosted massive sulphide accumulations of the Captains Flat-Woodlawn-type. These accumulations are contained largely within sediments and volcaniclastics at the base of the Woodlawn Volcanics within two main volcanic piles centred between Currawang and Woodlawn and in the Breadalbane area.

INTRODUCTION

This record summarises results of field work undertaken in 1985 and 1986 in parts of the GOULBURN and GUNNING 1: 100 000 Sheet areas. The location of the area is shown in Fig. 1. The work was part of project 2A.08: Volcanic-hosted massive sulphide deposits in southeastern Australia, whose overall objective was to determine the regional geological setting of the Captains Flat and Woodlawn-type massive sulphide deposits so as to understand the potential spatial and temporal distribution of additional similar deposits. The phase of the project outlined in this record aims to provide a coherent synthesis of the regional geological setting of the sulphide deposits, drawing on recent unpublished studies and fieldwork to augment and revise the published data.

This record presents 1:40 000 -- scale compilation sheets (compilation sheets 3 & 4), and an outline of the stratigraphy, structure and mineral occurrences. A reference to the compilation sheets is presented in Appendix 1 and brief petrographic descriptions are given in Appendix 2. The locations of specimens described petrographically are shown in Fig. 2.

Mapping was based on panachromatic airphotos at 1: 40 000 -- scale which were used in conjunction with ~1: 90 000 -- scale panchromatic airphotos.

The geology of the region is shown on the accompanying compilation sheets (1 & 2) and is generalised in Fig. 3. Diagrammatic stratigraphic relationships are given in Appendix 1 and Fig. 4.

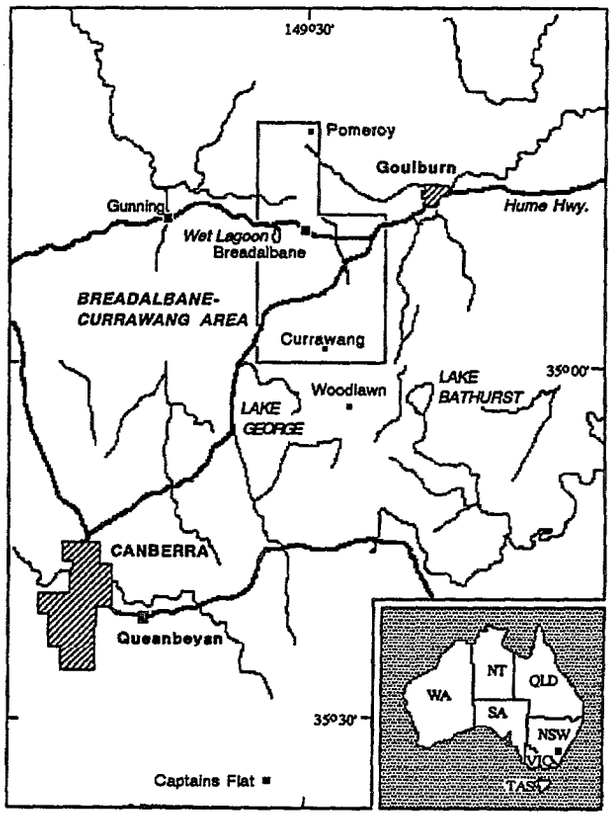


Fig.1. *Locality map.*

REGIONAL GEOLOGY

The Breadalbane -- Currawang area lies in the central part of the Captains Flat -- Goulburn Synclinorial Zone (Scheibner, 1985) comprising a thick sequence of Ordovician metasediments disconformably overlain by an intertonguing sequence of Siluro-Devonian volcanics and minor sediments. Ordovician rocks are intruded by the Early Devonian Wologorong Granite which occupies the centre of a broad regional N-trending antiform. These rocks, together with minor rhyolite and dolerite intrusives, were deformed during the mid Devonian and again in the mid Carboniferous. Lower to upper greenschist facies metamorphism accompanied the first of the two deformations both of which involved upright folding about N-trending axes.

STRATIGRAPHY

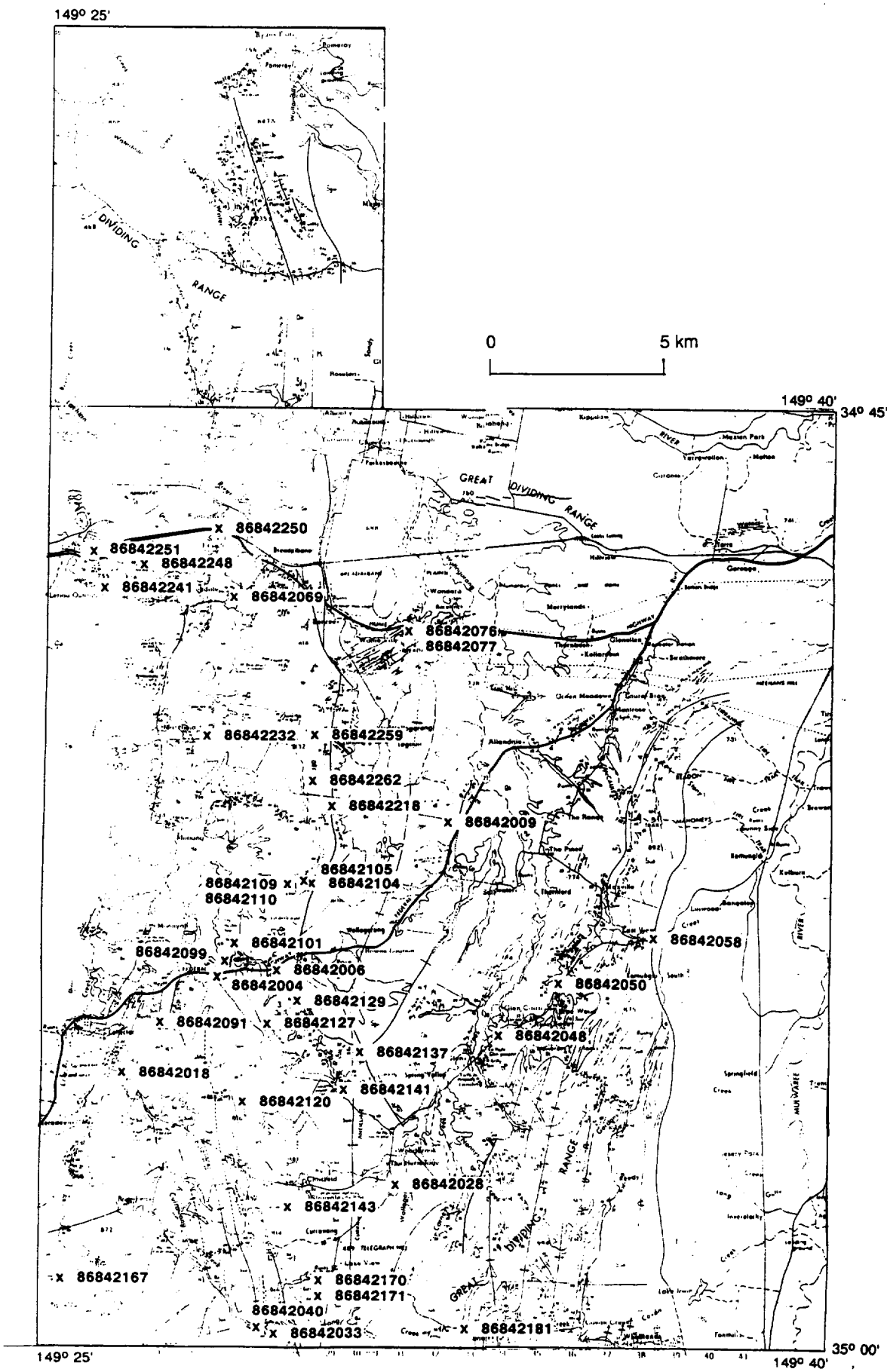
Ordovician

Birkenburn Beds (Op)

Distribution: Ordovician quartz-rich flysch, here correlated with the Birkenburn Beds (Felton & Huleatt, 1977), is the oldest and most extensive unit in the area, surrounding the Wologorong Granite and enclosing synformal Siluro-Devonian volcanic sequences.

Field relationships: The formation is overlain by the Woodlawn Volcanics where present and elsewhere by the Covan Creek Formation. The contact with the volcanics, intersected in a drillhole at Clara Vale prospect and exposed 200 m west of the prospect in a creek bed, is

Fig. 2. *Thin section sample locality map.*



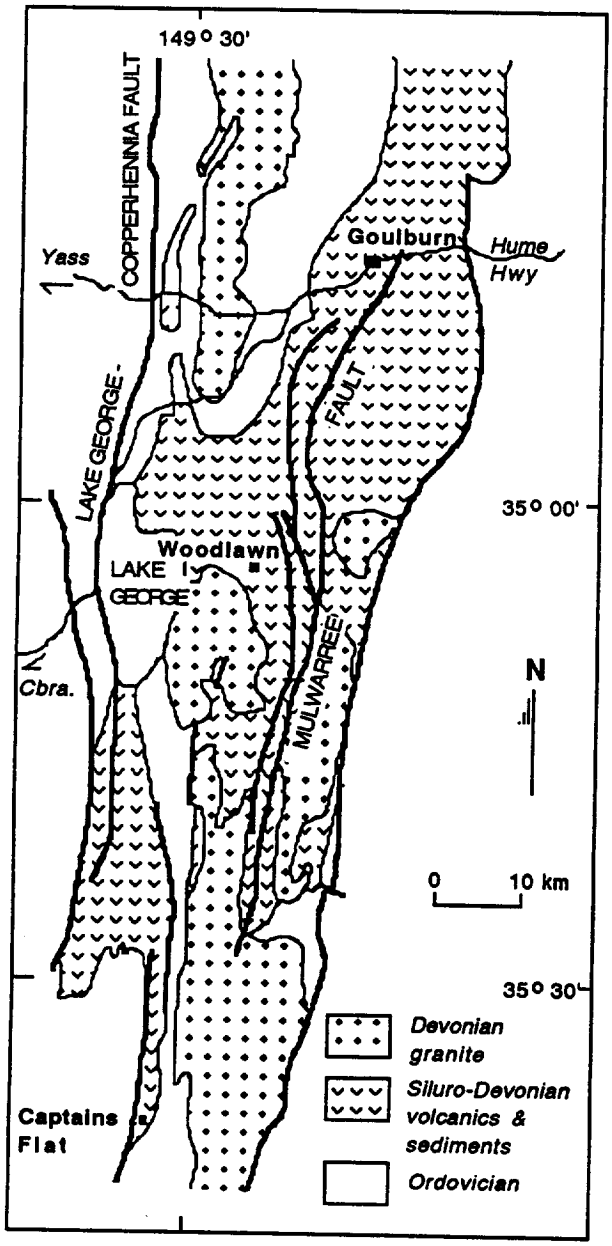


Fig. 3. *Regional geology of the Currawang - Breadalbane area.*

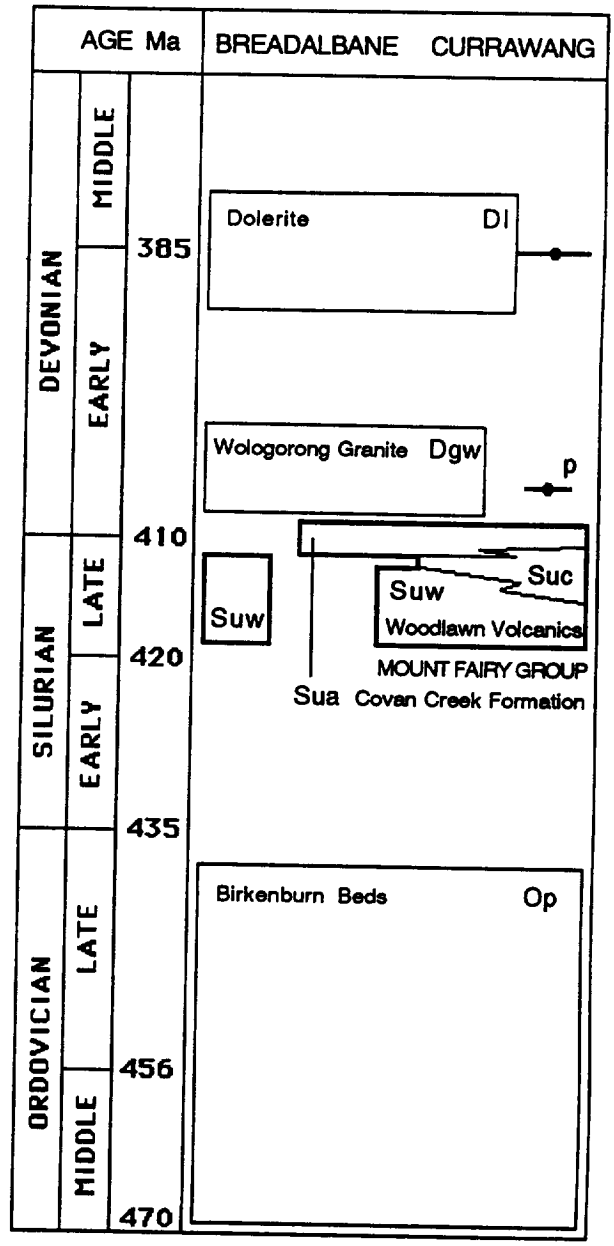


Fig. 4. *Rock relationship diagram.*

disconformable. The contact with the Covan Creek Formation is not exposed but is probably unconformable. The three sequences are broadly conformable and have the same structural history. Ordovician pyritic, graphitic, pelitic rocks are distinguished from similar rocks at the base of the Woodlawn Volcanics by their non-calcareous nature. The beds have been intruded by the Wologorong Granite which has generally concordant contacts and a metamorphic aureole. Minor dykes of the granite, broadly concordant with the granite contact occur within the metasediments up to 1km from the main intrusive body. Early Devonian dolerite dykes or sills, which intrude the granite and other units in the area, were not found within the Ordovician flysch, although a dolerite body does occur near the 'Spring Valley' along the contact with the overlying Woodlawn Volcanics.

Age: No fossils were identified during the survey, however, an Upper Ordovician age is indicated by graptolites present in cherty beds at Yarra (Offenburg, 1974). These beds are continuous with the black carbonaceous pelitic horizon which occurs at the top of the flysch sequence throughout much of the area.

Sherwin (1968) identified an early Bolidian sequence containing *Climacograptus bicornis* and *Leptograptus flaccidus arcuatus* about 30 m above a very late Eastonian unit containing *Dicanograptus hians, Dicranograptus tealei, Dicranograptus ziczac, Dicellograptus elegans, Orthograptus quadrimuscronatus* and indeterminate diplograptids.

Description: The Birkenburn Beds comprise a quartz-rich turbiditic sequence containing about equal proportions of psammitic and pelitic metasediments. The psammitic rocks are fine- to medium grained quartz-rich arenite and lesser very fine to medium-grained metaquartzite. Both rock types are thinly bedded with beds rarely up to 1 m thick. Laminated tops, graded bedding and loadcasts are common. Pelitic rocks include grey, purple and brown phyllite, silty phyllite, dark grey carbonaceous phyllite, siliceous carbonaceous slate and rare laminated to thinnly bedded brown to black chert. Fine-grained sandy laminae and thin beds with microlenticular cross bedding are interbedded with the pelites. Within the deformed contact aureole of the Wologorong Granite arenaceous and pelitic rocks are metamorphosed to, respectively, feldspar-biotite-quartz-muscovite schist and biotite-muscovite-quartz schist. Minor massive to brecciated gossanous ironstone occurs within carbonaceous pelitic-rich units and is probably a surficial oxidised product of pyritic strata at depth.

Petrographic descriptions (see Appendix 2):
biotite-quartz-muscovite schist (86842006, 86842104), chert (86842127), meta-arenite (86842109, 86842241, 86842259), metaquartzite (86842137), phyllite (86842050, 86842232)

Thickness: The thickness of the formation is difficult to determine because of the lack of marker horizons and the intensity of F_1 and F_2 folding. Where bedding dips are consistent and exposure reasonable, such as around the southern margin of the Wologorong Granite, at least 750 m can be inferred provided there is no repetition by bedding-parallel thrusts. This thickness represents a minimum as the base of the formation is not exposed. The upper 250 to 500 m of the unit is dominated by pelitic rocks, containing carbonaceous-rich strata. This horizon is present in both the Breadalbane and Currawang areas but appears to pinch out to the west around Collector. South of the area in BRAIDWOOD, a similar horizon, up to 150 m thick, containing black graptolite-bearing shale beds is differentiated as the Merigan Black Shale (Felton & Huleatt, 1977).

Remarks: The Birkenburn Beds form part of the extensive Ordovician quartz-rich turbidite deposits which occur throughout the Lachlan Fold Belt.

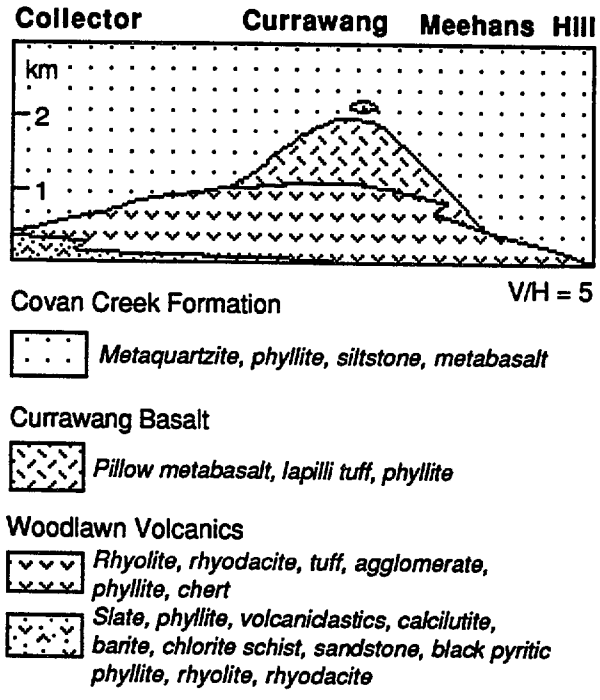
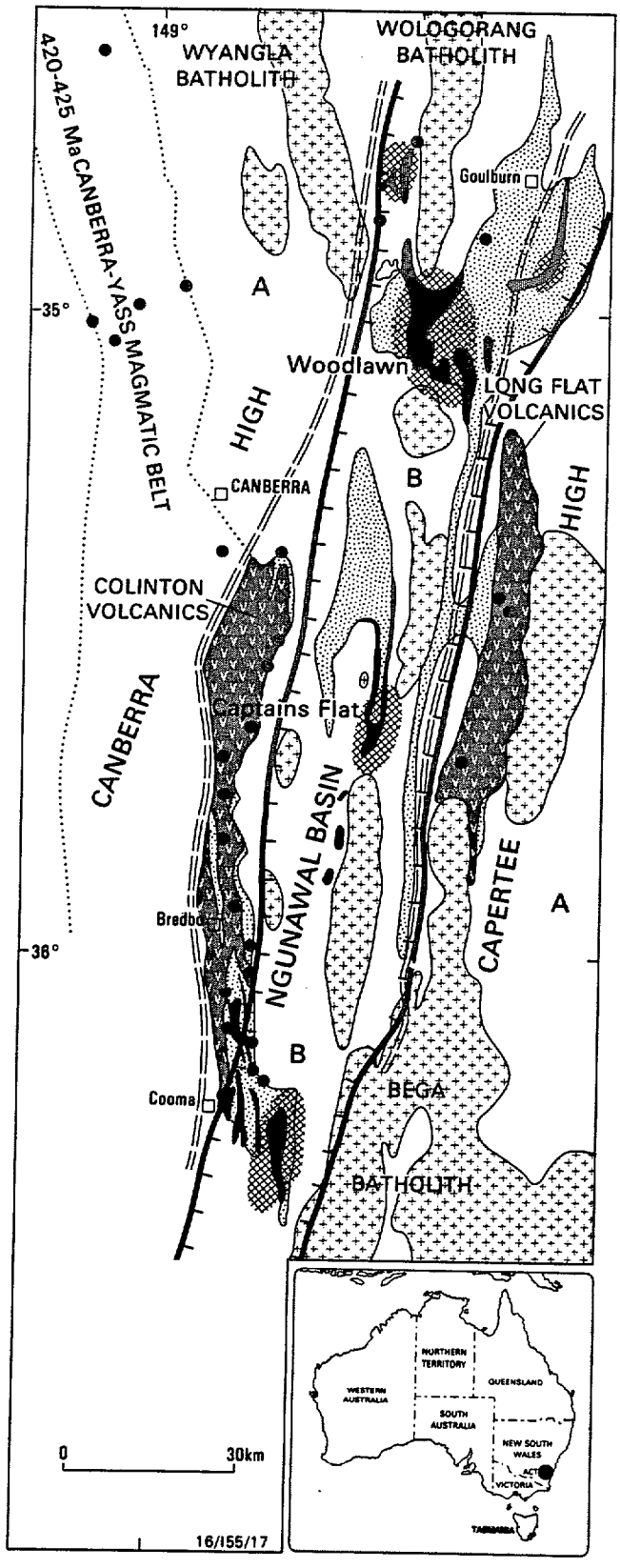


Fig. 5. *Siluro-Devonian volcanic stratigraphy*

Late Silurian to Early Devonian

Siluro-Devonian volcanics and minor sediments of the Mount Fairy Group (Felton & Huleatt, 1977) form a conformable intertonguing sequence, up to 3 km thick, diconformably overlying Ordovician sediments. Three formations are recognised in the Breadalbane -- Currawang area: the Woodlawn Volcanics, Currawang Basalt and the Covan Creek Formation. The relationship of these units is shown diagrammatically in Fig. 5. The deposits represent part of N-S elongate marine basinal sequence (the Ngunawal Basin, Fig. 6) flanked by coeval subaerial felsic volcanics (Bain & others, 1987).



Upper Silurian subaerial felsic volcanics

Upper Silurian granitoid batholiths

Upper Silurian marine sedimentary rocks

Upper Silurian marine volcanics

Submarine felsic volcanic centre

Approximate margin of Late Silurian marine basin

Strain discontinuity

A Low-strain zone

B High-strain zone

Base-metal deposits:

× Stratiform

● Vein

Fig. 6. *Geological setting of the Ngunawal Basin (after Bain & others, 1987).*

Woodlawn Volcanics (Suw)

Distribution: The northernmost parts of the Woodlawn Volcanics (Felton & Huleatt, 1977) crop out in the area, mostly in the south where it forms a discontinuous folded belt, between Collector and west of Meehans Hill, pinching out at the latter locality. The belt outlines the hinge of the shallow S-plunging Currawang Anticline. Farther to the north, in the Breadalbane area, a separate belt of volcanics, here also mapped as Woodlawn Volcanics, forms a double-plunging synform surrounded by Ordovician sediments and extending from Wet Lagoon to 2 km south of Pomeroy in the far north.

Field relationships: The formation overlies the Birkenburn Beds of Late Ordovician (early Bolindian to late Eastonian) age. The contact, intersected in a drillhole at Clara Vale prospect and exposed 200 m west of the prospect in a creek bed, is disconformable. Underlying Ordovician pyritic, graphitic, pelitic rocks are distinguished from similar rocks at the base of the Woodlawn Volcanics by their non-calcareous nature. In the south, in the hinge area of the Currawang Anticline where the formation is at its thickest, it is overlain by, and interfingers with the Currawang Basalt. The contact is not exposed. However, a diamond drillhole at Anomaly A (compilation sheet 3) passed through the contact and showed that rhyolite and tuff are intercalated with pillow basalt. Where the Currawang

Basalt is absent the Covan Creek Formation directly overlies the volcanics with apparent disconformity. The contact, largely obscured by scree shed from adjacent strike ridges of quartzite, is not exposed in the area.

Age: Shale beds within the Woodlawn Volcanics south of the area contain poorly preserved graptolites. Species identified include *Monograptus sp.* and *Monograptus bohemicus*, indicating a Middle to Late Silurian age (Strusz & Nicoll, 1973). U-Pb and Rb-Sr whole rock data on the volcanics at the Woodlawn mine give Siluro-Devonian ages of 413±6 and 409±4 Ma (Gulson, 1977).

Description: In both the Currawang and Breadalbane areas the sequence, up to 1000 m thick, comprises an upper rhyolitic volcanic unit and a lower thinner, discontinuous unit of mixed clastic, chemical and volcanilithic sediments. The lower unit is the prefered host to base metal mineralisation at both areas. Where the formation thins to about 350 m thick near Collector rock types characteristic of the lower unit predominate.

The *lower unit*, differentiated as the "Claravale Beds" by PanAust Pty Ltd is poorly exposed and is not distinguished on the accompanying map. Most information on the unit comes from drillhole data (e.g. NSW Department of Mineral Resources, 1971). In the Breadalbane Synform the unit, ranging from 150 m in the Hannan's Flat area to 300 m thick at Wet Lagoon, is either faulted off or absent from the eastern limb of the synform. It consists of interbedded chloritic schist, slate, phyllite, grey silty phyllite, siliceous phyllite, minor felsic volcaniclastics, agglomerate, laminated pyritic, baritic, exhalite beds and lenses up to 1 m thick, and rare limestone (calcilutite). Volcanilithic breccia exposed on the northwestern and southern shores of Wet Lagoon contains banded gossanous clasts, indicating imbrication of statiform sulphides. At the surface massive and brecciated ironstones are developed over pyritic and chloritic strata.

Farther to the south, in the Currawang area, the lower unit is exposed east of Collector and between Claravale and The Glen (compilation sheet 3) where it forms a discontinous horizon, up to 100 m thick, consisting of interbedded felsic tuff, agglomerate, black pyritic phyllite, shale, sericitic siliceous phyllite, fossiliferous calcilutite, calcareous siltstone, and fine-grained sandstone. Rip-up mud clasts, up to 30 cm across, are common in sandstone beds due east of Collector. Rare laminated to massive barite beds up to 2 m thick are exposed within the unit at the Clara Vale prospect where a 1 m thick greyish green calcareous chloritic tuffaceous sandstone bed, intersected in drilling, forms the base of the unit overlying Ordovician pyritic graphitic shale. About 200 m west of the prospect at GR 293316, outcrops of conglomerate, containing rounded rhyolite boulders up to 40 cm across in a poorly sorted sandy matrix, locally form the base of the unit unconformably overlying Ordovician quartz-rich greywacke. Minor lenses of fossiliferous limestone occur to the east of the prospect.

In both the Breadalbane and Currawang areas the felsic volcanics are rhyolitic to rhyodacitic in composition and include crystal tuff, lapilli tuff and agglomerate. Resorbed euhedral phenocrysts of quartz, plagioclase and rare biotite are commonly present in a recrystallised base of quartz, sericite, chlorite and carbonate.

The *upper unit*, ranging from about 500 m thick in the Breadalbane Synform to about 1000 m in the Currawang area, consists mostly of rhyolitic to rhyodacitic lavas, tuff, ignimbrite, agglomerate, volcaniclastics and minor phyllite and rare hematitic chert. The lavas and ignimbrites are typically massive, and rarely flow-banded, with abundant euhedral phenocrysts of quartz (3 to 10 mm across) and lesser kaolinised pale pink plagioclase (< 2 mm across). In the Wet Lagoon area the upper half of the unit also contains altered (chlorite and epidote) porphyritic mafic volcanics, chloritic talcose meta-tuff, ironstone and chloritic phyllitic siltstone. The ironstone is probably a surficial oxidised product of sulphide-bearing magnetite chlorite schist and breccia at depth (NSW Department of Mineral Resources, 1971).

Petrographic descriptions (see Appendix 2): hematitic chert (86842120), meta-arenite (86842250), meta-rhyolite (86842044, 86842099, 86842110), meta-lapilli tuff (86842069), medium metaquartzite (86842091), pebbly volcanilithic meta-arenite (86842141), phyllite (86842248).

Remarks: The Woodlawn Volcanics formed as subaqueous, and possibly subaerial (Gilligan & others, (1979) accumulations of felsic and rare mafic volcanic flows, and

associated epiclastic and volcaniclastic deposits. Sediments and volcaniclastics are concentrated at the base and are probably lateral equivalents of the De Drack Formation which interfingers and underlies the volcanics farther to the south (Felton & Huleatt, 1977; Gilligan & others, 1979). Ranges in thickness of the unit indicate that the main volcanic pile was centred somewhere between Currawang and Woodlawn to the south. This volcanic pile, about 20 to 25 km across, was probably continuous with a secondary pile to the north, indicated by the thickening of the volcanics in the Breadalbane area. The spatial proximity and similar geochemistry (Fig. 7) of the Woodlawn Volcanics and the Wologorong Granite indicate a probable comagmatic relationship.

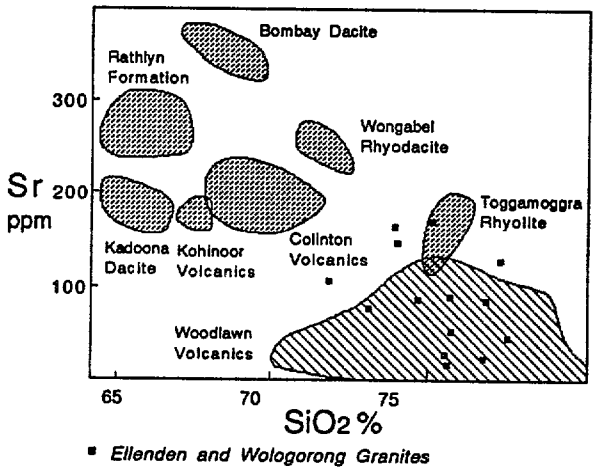


Fig. 7. *Silurian volcanic geochemistry, Sr vs SiO_2 plot (data from BMR Rockchem Database).*

Currawang Basalt (Suc)

Distribution: The Currawang Basalt (Felton & Huleatt, 1977) crops out as scattered pavements and boulders over an area of about 40 km^2 centred on Telegraph Hill in the south. Its extent in the subsurface is outlined by deep dark brown soils, distinguishing it from adjacent sandstone or felsic volcanics which have associated paler soils.

Field relationships: The basalt overlies and interfingers with the Woodlawn Volcanics. A diamond drillhole at Anomaly A showed that intercalation of pillow basalt and rhyolite occurs on a local scale at the contact (Jododex Australia Pty Ltd., 1981). The contact of the unit with the overlying Covan Creek Formation is obscured by scree, but it is probably conformable and faulted in places. Pillow basalt flows interbedded with sandstone at the base of the Covan Creek Formation, exposed 1 km southwest of the Currawang mine, indicate that basaltic volcanism was transitional with siliciclastic deposition and that the two formations may interfinger with one another. The top of the Currawang Basalt is here defined as the base of the lowermost sandstone bed. Medium-grained dolerite bodies and dykes, of probable early Devonian age, intrude the basalt. The full extent of the dolerite was not determined as the outcrop pattern and associated residual soils of both rock types could not be readily distinguished.

Age: No direct age has been determined for the unit. However, a Siluro-Devonian age is probable given its stratigraphic position between the Woodlawn Volcanics and the Covan Creek Formation.

Description: The unit consists of predominantly massive to foliated dark green meta- pillow basalt (spilite) and lesser meta-basaltic lapilli tuff and tuffaceous phyllite. Keratophyre and chert described in the formation elsewhere (e.g. Gilligan & others, 1979) were not found in the area. The metabasalt is typically porphyritic with altered plagioclase and minor clinopyroxene (altered to chlorite and epidote) phenocrysts in a groundmass of plagioclase laths and metamorphic actinolite, chlorite, sphene, epidote, quartz and minor biotite. The presence of carbonate-chlorite-epidote nodules, up to 1 mm across, indicates that some of the basalts are amygdaloidal.

Petrographic descriptions (see Appendix 2): metabasalt (86842028, 86842143, 86842170), meta-lapilli tuff (86842171).

Thickness: Estimated maximum thickness is 1000 m (Felton & Huleatt,1977). However, the lack of any bedding surfaces and its structural position within the shallow-plunging to subhorizontal hinge of the Currawang Anticline make it difficult to determine the thickness in the map area.

Remarks: The Currawang Basalt forms a lens-shaped pile of subaqueous basaltic, mainly pillowed flows and minor epiclastics intercalated with underlying felsic volcanics and overlying siliciclastic deposits. The basalt

caps the underlying broader felsic volcanic dome composed of Woodlawn Volcanics, itself forming a substantial sheet about 8 km across.

Covan Creek Formation (Sua)

Distribution: The Covan Creek Formation (Felton & Huleatt, 1977) occupies two shallow S-plunging to subhorizontal synclinoria flanking the Currawang Anticline in the south. The formation is the major ridge-forming unit in the area, forming part of the Great Dividing Range which runs along the eastern margin of the area, rising up to 250 m above the adjacent Mulwaree River floodplains. Within the ranges, psammitic rocks crop out as low strike ridges separated by less common recessive pelitic units.

Field relationships: The Covan Creek Formation overlies the Currawang Basalt, Woodlawn Volcanics and undivided Ordovician sediments. Contacts are poorly exposed, mostly being obscured by scree. Contact with the underlying Currawang Basalt is probably conformable and faulted in places. Pillow basalt flows interbedded with sandstone at the base of the Covan Creek Formation, exposed 1 km southwest of the Currawang mine, indicate that basaltic volcanism was transitional with siliciclastic deposition and that the the two formations may interfinger with one another. The base of the Covan Creek Formation is here defined as the base of the lowermost sandstone bed. The contacts with the Woodlawn Volcanics and Ordovician strata are not exposed but are interpreted here as, respectively, disconformable and unconformable. The top of the unit is not exposed and uppermost beds in the unit are faulted off against the Early Devonian Gundary Beds to the east. In the southeast numerous dolerite sills up to 300 m thick intrude the formation.

Age: The formation forms a widespread siliciclastic unit which interfingers with an underlying Siluro-Devonian mafic and felsic volcanic sequence (Currawang Basalt and Woodlawn Volcanics). South of the area, in BRAIDWOOD, the unit is unconformably overlain by the late Early Devonian Tarago Conglomerate (Felton & Huleatt, 1977). A Late Silurian to Early Devonian age is therefore probable. Possible plant fragments from BRAIDWOOD may indicate an earliest Devonian age (Sherwin, 1973).

Description: The formation consists of interbedded white, pale grey or yellowish brown , massive medium- to coarse-grained metaquartzite, metasiltstone, phyllite and minor metabasalt. Overall pelitic rocks comprise about 75% of the unit decreasing to about 50% towards the base of the unit. The metaquartzite, well exposed as blocky strike-ridges, forms beds generally 1 to 3 m thick and rarely up to 5 m thick. Graded bedding is common with the top few cms fine-grained and laminated. Quartz-veining in the metaquartzite is common and predates a penetrative foliation (S1). Pelitic rocks include laminated pale green to brown metasiltstone, silty and sandy phyllite which are interbedded with minor very fine to fine-grained metaquartzite beds up to 40 cm thick. These beds are typically graded and have laminated, and rarely, small-scale ripple cross-stratified tops. Loadcasts are also present in places. Limited measurements of assymmetrical ripples at three separate localities indicate a north to easterly directed current (Table 1).

Deeply weathered metabasalt forms a 100 m thick lens about 250 m above the base of the formation 1 km southwest of the Currawang mine. Pillow structures in the metabasalt are exposed in a roadside culvert at GR 272247. At the same horizon, about 5 km north of the previous locality, two roadside exposures about 10 m thick of deeply weathered mafic rock, probably metabasalt, occur within a dominantly phyllite/siltstone unit. The metabasalt is indistinguishable from the underlying Currawang Basalt.

TABLE 1. *Palaeocurrent data for the Covan Creek Formation*

Grid ref.	*Azimuth*
243274	052°
219293	008°
380240	113°

Petrographic descriptions (see Appendix 2): medium metaquartzite (86842018, 86842167), meta-felsic volcanic breccia (86842033), silty phyllite (86842040).

Thickness: At least 1200 m and possibly up to 2000 m of the formation are present in the area. The maximum thickness of the unit may be partially inflated owing to the presence of

less well exposed dolerite sills which may account for up to 20% of the estimate.

Remarks: The Covan Creek Formation probably formed part of a regionally extensive sheet of quartz-rich turbidites which included the correlative Carwoola Formation (Bain & others, 1987), and possibly the coeval Towrang Beds around Goulburn and the Burraga Beds around Taralga (Henry, 1978; Pickett, 1982). Deposition was probably in a shallow-marine basin (the Ngunawal Basin) below wave base. Adjacent uplifted Ordovician sediments are proposed as a source for the flysch (Bain & others, 1987).

Devonian

Wologorong Granite (Sgw)

Distribution: The southern portion of the Wologorong Granite (Garrety, 1937) is exposed in the core of the S-plunging Currawang Anticline where it forms an elongate north-south trending mass extending northwards from Rose Lagoon. Most of the granite occupies low-lying areas (~700 -- 720 m ASL) covered by Tertiary to Recent lacustrine and fluviatile sediments associated with the wetlands of the Breadalbane plains and the Wologorong and Rose Lagoons. Exposures of the granite are limited to either scattered tors on undulating rises adjacent to the Federal and Hume Highways or in erosion gullies along the western margin.

Field relationships and age: The granite has intruded and metamorphosed the Ordovician Birkenburn Beds and been itself intruded by NE and NW-trending dolerite dykes. The contact with the metasediments is concordant, sheared and dips 45° -- 80° W where exposed in erosional gullies west of of Wologorong Lagoon. Within 100 m of the contact the granite is strongly foliated with a prominent steeply-plunging mineral elongation lineation. In places quartz veins, up to 3 m wide, separate the granite from the metasediments and are themselves boudinaged and deformed with the adjacent rocks. Near the contact F_1 folds in the Ordovician rocks are isoclinally folded, locally recumbent, indicating that the granite was emplaced prior to the first deformation (mid Devonian) in the area and that the granite contact was a locus of high strain. Contact metamorphic textures in the metasediments are overprinted by the S_1 foliation which is axial planar to the F_1 folds.

Rb-Sr whole rock data for the granite yield an age of 405±11 Ma, interpreted as the probable age of emplacement (Shaw & others, 1982). Rb/Sr biotite ages, ranging between 339 and 381 Ma (Shaw & others, 1982), probably reflect partial or complete resetting during either the mid Devonian (D_1) and/or mid Carboniferous (D_2) deformations.

Description: In the area the granite ranges from massive coarse equigranular biotite leucogranite in the centre through fractured and altered granite to strongly foliated fine to coarse equigranular leucogranite at the pluton margins. Xenoliths, up to 10 m across, of meta quartz-rich arenite, not observed in natural outcrop, are exposed in a road cutting on the Hume Highway at GR 315452.

Petrographic descriptions (see Appendix 2): altered leucogranite (86842076), coarse equigranular leucogranite (86842009), foliated granite (86842218).

Remarks: Shaw and others (1982) suggested that the aluminous nature of the biotite, high quartz abundances (37.2 - 41.8%) and moderate amounts of normative corundum (mostly 1 - 2%) indicate an S-type character for the Wologorong Granite. However, high Na_2O contents of the granite are unlike other S-type granites farther to the west in the Lachlan Fold Belt and Chappell and others (1988) regarded the Wologorong Granite as probably I-type.

Unnamed intrusives

Numerous *porphyritic felsic sills*, up to 5 m thick, intrude the Ordovician metasediments around the margins of the Wologorong Granite. Minor sills also crop out near the Breadalbane iron-copper mine and in the Bangalore Creek area. The sills are poorly exposed either as scattered boulders or in erosional gullies and road cuttings. In the latter two situations the conformity of the intrusives and their pre-deformational age are clearly expressed. The sills generally have a well defined S_1 foliation and are affected by both F_1 and F_2 folds. The sills, containing quartz and plagioclase feldspar phenocrysts up to 4 mm across, are indistinguishable from rhyolite of the Woodlawn Volcanics. They probably represent subvolcanic intrusives related to the Silurian Woodlawn Volcanics

and associated with the coeval Early Devonian Wologorong Granite.

Petrographic descriptions (see Appendix 2.):
meta-rhyolite (86842105, 86842110, 86842129, 86842251, 86842262).

Dolerite intrusives are widespread in Siluro-Devonian strata and Early Devonian granite in the region. The dolerite is generally recessive and poorly exposed as isolated rounded boulders, however, its presence in the subsurface is indicated by dark reddish brown residual soils and a dark phototone.

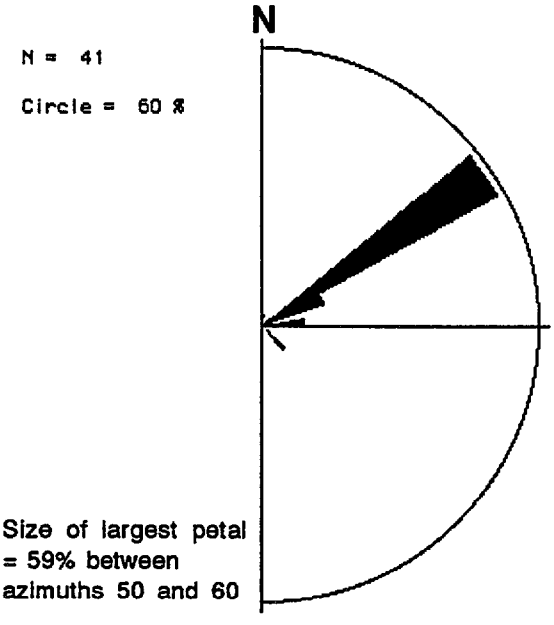


Fig. 8. *Rose diagram of dolerite dyke trends.*

Within the Wologorong Granite they are concentrated in the Wologorong Lagoon area where they occur as NW and NE-trending dyke swarms (Fig. 8). The dykes are fine-grained, up to 5 m wide with chilled margins 20 cm across, and are strongly foliated parallel to the foliation in the enclosing granite.

Within the metasediments the dolerite is mostly present as sills up to 300 m thick and is concentrated in Silurian units, in particular the Covan Creek Formation southeast of Currawang. Here the dolerite is massive and coarse-grained with ophitic augite crystals up to 1 cm across. In places the dolerite is strongly sheared and foliated parallel to the S_1 in adjacent rocks.

There are no isotopic age determinations of the dolerite, however, the dykes must be Early to Mid Devonian in age as they intrude Early Devonian granite and are pre Mid Devonian folding and metamorphism.

Petrographic descriptions (see Appendix 2.):
meta-dolerite (86842048, 86842077, 86842181).

A *kaolinised porphyritic dyke*, about 0.5 m wide, is exposed in a roadside quarry near Bangalore Creek at GR 357346. The dyke intrudes Ordovician carbonaceous phyllite, transgressing a prominent bedding-parallel S_1 foliation. The composition of the dyke is indeterminate owing to complete kaolinisation, however, paler coloured psuedomorphs of tabular feldspar, up to 1 cm across, are common. The age of the intrusion is unknown except that it post-dates the Mid Devonian deformation.

Cainozoic

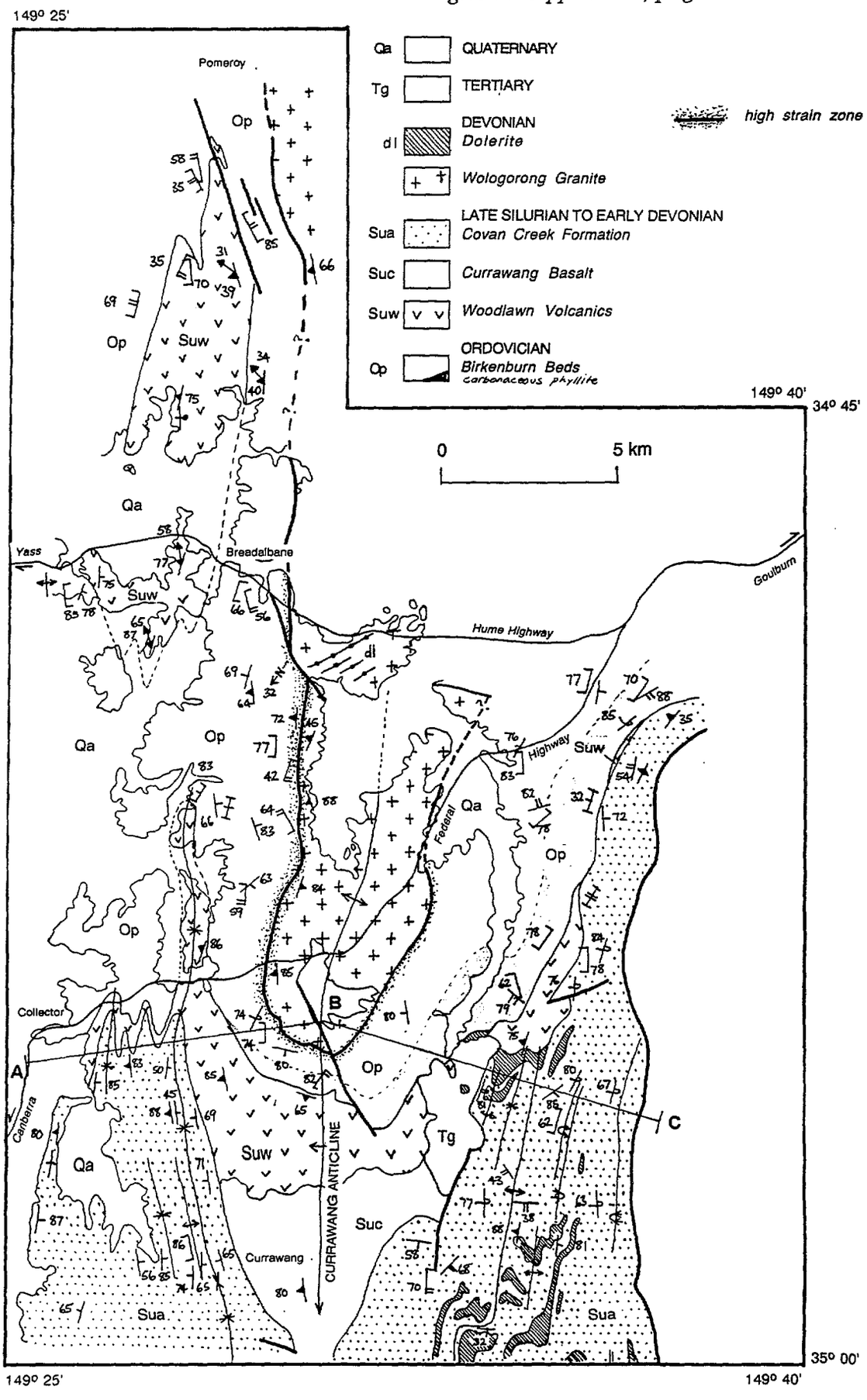
Minor surficial Tertiary deposits form remnant cappings on older rocks throughout the area and unconsolidated Quaternary deposits occupy creek beds and low-lying floodplains. No attempt was made to study these deposits in any detail, however, three units were distinguished viz. Tertiary basalt flows (Tb) and gravel deposits (Tg) and Quaternary alluvial and lacustrine deposits (Qa).

STRUCTURE

The regional structure of the Breadalbane-Currawang area is dominated by the subhorizontal to gently S-plunging Currawang Anticline. A N-S elongate foliated body of the Wologorong Granite occupies the core of the anticline and is surrounded by a high-strain zone in adjacent contact metamorphosed Ordovician sediments. Predominantly subhorizontal to S-plunging synclinoria of Siluro-Devonian metasediments and volcanics flank the anticline to the west and east. The eastern synclinorium is truncated along its eastern margin by the Mulwarree Fault. Major structures are shown in Figs. 9 & 10 and equal area stereoplots of all structural data are given in Appendix 3.

Throughout the area. Ordovician and Siluro-Devonian strata display an identical structural history, involving two major E-W compressive deformations: the first (D_1) is probably mid Devonian in age and is correlated with the Taberaberan Orogeny, the second

Fig. 9. *Structure of the Breadalbane -- Currawang area. Reference to map symbols is given in Appendix 1, page 23.*



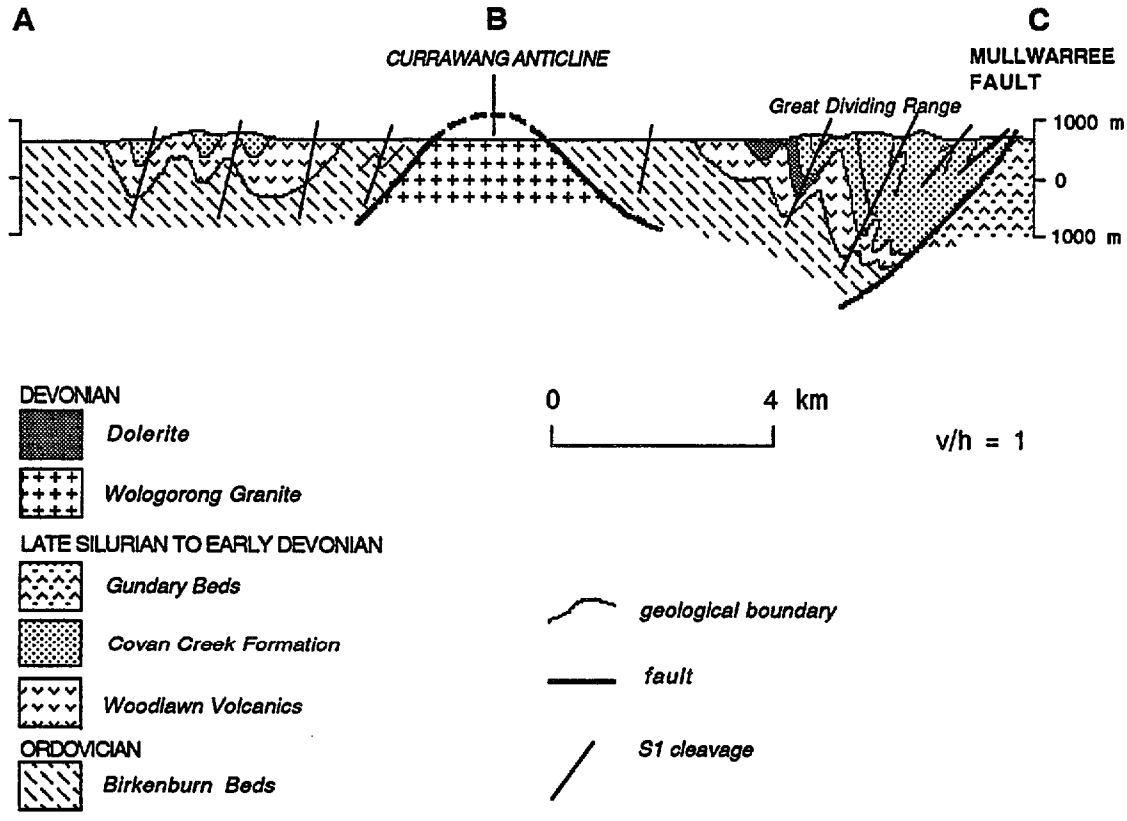


Fig. 10. *Cross section ABC.*

(D_2) may be mid-Carboniferous (i.e. Kaniblan).

The truncation of a carbonaceous pelitic unit beneath Siluro-Devonian volcanics 5 km east of Collector and its progressive deepening eastwards beneath the contact is consistent with relationships of a similar unit (the Merigan Black Shale), farther to the south in BRAIDWOOD (Felton & Huleatt, 1977), and indicates a relative regional eastward dip ofabout 5° in the Ordovician strata prior to deposition of the Siluro-Devonian volcano-sedimentary sequence. Apart from this slight angularity, there is no evidence of pre-Siluro-Devonian structures within the Ordovician rocks such as downward-facing beds or recumbent folds which occur in Ordovician flysch to the southwest in the Queanbeyan area (Stauffer & Rickard, 1966) and to the west near Jerrawa (Scheibner, 1976). The angular discontinuity between the Ordovician and Siluro-Devonian strata corresponds to a hiatus in deposition and a change from deep-water to shallow-marine, and possibly subaerial environments. There is no evidence to suggest emergence of Ordovician strata during this interval.

Middle Devonian folding

Folding accompanied greenschist facies metamorphism during the oldest and most intense deformation (D_1), forming the predominant structural fabric in rocks in the region. F_1 folds which are tight to isoclinal, rarely open, and mostly plunging to the south, form the prominent mesoscopic and map-scale (wavelengths of 0.5 to 1 km) folds. The folds are typically steeply inclined with subhorizontal to moderate plunges. A penetrative cleavage (S_1) is axial plane to the folds and is present as either a slaty cleavage or schistosity in pelitic units and as either a spaced cleavage or foliation in psammitic rocks. Regionally the cleavage trends due north dipping 70° to 80° to the west (Appendix 3.). Dips are subvertical west of the Currawang Anticline and generally shallow (west-dipping) progressively towards the east approaching the Mulwaree Fault where F_1 folds are overturned (Fig. 10). Quartz veins are typically boudinaged and clasts in volcaniclastic sediments are flattened within the S_1 surface. Except for the Covan Creek Formation, a steeply pitching stretching lineation, corresponding to a mineral

elongation and quartz-rodding is commonly present on the S_1 surface.

The S_1 surface is the main penetrative fabric formed during lower to upper greenschist facies regional metamorphism. In clastic and felsic igneous rocks the surface is defined by aligned biotite, chlorite and muscovite folia whereas in mafic rocks it forms anastomosing zones of foliated chlorite, biotite, fibrous actinolite and epidote. Quartz phenocrysts in felsic volcanics and pre-existing quartz veins in other rocks are recrystallised into finer-grained unstrained polygonal lenses and stringers imparting some compositional differentiation character and enhancing definition of the foliation.

Fig. 11. *Photomicrograph of deformed cordierite porphyroblasts within the contact aureole of the Wologorong Granite.*

A high-strain zone, about 1 km wide at the surface, extends around the entire margin of the Wologorong Granite in the area. Within a 100 m of the contact with Ordovician metasediments the margins of the granite are strongly foliated with a prominent steeply-plunging mineral elongation lineation. This foliation and lineation are concordant with the S_1 cleavage (Appendix 2). Boudinaged quartz veins, up to 3 m wide, are common at the contact and in the metasediments. Within metasediments F_1 fold hinges and S_0/S_1 intersection lineations subparallel the E-W steeply plunging mineral elongation lineation (Appendix 3) suggesting rotation of F_1 folds within the high-strain zone parallel to the transport direction indicated by the lineation. The concordant granite contact probably provided a locus for the high-strain zone which developed as a decollement during folding. The presence of deformed hornfels adjacent to the granite (Fig. 11) and the lack of stratigraphic repetition indicates that major thrusting was not involved.

The age of the D_1 deformation is probably Middle Devonian. In the area it affects all units including Siluro-Devonian strata, Early Devonian Wologorong Granite and dolerite intrusions. Farther to the south in BRAIDWOOD the deformation also affects the Early-Middle Devonian Mulwaree Group (Henry, 1978). Although this group rests on older rocks with a marked unconformity (Felton & Huleatt , 1977), the S_1 cleavage is axial planar to asymmetrical overturned folds typical of the deformation in the older units (Henry, 1978). Similar lower greenschist facies assemblages are present in both the Mulwaree Group and underlying Ordovician, Silurian and Devonian strata (Henry, 1978). These relationships are consistent with Middle Devonian ages for the deformation indicated by Rb-Sr isotopic dating of S_1 biotite (374±3 Ma) and total rock and sericite K-Ar dates of between 370 Ma and 380 Ma in meta-volcaniclastic rocks of the Kohinoor Volcanics near Captains Flat (unpublished AMDEL Reports; G 6433/86 & G 6695/86). In the same area the Gourock Granodiorite yields partly reset ages of 373 ± 6 Ma (K-Ar biotite) and 380 ± 6 Ma (biotite-whole-rock Rb-Sr isochron) (Wyborn & Owen, 1986).

Mid Carboniferous upright folding

A second regional deformation (D_2), characterised by broad regional anticlinoria and synclinoria, with localised more intensely folded zones, affected all units in the area. The Currawang Anticline, and possibly the adjacent synclinorial zones east of Collector and in the Covan Creek area are regional F_2 structures (Figs. 9 & 10). A subvertical north-trending cleavage (S_2), axial plane to mesoscopic F_2 folds, is widely developed particularly in the hinge zone of the Currawang Anticline and in the Breadalbane area. In these areas the cleavage forms either a fine crenulation in pelitic rocks or a spaced cleavage in psammitic rocks. Elsewhere the cleavage is a less well developed non-

penetrative spaced cleavage. Both the foliation in the granite and the S_1 cleavage in metasediments and volcanics are refolded by S_2 producing upright open to tight and rarely isoclinal gently-plunging folds. Along the western margin of the Wologorong Granite where F_2 folds are tight to isoclinal, F_1 folds are locally refolded into recumbent orientations. No metamorphic mineral growth is associated with S_2. Foliated micas, defining S_1, are either deformed by S_2 or rotated parallel to S_2.

The age of F_2 folding is not constrained in the area. However, folding probably occurred during the mid Carboniferous E-W compression event which produced the adjacent Cookbundoon Syncline (Fergusson, 1991) and meridional folds throughout the eastern and northeastern part of the Lachlan Fold Belt (Powell & Veevers, 1984).

Kinking and faulting

Minor kinks, a SW gently-dipping set and a more steeply dipping NE-trending set, are present in both Ordovician and Siluro-Devonian rocks. However, only the former set is present in the Siluro-Devonian rocks. Both kink orientations (Appendix 2) correspond to dolerite dyke trends (Fig. 8) and the NW-trending kinks also parallel minor faults in the region. Where displacement can be ascertained the faults show a component of sinistral strike-slip displacement.

The timing of kinking and possibly associated faulting is poorly constrained. Both postdate S_1 and the relationship with S_2 is unknown. They are possibly late D_1 or D_2 in age.

ECONOMIC GEOLOGY

Minor amounts of copper, zinc, silver, gold, lead and iron are the only metals that have been produced from the Breadalbane -- Currawang area. However, numerous base metal prospects are located in the region and continue to be investigated. Gold, limestone, and barite occurrences have been investigated by exploration companies, mostly in the case of the latter, for possible associated base metals.

Since the late 1960's exploration companies have been active in the area searching principally for volcanogenic Cu-Pb-Zn massive sulphide deposits similar to those of Captains Flat and Woodlawn deposits farther to the south. The surveys have included: stream sediment, soil and rock chip geochemistry (Cu, Pb, Zn, Ag, Au, Ni, & Ba): aeromagnetics; airborne EM; geological mapping; ground geophysical surveys; auger and diamond drilling. Several prospects have been located and, recently, economic mineralisation has been delineated at Currawang. Reports of these surveys are held by the NSW Department of Mineral Resources, Sydney.

The location of all mines and prospects is shown on the accompanying compilation sheets 3 & 4 and in Fig. 12.

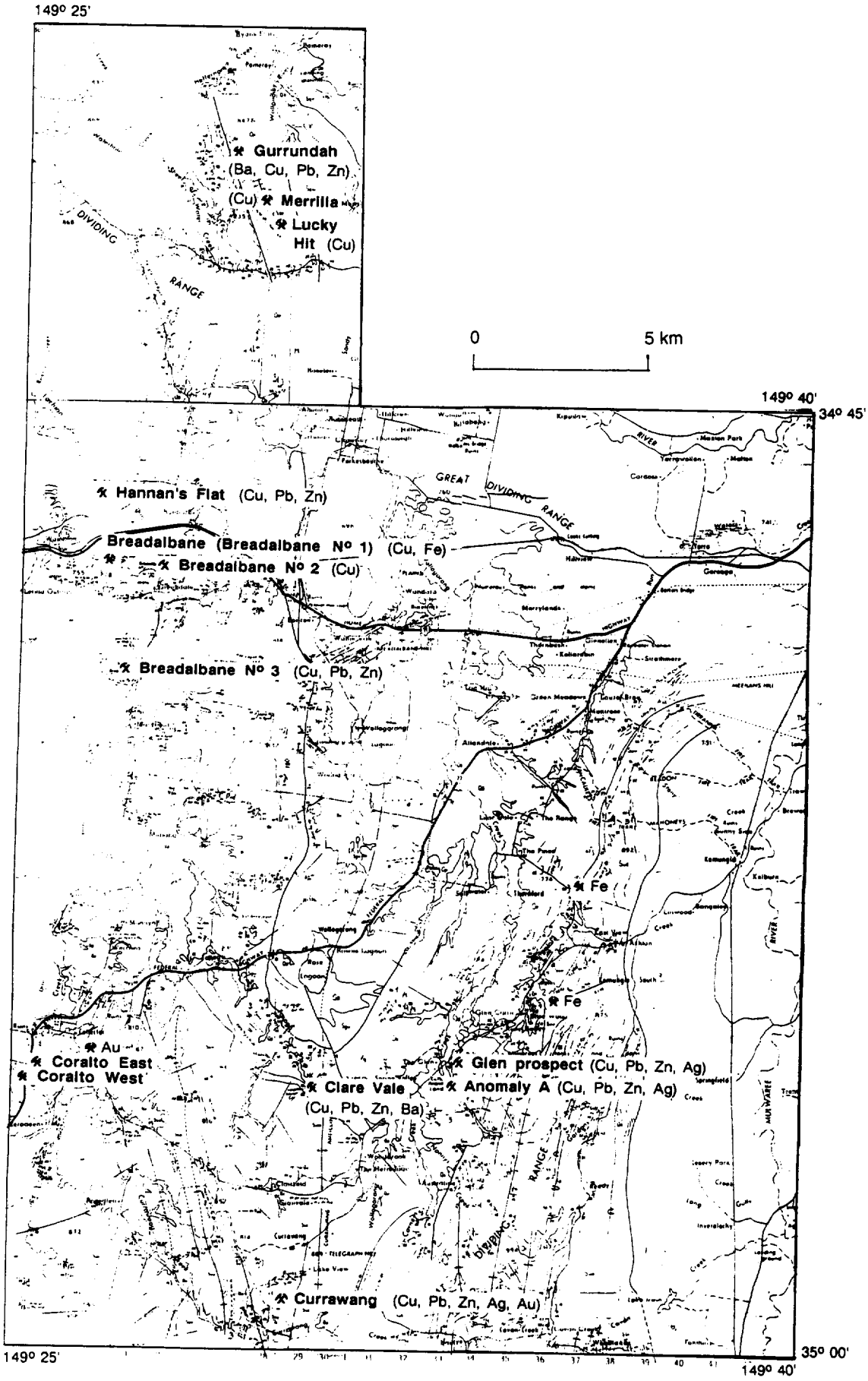
Breadalbane area

An iron mine, two copper mines, and numerous base metal prospects are located in a N-trending synform (the Breadalbane Synform) of Woodlawn Volcanics situated midway between Cullerin and Breadalbane. The only producers in the area were the Breadalbane iron and copper mine and the Lucky Hit-Merrilla copper mines. Exploration efforts in the area since 1968 have resulted in numerous discoveries of subeconomic base metal sulphide mineralisation. Several of these are currently being investigated by Pan Australia Mining Ltd. Recent diamond drilling at Wet Lagoon intersected subeconomic stringer sulphide mineralisation within agglomerate (Pan Australia Ltd., 1984). Other base metal prospects include: Breadalbane N°'s 1, 2 and 3: Hannan's Flat, Bohara, Gurrundah barite occurrence and Ridge. No published information or Open File reports are available on the location and geology of the Wet Lagoon, Bohara and Ridge prospects.

Breadalbane iron -- copper mine

Iron and copper were produced from two separate adjacent lodes at Breadalbane. The principal iron orebody was worked between 1918 and 1929 for a production of about 50 000 t of iron ore. A smaller lode along strike to the north, known as Lal Lal or Hannan's iron mine produced a small unrecorded amount of ore (Geological Survey of NSW, 1940). The copper orebody which adjoins the principal iron ore deposit has been known at various times as *Breadalbane, Cullerin*, and *Mountain copper mine*. The mine was worked

Fig. 12. *Mineral occurrences in the Breadalbane - Currawang area.*



in 1885 (Carne, 1908), with about 2 000 t of ore produced between 1906 and 1917.

Iron lodes: Both iron orebodies were exposed as prominent strike ridges which have largely been removed by open cut mining. The largest body formed a lens 243 m long by 44 m wide and was mined to a depth of 15 m. The lodes strike a few degrees west of north and dip steeply to the east. They consist of either a hard dense banded limonite ore or micaceous hematite (Geological Survey of NSW, 1940). A crosscut in the adjoining copper mine intersected the main lode at a depth of about 30 m where it was strongly pyritic (Carne, 1908).

The copper lode : The copper lode, up to 2.4 m wide, parallels the iron lodes about 20 m farther to the east. Workings included two underlay shafts, one up to 72 m deep with a 10 m crosscut at 30 m depth, and a vertical shaft. Most of the ore was in the near surface oxidised zone where it consisted of iron oxides, chlorite and copper carbonate. Below 30 m the ore was pyritic and contained chalcopyrite (Carne, 1908). The lode was worked to depths of 46 m where it was composed of magnetite, chlorite, talc, pyrite, chalcopyrite and assayed almost 3% Cu (NSW Department of Mineral Resources, 1971).

Breadalbane N° 1 prospect

In 1971 geochemical sampling of the ironstone lodes in the main opencut and gossans exposed in the adjacent haulways yielded, respectively, anomalous Cu, and Cu, Pb, & Zn values. A magnetometer survey over the iron and copper workings outlined a coincident E-dipping magnetic anomaly. Four drillholes by the NSW Department of Mineral Resources for Continental Explorations Ltd., designed to test the anomalies, failed to intersect economic mineralisation (NSW Department of Mineral Resources, 1971). The best intersections were 0.17% Cu over 48 m, and 0.24% Cu over 35.7 m. The drilling showed that the primary source of the residual oxide lodes was either magnetite-chlorite schist or breccia containing variable amounts of talc, pyrite and chalcopyrite. The schist and breccia occur within a sequence of sericite-chlorite schist, sandstone, tuffaceous sandstone, agglomerate, and slate containing minor concordant veinlets of pyrite and trace amounts of sphalerite and chalcopyrite.

Breadalbane N° 2 prospect

Two ironstone pods about 100 m apart are exposed on alluvial flats about 1.5 km east of the Breadalbane iron mine. Gravity and magnetic surveys over the outcrops defined a strong magnetic anomaly interpreted as a pipe-shaped source approximately 70 m in diameter at 30 to 45 m depth with a mass between 600 000 and 1 000 000 t.

In 1970-71 five drillholes put down by the NSW Department of Mineral Resources for Continental Exploration Ltd. showed that the source of the geophysical anomaly was at least two zones of mineralisation consisting of pyrite - pyrrhotite - chalcopyrite - bearing magnetite-chlorite schist and breccia (NSW Department of Mineral Resources, 1970a). The zones occur within a sequence of laminated and cleaved fine- to medium-grained, sericitic, chloritic and talcose tuffs, and minor porphyritic felsic volcanics. In places the magnetite-chlorite rocks grade into rocks interpreted as altered (chlorite-epidote) porphyritic mafic volcanics. The drillholes intersected significant mineralised sections varying in depth between 60 and 120 m below the surface. The best intersections were 12.2 m of 1.15% Cu and 1.5 m of 8% Cu.

Breadalbane N° 3 prospect

Isolated low rubbly outcrops of gossan are exposed about 3 km south of the Breadalbane mine. Investigations in 1970 showed coincident SP and soil geochemical (Cu & Zn) anomalies which were tested by diamond drilling. Three holes were drilled and showed that pyritic tuffaceous sediments containing traces of sphalerite, chalcopyrite and galena were the source of the anomalies (NSW Department of Mineral Resources, 1970b). The sulphides were either disseminated or concentrated in veinlets and breccia zones. The sulphide-bearing sediments were interbedded with sericite schist, slate, feldspathic sandstone and siltstone.

Hannan's Flat area

In the early 1970's soil geochemical (Cu, Pb, Zn), magnetometer and IP surveys by Continental Exploration Ltd., located several anomalies on the plains 1 to 2 km north of the Breadalbane mine. Follow-up diamond drilling intersected a massive sulphide lode, up

to 10 m wide and possibly continuous over 550 m long, consisting mainly of magnetite, pyrite and pyrrhotite. The lode is associated with brecciation and faulting and is thought to be epigenetic (Continental Exploration Pty Ltd., 1974).

Locally the base of the Silurian sequence consists of 10 m of limestone overlain by 150 m of grey chloritic shale which in turn is overlain by massive felsic volcanics and volcaniclastics. Two zones of low-grade mineralisation, consisting chiefly of pyrite with chalcopyrite, sphalerite and galena were found in the grey shale sequence in several drillholes. The sulphides occur in bands parallel with bedding and are folded with the enclosing rocks. Irregular patches, streaks and veinlets of sulphides probably represent remobilised portions of an original syngenetic concentration represented by the banded sulphides (Continental Exploration Pty Ltd., 1974).

Lucky Hit - Merrilla mines

In the Pomeroy area, north of Breadalbane, several copper-bearing shear zones were worked between 1905 and 1919 for a total production of 202 t Cu from ore averaging 8% Cu and 127 t Cu-Pb ore at the, respectively, Lucky Hit and Merrilla mines (Felton, 1975). Although the lodes have been recently investigated no published information or Open File reports are available. Recent work involved extensive costeaning and older workings include an open cut, shafts and extensive underground development, along two major *en echelon* shear zones about 150 m apart, over a 1 km length. At Lucky Hit two parallel lodes, the Main and East lodes, about 25 m apart, were worked over strike lengths of, respectively, 160 m and 80 m. The shear zones subparallel bedding surfaces and a penetrative S_1 cleavage, trending NW and dipping steeply to the SW, within interbedded mica schist, phyllite and meta quartz-rich arenite. The metasediments lie within the deformed contact aureole of the Wologorong Granite and are here interpreted as part of the Ordovician Birkenburn Beds, not the Silurian-Devonian volcanic-sedimentary sequence as previously interpreted (e.g. Felton, 1975; Gilligan, 1974).

The ore consisted of a primary banded sulphide ore of pyrite and chalcopyrite with secondary malachite, native copper, azurite, cuprite, chalcocite, melancorite and ?tenorite within 3 m wide quartz veins filling shear zones (Felton, 1975). Galena also occurs within the ore mined at Merrilla and Pb-Zn mineralisation was intesected in diamond drillholes at the Lucky Hit mine (Gilligan, 1974). The mineralisation may represent vein deposits either remobilised from originally syngenetic concentrations in the nearby basal Siluro-Devonian Woodlawn Volcanics, which is the host to base metal mineralisation in the region, or associated with intrusion of the Wologorong Granite.

Gurrundah barite prospect

About 1 km north of the Lucky Hit - Merrilla lodes barite outcrops within the Silurian volcanic sequence have been tested for near surface potential and in the subsurface for base metals associated with nearby gossans. In 1983 Newmont carried out geological mapping, stream sediment and soil geochemistry, EMP surveys, and percussion and diamond drilling. Subeconomic grades and thicknesses of Cu-Pb-Zn mineralisation were intersected, however, the geophysical surveys failed to show a continuation of sulphides at depth. No further work has been done on the prospect (Newmont Holdings Pty Ltd., 1983).

The drilling showed that the barite occurs in laminated pyritic exhalative horizons within a metasedimentary sequence of quartzite, micaceous sandstone, laminated slates and minor tuffaceous sediments, chloritic felsic volcanics and rare limestone. The sequence is at the base of the Woodlawn Volcanics and is probably a lateral equivalent of the mineralised horizon farther south at Hannan's Flat.

Currawang area

The Currawang mine and several base metal prospects in the vicinity are located within volcanic-sedimentary sequences in either the Woodlawn Volcanics or the Currawang Basalt. The sequences crop out in the hinge of the gently S-plunging Currawang Anticline. The Currawang mine was the only producer in the area accounting for 1048.5 t Cu.

Currawang copper mine

Cu-Pb-Zn-Ag-Au mineralisation occurs at Currawang about 1.8 km SW of Telegraph Hill within sheared basaltic tuff, flows and

intercalated fine-grained clastic sediments of the Currawang Basalt. The mine was worked intermittently between 1866 and 1871 by open cut and shafts up to 70 m deep (Felton, 1975). Surface workings extend over 110 m along a NW-trending shear zone, up to 8 m wide, dipping steeply to the SW. The ore, averaging 12% Cu (Felton, 1975), comprises fine-grained and banded sphalerite and pyrite with lesser galena, chalcopyrite, arsenopyrite, pyrrhotite, tetrahedrite, tenantite, magnetite, chalcocite and covellite, and typically occurs within the sheared chloritic and talcose host rock matrix or along shear surfaces (Felton, 1975; Gilligan, 1974). Investigations of the mine during the 1970's included soil geochemistry, diamond drilling and IP, magnetic, and SP surveys (Felton, 1975). In 1989 a drilling program delineated a 530 000 t orebody centred about 800 m east of the old workings; underground operations commenced in 1990. The orebody, containing 2.5% Cu, 3.92% Pb, 12.98% Zn, 75 gm/t Ag and 0.25 gm/t Au (Denehurst, 1991), is subvertical and tabular in shape about 150 m long, 200 m deep and up to 25 m wide (M. Bouffler, Woodlawn Mines, Denehurst Ltd. pers comm, Feb. 1992).

Gilligan (1974) suggests that the mineralisation at Currawang may have been derived from fumerolic activity associated with felsic volcanism (Woodlawn Volcanics) and that subsequent deformation has remobilised the mineralisation into shear zones. The shear zone crosscuts S_1 in the host rocks and parallels other minor faults in the region which show a component of sinistral strike-slip displacement. The age of this faulting is indeterminate but is probably either late D_1 (mid Devonian) or D_2 (mid Carboniferous) in age.

Clare Vale prospect

Barite was discovered at the base of the Woodlawn Volcanics near Clare Vale by Hastings Exploration N.L. in 1970. Between 1971 and 1975 Jododex Australia Pty Ltd. carried out detailed geological mapping, soil geochemistry (Cu, Pb, Zn & Ba), geophysical surveys (IP dipole-dipole & self potential) and diamond drilling. The soil geochemical survey yielded no significant anomalies with values up to 150 ppm Cu, 90 ppm Pb, and 240 ppm Zn in the vicinity of the barite occurrence. Anomalous geophysical responses were all attributed to either black shales or cultural features such as fences (Jododex Australia Pty Ltd., 1975).

Five percussion holes (with a short bottom diamond core) totalling 168 m were drilled in an attempt to obtain additional geochemical and stratigraphic information. The holes intersected felsic to intermediate tuffs and flows interbedded with fine-grained sediments. Barite in association with disseminated pyrite occurs as disseminated blebs, veinlets, and massive pods in bedding-parallel bands within the sediments. No base metal sulphides were found.

Two diamond drillholes designed to test mild geochemical/geophysical anomalies failed to intersect mineralisation. One hole passed through interlayered crystal tuff, lapilli tuff, agglomerate and calcilutite of the Woodlawn Volcanics and bottomed in Ordovician graphitic shale. The other intersected only Ordovician black graphitic shale.

Glen prospect

Systematic stream sediment and soil geochemical surveys by Samedan between 1977 and 1979 delineated a number of significant Cu-Pb-Zn anomalies in the vicinity of the Glen property. Seven diamond drillholes placed on the most significant of these (the Glen prospect) intersected sulphide mineralisation. The best intersection was 10.46 m averaging 0.37% Cu, 1.27% Pb, 2.11% Zn and 5 ppm Ag. Another two holes were drilled by Jododex in 1979/80 and intersected 7.5 m averaging 0.47% Cu, 1.58% Pb, 2.23% Zn and 7 ppm Ag. The base metal sulphides occur as stringers in an interbedded sequence of crystal tuff, lapilli tuff, agglomerate, black pyritic mudstone, shale and fine-grained sandstone (Jododex Australia Pty Ltd., 1981).

Anomaly A

During the later half of 1980 an airborne EM survey carried out for Jododex over the Glen prospect area delineated anomolous zones. Follow-up geochemical and ground EM surveys located a 500 m long and 200 m wide anomaly (Anomaly A) about 1 km south of the Glen prospect. Four diamond drillholes put down to test the anomaly failed to intersect significant base metal mineralisation (Jododex Australia Pty Ltd., 1981). The highest assay

from a 2 m interval was 390 ppm Cu, 0.18% Pb, 0.38% Zn and 13 ppm Ag.

The mineralisation at both the Glen prospect and Anomaly A occurs mostly in a cherty tuff-shale sequence separating an underlying felsic volcanic sequence (rhyolite, coarse-grained felsic tuff, fine-grained volcaniclastics and shale) to the west from a more mafic volcanic and volcaniclastic sequence to the east (pillow basalt, dolerite and rhyolite). The sulphide mineralisation, consisting of sphalerite, galena, and chalcopyrite is fine-grained in the fine-grained sediments and volcaniclastics and forms streaks and S_1-parallel veinlets in coarser rocks. Whole rock geochemistry of core samples indicated only weak alteration and alkali depletion within or close to mineralised zones (Jododex Australia Pty Ltd., 1981).

Other prospects

Coralto East and West Anomalies

Following an airborne magnetometer survey two anomalies about 1 km south of Collector were followed up by detailed ground magnetometer and IP surveys. A diamond drillhole put down on each anomaly (the Coralto East and West Anomalies) terminated in interbedded Ordovician sandstone and siltstone beneath, respectively, 35 to 50 m of Cainozoic alluvium. No mineralisation was detected and magnetic gravel in the overburden was considered to be the source of the magnetic anomalies (North Broken Hill Ltd., 1978).

Bangalore Creek area

Follow-up soil sampling by Jododex of stream sediment geochemical anomalies in the Bangalore Creek area located by Samedan obtained values up to 130 ppm Cu, 480 ppm Pb and 350 ppm Zn over Ordovician black shales north of the quarry on the west side of the creek and farther to the north about 3 km east of the Federal/Hume Highway junction (Jododex Australia Pty Ltd., 1980). The anomalies were not considered significant and no further work was carried out.

Minor iron deposits

A number of discontinuous ironstone lenses, extending over about 1 000 m at *McCauleys prospect* (also referred to as *South Komungla*) are exposed between Bangalore Creek and the Maxville property. The ironstones consist of concretionary limonite with abundant slate fragments (Geological Survey of NSW, 1940). They are developed over limestone lenses at the base of the Woodlawn Volcanics separating underlying Ordovician carbonaceous black slates to the west from foliated rhyolite to the east. Of the estimated 20 000 t present one truckload of ore was produced in 1902.

Several small iron deposits are shown on the Goulburn 1:250 000 Metallogenic map in the Bangalore Creek area but were not investigated during the current survey. The largest of these was estimated to contain 20 000 t of ore (Geological Survey of NSW, 1940). The deposits probably represent surficial limonitic cappings developed over Ordovician and Silurian iron-rich beds and limestone.

Gold

An easterly dipping, N-trending quartz vein within slate and quartzite of the Covan Creek Formation, has been worked for gold about 2 km southeast of Collector. There is no record of production or when development took place (Felton, 1975).

CONCLUSIONS

The Breadalbane -- Currawang area lies in the central part of the Captains Flat -- Goulburn Synclinorial Zone (Scheibner, 1985) comprising a thick sequence of Ordovician metasediments disconformably overlain by a 3 km thick conformable intertonguing sequence of Siluro-Devonian volcanics and minor sediments. Three Siluro-Devonian formations are recognised: the Woodlawn Volcanics; Currawang Basalt; and the Covan Creek Formation. The distribution and internal stratigraphy of these formations has been reinterpreted from previous work. Rather than froming a continous belt between the Breadalbane and Currawang areas, as shown on published maps of the area (e.g. Felton, 1974), two distinct volcanic piles are distinguished. These piles represent part of a deformed marine basinal sequence (the Ngunawal Basin) flanked by coeval subaerial felsic volcanics (Bain & others, 1987). Intrusive rocks include the Early Devonian Wologorong Granite and minor bodies of rhyolite and dolerite. The truncation of an

Ordovician carbonaceous pelitic unit beneath Siluro-Devonian rocks indicates a relative regional eastward dip of about 5^{0} in the Ordovician strata prior to deposition of the Siluro - Devonian volcano - sedimentary sequence. Apart from this slight angularity, there is no evidence of pre-Siluro-Devonian structures within the Ordovician rocks.

Ordovician rocks together with Siluro-Devonian strata, granite and minor rhyolite and dolerite intrusives, were deformed during two major E-W compressive deformations: the first (D_1) is probably mid Devonian in age and is correlated with the Taberaberan Orogeny, the second (D_2) may be mid-Carboniferous (i.e. Kaniblan). Lower to upper greenschist facies metamorphism accompanied the first of the two deformations both of which involved upright folding about N-trending axes. The regional structure of the Breadalbane-Currawang area is dominated by the subhorizontal to gently S-plunging Currawang Anticline formed during D_2. A N-S elongate intrusive and tectonised body of the Wologorong Granite occupies the core of this anticline and is surrounded by a previously unrecognised D_1 high-strain zone in adjacent contact metamorphosed Ordovician sediments.

Minor amounts of copper, zinc, lead, silver, gold and iron are the only metals that have been produced from the area. Gold, limestone, and barite occurrences have been investigated, mostly in the case of the latter, for possible associated base metals. Most base metal mineralisation in the Currawang--Breadalbane area represents deformed volcanogenic-hosted massive sulphide accumulations of the Captains Flat-Woodlawn-type. Mineralisation is contained largely within sediments and volcaniclastics at the base of the Woodlawn Volcanics and occurs within the two main volcanic piles centred between Currawang and Woodlawn and in the Breadalbane area. The basal rocks may be lateral equivalents of the De Drack Formation which interfingers and underlies the volcanics farther to the south (Gilligan & others, 1977). Where base metal mineralisation is not hosted by the Woodlawn Volcanics, such as at the Lucky Hit-Merrilla and Currawang mines, it occurs in close proximity to the volcanics within shear zones and possibly represents remobilised sulphides derived from originally syngenetic concentrations associated with the nearby felsic volcanics.

ACKNOWLEDGEMENTS

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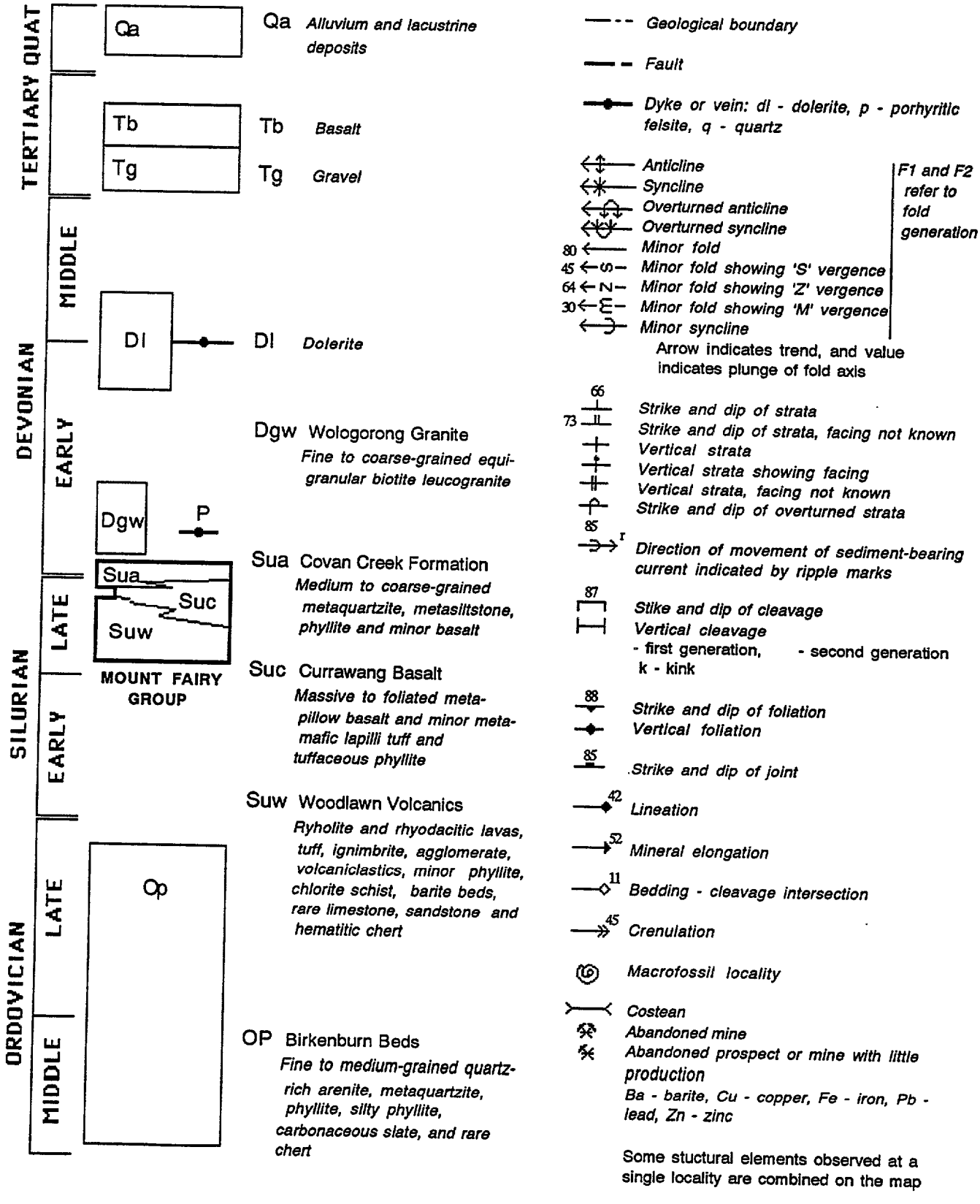
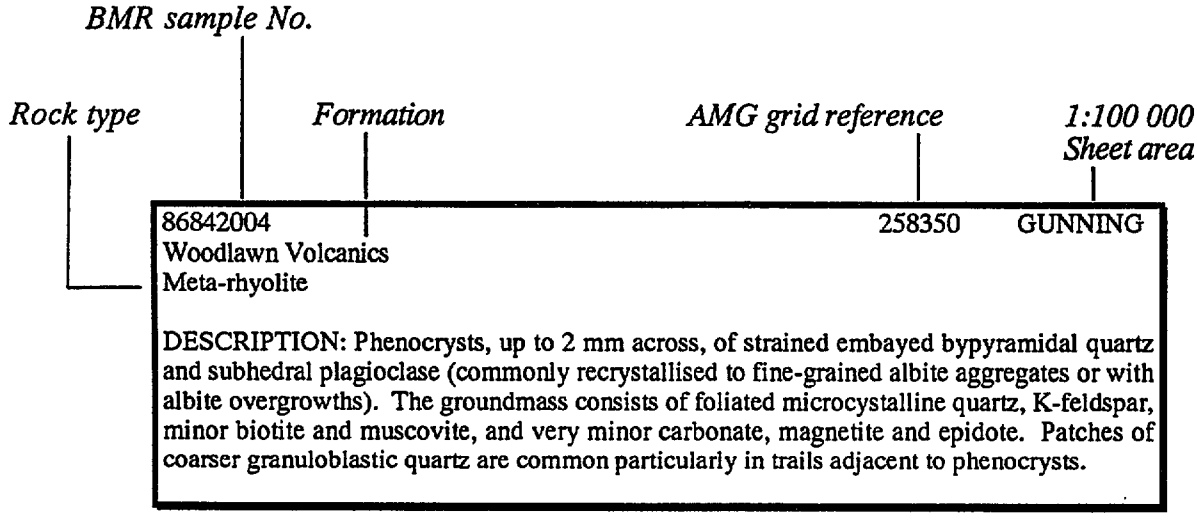
APPENDIX 1. REFERENCE TO COMPILATION SHEETS 3 AND 4



APPENDIX 2. PETROGRAPHIC DESCRIPTIONS



86842004 258350 GUNNING
Woodlawn Volcanics
Meta-rhyolite

DESCRIPTION: Phenocrysts, up to 2 mm across, of strained embayed bypyramidal quartz and subhedral plagioclase (commonly recrystallised to fine-grained albite aggregates or with albite overgrowths). The groundmass consists of foliated microcystalline quartz, K-feldspar, minor biotite and muscovite, and very minor carbonate, magnetite and epidote. Patches of coarser granuloblastic quartz are common particularly in trails adjacent to phenocrysts.

86842006 275352 GUNNING
Birkenburn Beds
Plagioclase-biotite-quartz-muscovite schist

DESCRIPTION: Strongly foliated muscovite and biotite-rich bands alternating with muscovite-biotite bands containg lenses of quartz and minor fine to medium-grained subangular quartz and plagioclase grains. These grains, located mostly in the quartz lenses, are pre-foliation (S_1) and are probably detrital. Lensoidal iron oxide stained patches (0.5mm long) in mica-rich bands are possibly after pre-S_1 cordierite (contact metamorphic). Compositional banding is parallel to S_1 foliation. Fine wavy crenulation at a high angle to S_1 deforms S_1 minerals and locally forms a spaced cleavage only developed in mica-rich bands. The schist is probably a highly strained and metamorphosed pelitic rock containg bands of fine to medium feldspathic arenite.

86842009 325395 GOULBURN
Wologorong Granite
Coarse equigranular leucogranite

DESCRIPTION: Strained coarse grained equigranular anhedral microperthitic microcline, quartz, and minor plagioclase (cores are altered to muscovite and epidote) and biotite (<3%). Biotite grains are commonly deformed and altered to chlorite, epidote and white mica. Most grain boundaries between quartz and feldspar are sutured and marked by fine-grained recrystallised polygonal grains with minor metamorphic muscovite and epidote in places. Swapped rims between adjoining K-feldspar grains are also common.

86842018 231322 GUNNING
Covan Creek Formation
Medium quartzite

DESCRIPTION: Recrystallised and strained, poorly sorted, fine to medium-grained quartz with sutured boundaries. Granuloblastic fabric. Some grains flattened parallel to a poorly defined foliation (S_1) marked by minor aligned muscovite. Minor well-rounded detrital tourmaline and zircon grains.

86842028 308288 GOULBURN
Currawang Basalt
Meta-amygdaloidal basalt

DESCRIPTION: Scattered euhedral phenocrysts of plagioclase in a fine base of interlocking plagioclase laths, metamorphic fibrous actinolite, chlorite, opaques, granular sphene and epidote. Rounded amygdales, up to 1mm across, filled with carbonate, chlorite and epidote.

86842033 273245 GUNNING
Covan Creek Formation
Meta- felsic volcanic breccia

DESCRIPTION: Elongate clasts of recrystallised microcrystalline quartz, K-feldspar, carbonate, muscovite, biotite, and very minor plagioclase. Relic perlitic texture. Minor lenses of polygonal strained quartz. Clasts and lenses are separated by zones of foliated micas, undeformed carbonate, and minor quartz, feldspar and sphene (S_1 foliation). Secondary iron oxide staining.

86842040 267247 GUNNING
Covan Creek Formation
Laminated silty phyllite

DESCRIPTION: Foliated biotite, minor muscovite and quartz, with laminae of recrystallised silty quartz, minor muscovite and biotite. Foliation (S_1) formed bv foliated biotite-rich zones in mica-rich bands at an acute angle to bedding.

86842048 340331 GOULBURN
Unnamed dyke
Metadolerite

DESCRIPTION: Coarse ophitic colourless clinopyroxene (augite) crystals, mostly replaced by fibrous pale green to colourless amphibole (actinolite) and minor chlorite, mould euhedral plagioclase (labradorite?) crystals. Scattered metamorphic epidote and irregular sphene - opaque intergrowths. Minor zones of sheared foliated actinolite and chlorite.

86842050 357346 GOULBURN
Birkenburn Beds
Carbonaceous phyllite

DESCRIPTION: Highly foliated sericite and fine disseminated carbonaceous matter (S_1 foliation). Quartz veinlets transposed and recrystallised into lenses of polygonal unstrained quartz parallel to the S_1 foliation. Small isoclinal fold hinges preserved in places. Crosscutting (ie. post-S_1) undeformed veinlets of crustified quartz and iron oxides have altered margins - depleted in carbonaceous matter.

86842058 385359 GOULBURN
Gundary Beds
Rhyolite

DESCRIPTION: Scattered phenocrysts, up to 4mm across, of rounded embayed pyramidal quartz, rounded K-feldspar and euhedral sericitised plagioclase in a unstrained microcrystalline groundmass of rosette graphic intergrowths of K-feldspar and quartz, stuby K-feldspar crystals, polygonal quartz, biotite (with metamorphic chlorite alteration and overgrowths) and minor scattered opaques.

86842069 264462 GUNNING
Woodlawn Volcanics
Meta- lapilli tuff

DESCRIPTION: Highly foliated metamorphic actinolite, chlorite, granular epidote and sphene, minor plagioclase and quartz. Streched 'fragments' of recrystallised quartz-chlorite-epidote-sphene aggregates, and polygonal quartz lenses are probably altered felsic volcanic rock fragments. Outcrop samples contain rhyolite clasts.

86842076 315452 GOULBURN
Wologorong Granite
Altered leucogranite

DESCRIPTION: Medium to coarse-grained highly strained quartz, K-feldspar and plagioclase mostly recrystallised to fine-grained poygonal aggregates, particularly along grain boundaries. Plagioclase is recrystallised to albite and granular epidote. Fractures, quartz veinlets, trails of unstrained polygonal quartz, fibrous actinolite? and epidote crystals define a prominent foliation (S_1).

86842077 315452 GOULBURN
Unnamed dyke
Metadolerite

DESCRIPTION: Deformed fine-grained subhedral plagioclase (andesine?), metamorphic subprismatic to acicular pale to dark green amphibole (actinolite), minor graphic intergrowths of quartz and K-feldspar interstitial to plagioclase crystals, and very minor metamorphic epidote, chlorite and sphene-opaque intergrowths.

86842091 242337 GUNNING
Woodlawn Volcanics
Foliated medium metaquartzite

DESCRIPTION: Strained, very poorly sorted quartz grains, up to 0.5 mm across, mostly recrystallised to a fine-grained polygonal mozoaic with a prominent elongation direction parallel to scattered aligned muscovite grains (S_1 foliation). Muscovite-rich lenses, up to 1 cm across, are probably flattened recrystallised mud and silt clasts. Minor subangular to subrounded detrital tourmaline and zircon? grains.

86842099 261353 GUNNING
Woodlawn Volcanics
Meta-rhyolite

DESCRIPTION: Strongly foliated microcrystalline mosaic of granoblastic quartz, K-feldspar?, biotite, minor muscovite, plagioclase and carbonate. Scattered strained phenocrysts of rounded, flattened and embayed quartz , up to 5 mm across (commonly recrystallised into finegrained polygonal quartz), and fractured and strained subhedral plagioclase. Fine-grained, Fe-oxide stained carbonate, quartz and albite fill fractures within and spaces between boudinaged plagioclase crystal fragments and pressure shadows adjacent to quartz and feldspar phenocrysts. Lenses and trails of fine-grained polygonal quartz parallel to the foliation (S_1) are probably recrystallised quartz phenocrysts. A weakly defined lineation on S_1, noticeable in handspecimen, is a mineral elongation.

86842101 263360 GUNNING
Woodlawn Volcanics
Meta-rhyolite

DESCRIPTION: Strained, embayed and slightly flattened quartz, up to 4mm across, and euhedral plagioclase phenocrysts, up to 2mm across, in a foliated recrystallised microcrystalline base of granuloblastic quartz, K-feldspar, minor aligned biotite, and scattered epidote. Coarser grained quartz - biotite beards on most phenocrysts. Some quartz phenocrysts recrystallised to polygonal aggregates. Minor undeformed metamorphic chlorite-sphene-epidote-carbonate aggregates probably after a mafic mineral phenocryst.

86842104 286377 GOULBURN
Birkenburn Beds
Biotite - muscovite - quartz schist

DESCRIPTION: Banded foliated biotite, muscovite and quartz. Foliation (S_1) parallels compositional banding. Crenulation cleavage, at a high angle to S_1, deforms foliated micas - no associated recrystallisation. Probably a meta-silty shale.

86842105 283377 GUNNING
Unnamed sill?
Meta-rhyolite

DESCRIPTION: Deformed subhedral crystals and aggregates of plagioclase form phenocrysts with polygonal quartz mosaic (recrystallised quartz phenocrysts) in a recrystallised microcrystalline base of foliated quartz, alkali feldspar, and minor plagioclase. The foliation (S_1) is marked by stringers of coarser grained polygonal quartz, biotite-epidote intergrowths, and minor aligned biotite. Rare scattered metamorphic sphene. Biotite is partly altered to chlorite. Indistinguishable from rhyolite in the Woodlawn Volcanics.

86842109 278377 GUNNING
Birkenburn Beds
Meta- medium quartz-rich arenite

DESCRIPTION: Fine- to medium-grained, poorly sorted, subrounded detrital? grains of quartz, minor microcline, and rare plagioclase in a finer recrystallised matrix containing anastomosing zones of foliated biotite and minor muscovite between zones of randomly oriented micas, polygonal quartz and feldspars. Rare epidote and idiomorphic garnet syn S_1? Quartz veinlet (now consisting of unstrained polygonal grains) tightly folded by S_1 foliation.

86842110 278377 GUNNING
Unnamed sill?
Meta-rhyolite

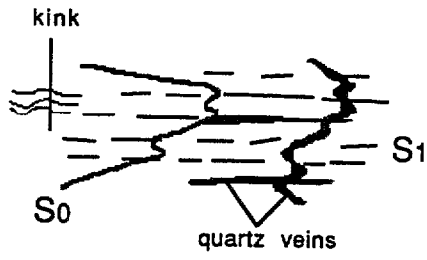
DESCRIPTION: Deformed phenocrysts (up to 2mm across) of: plagioclase euhedral crystals and aggregates; and embayed quartz which is recrystallised to polygonal aggregates in places. The groundmass is totally recrystallised to a foliated mosaic of strained quartz, K-feldspar, plagioclase, minor aligned biotite, and rare epidote. Indistinguishable from rhyolite of the Woodlawn Volcanics.

86842120 265313 GUNNING
Woodlawn Volcanics
Hematitic chert

DESCRIPTION: Microcrystalline polygonal unstrained quartz mozaic with disseminated hematite crystals which form trails in places parallel to rare aligned biotite (S_1 foliation).

86842127 273336 GUNNING
Birkenburn Beds
Chert

DESCRIPTION: Microcrystalline quartz mozaic veined by coarser polygonal quartz. These veins are folded and transposed by a foliation (S_1) marked by crosscutting lenses and veins of coarser polygonal quartz. A small isoclinal fold hinge outlined in a carbonaceous muscovite schist band is deformed by a wavy crenulation at a high angle to the S_1 foliation.



86842129 282343 GUNNING
Unnamed sill
Meta-rhyolite

DESCRIPTION: Recrystallised very fine-grained polygonal mozaic of quartz, minor K-feldspar and rare plagioclase, with minor sutured coarser grains of plagioclase and quartz (possibly recrystallised phenocrysts). Well-defined metamorphic foliation (S_1) marked by aligned biotite, minor muscovite, opaques and trails of granular epidote and biotite/chlorite. Trace zircon. Veins of fine-grained polygonal quartz parallel the S_1 foliation

86842137 300327 GOULBURN
Birkenburn Beds
Medium metaquartzite

DESCRIPTION: Medium-grained, poorly sorted, recrystallised, sutured quartz grains with scattered randomly oriented pale brown biotite crystals. These crystals are partly altered to a more abundant fine-grained pale greenish brown biotite/chlorite which is weakly foliated. Trace rounded detrital zircon. Contact metamorphic rock overprinted by retrogressive regional metamorphism.

86842141 293316 GOULBURN
Woodlawn Volcanics
Meta-pebbly volcanolithic arenite

DESCRIPTION: Highly strained pebbles (<1 cm) of felsic volcanics (consisting of foliated actinolite, quartz, opaques, feldspar? and rare quartz phenocrysts) and coarse-grained quartz in a strongly foliated (S_1) matrix of subprismatic actinolite, quartz, minor biotite, muscovite, opaques and tourmaline. Quartz grains are sutured with quartz overgrowths in low strain zones.

86842143 278282 GUNNING
Currawang Basalt
Meta-basalt

DESCRIPTION: Fine-grained mozaic of metamorphic granular actinolite, minor chlorite and rare quartz and opaques. Relict interganular fabric. Small rounded epidote aggregates, up to 1 mm across, may be amygdales. Epidote veinlets common.

86842167 212262 GUNNING
Covan Creek Formation
Medium metaquartzite

DESCRIPTION: Recrystallised and strained, poorly sorted, fine to medium grained quartz and chert. Granuloblastic fabric. Minor aligned muscovite and lesser biotite mark a poorly defined foliation (S_1). Minor well-rounded detrital tourmaline and zircon grains. Minor flattened muscovite aggregates, up to 4 mm long, probably represent mud clasts.

86842170 287260 GOULBURN
Currawang Basalt
Meta-basalt

DESCRIPTION: Slightly porphyritic. Minor phenocrysts, up to 0.1 mm across, of plagioclase euhedra and rare chlorite-epidote psuedomorphs after clinopyroxene crystals in an altered subtrachytic groundmass of deformed plagioclase (andesine?) laths, metamorphic chlorite, fine granular opaques and rare biotite. The metamorphic foliation (S_1) forms anastomosing zones which wrap around fractured and extended epidote nodules. Spaces between the fragmented nodules are occupied by biotite/chlorite.

86842171 287255 GOULBURN
Currawang Basalt
Meta-lapilli tuff

DESCRIPTION: Flattened rounded fragments of chloritised porphyritic mafic volcanic in a cherty matrix of microcrystalline quartz mozaic, foliated biotite/chlorite, granular opaques and rare altered feldspar euhedra. Veins and patches of coarser quartz. The mafic volcanic fragments consist of plagioclase phenocrysts in an altered groundmass of plagioclase laths, chlorite and opaques.

86842181 329246 GOULBURN
Unnamed dyke
Metadolerite

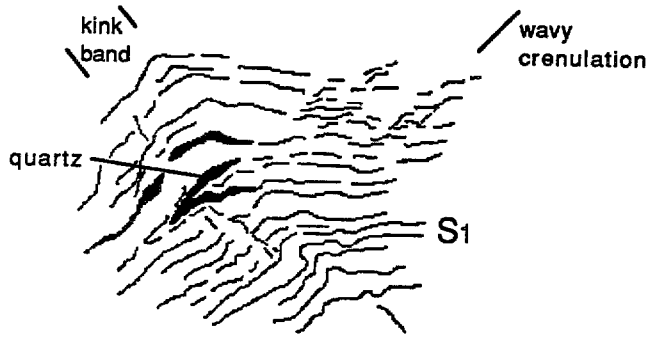
DESCRIPTION: Medium-grained subophitic fractured colourless augite crystals, commonly showing marginal fibrous actinolite and chlorite alteration, mould fractured and strained plagioclase (labradorite?) euhedra. Minor opaques and apatite. Microfractures and chlorite, actinolite and granular epidote filled anastomosing foliated zones define a poorly developed S_1 foliation.

86842218 292400 GOULBURN
Wologorong Granite
Foliated granite

DESCRIPTION: Fractured and strained medium-grained (<4 mm) microperthite, microcline, and plagioclase with anastomosing zones of fine-grained strained polygonal quartz and muscovite - biotite folia. This foliation (S_1) is crosscut by Fe-oxide filled fractures at about 45^{o}. The rock is a deformed, probably medium equigranular, biotite leucogranite. Only the feldspars represent primary minerals. A prominent mineral lineation in handspecimen is marked by elongation of mica-rich zones within the S_1 foliation surface.

86842232 256422 GUNNING
Birkenburn Beds
Silty phyllite

DESCRIPTION: Banded foliated biotite and muscovite zones alternating with biotite, muscovite and quartz zones. The banding, which is parallel to the foliation (S_1), is probably transposed bedding. Small isoclinal fold hinges are present in quartz veinlets which are mostly tansposed by the S_1 foliation into a series of polygonal quartz lenses. The S_1 foliation is folded by a kink cleavage, about 1cm wide and a wavy fine crenulation confined mostly to mica-rich bands.



86842241 227467 GUNNING
Birkenburn Beds
Meta-arenite

DESCRIPTION: Very poorly sorted, coarse-grained, strained subrounded grains of quartz, chert, rare plagioclase and detrital muscovite in a very fine-grained, weakly foliated recrystallised matrix of quartz, biotite, opaques, minor muscovite and epidote. The coarse sandy quartz grains are flattened in the S_1 foliation plane.

86842248 238474 GUNNING
Woodlawn Volcanics?
Phyllite

DESCRIPTION: Microcrystalline foliated white mica, minor biotite and quartz. Secondary iron oxides are concentrated in crenulation fracture cleavage planes spaced about 0.1mm apart and perpendicular to the less penetrative S_1 foliation. All micas are deformed and fractured by the crenulation.

86842250 259483 GUNNING
Woodlawn Volcanics?
Meta-greywacke?

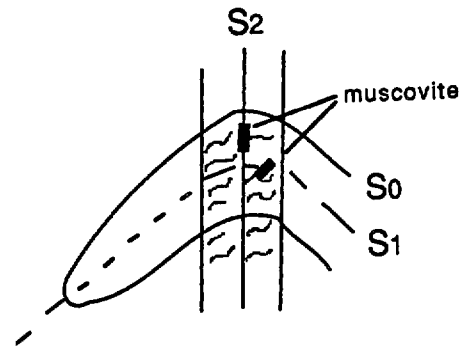
DESCRIPTION: Scattered, very coarse-grained, poorly sorted, flattened and strained grains of quartz, chert and minor plagioclase and Kfeldspar? in a strongly foliated matrix of biotite, quartz, minor muscovite, andalusite? and feldspar. The main foliation (S_1) is deformed by closely spaced kinks. Secondary Fe-oxides are concentrated along the S_1 foliation and kink surfaces.

86842251 223475 GUNNING
Unnamed sill
Meta-quartz feldspar porphyry

DESCRIPTION: Strained subhedral quartz and plagioclase phenocrysts, up to 1mm across, in a fractured and partly recrystallised microcrystalline and foliated groundmass of quartz, K-feldspar, plagioclase, biotite and minor muscovite, and opaques. Anastomosing zones of foliated mica and microbreccia define the S_1 foliation.

86842259 285422 GUNNING
Birkenburn Beds
Meta-arenite

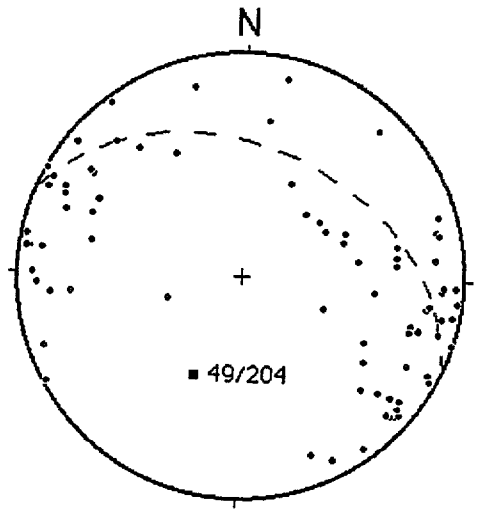
DESCRIPTION: Foliated metamorphic muscovite, biotite, quartz, and poorly sorted fine to medium grained detrital grains of plagioclase, quartz and K-feldspar? Foliation (S_1) mostly parallels composional banding (mica-rich versus quartz-feldspar - rich bands), and is axial plane to isoclinal fold closures. The S_1 foliation is deformed by a closely spaced (0.2mm apart) crenulation cleavage, which in places, has partly deformed (syn-S_2) coarse muscovite crystals parallel to the S_2 plane. Minor randomly oriented coarse muscovite also cuts across the S_1 foliation within the intervening microlithons. S_1 and compositional banding are openly folded by the S_2 cleavage. Iron oxide staining is particularly common along the S_2 cleavage.



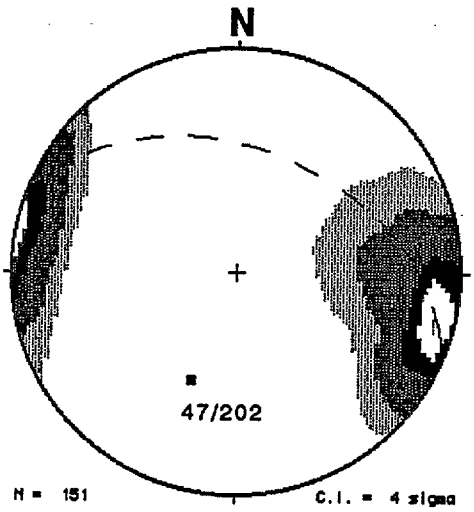
86842262 286408 GOULBURN
Unnamed sill
Meta-rhyolite

DESCRIPTION: Strongly foliated banded microcrystalline quartz and feldspar (K-feldspar?, minor plagioclase), fine-grained polygonal quartz and muscovite-biotite folia. Scattered phenocrysts (<2 mm) of highly strained quartz (recrystallised to fine-grained polygonal aggregates in places), fractured plagioclase and K-feldspar? The main metamorphic foliation (S_1) is deformed and tightly folded by a crenulation at a high angle. In places micas are rotated into narrow zones parallel to the crenulation forming a weakly developed nonpenetrative spaced cleavage (S_2). Micas in these zones are commonly stained by secondary Fe-oxides.

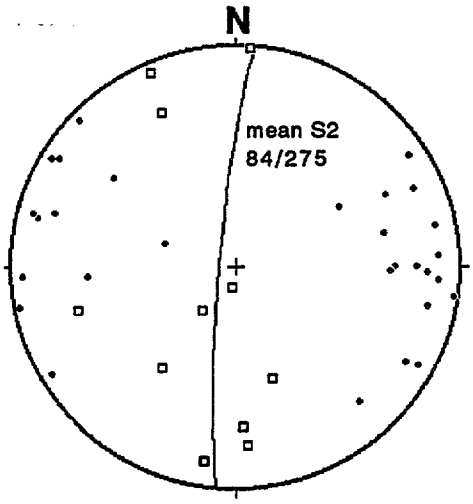
APPENDIX 3 EQUAL AREA STEREONET PLOTS



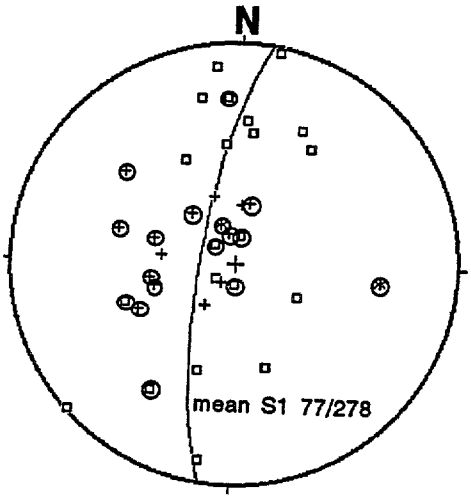
• Pole to S0



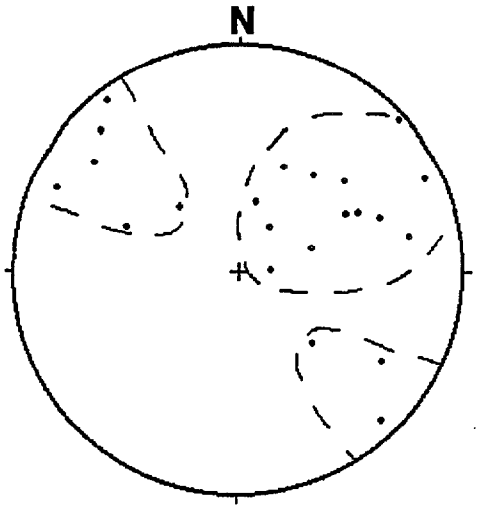
Poles to S1



□ Pole to S2
+ F2 axis



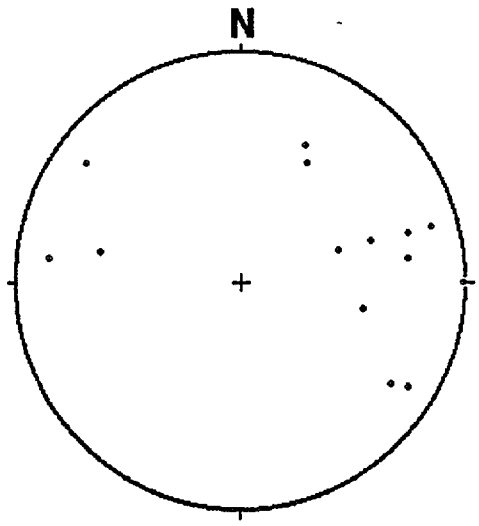
□ F1 axis
+ S0/S1 intersection lineation
* Elongation lineation
O Less than 1 km from granite



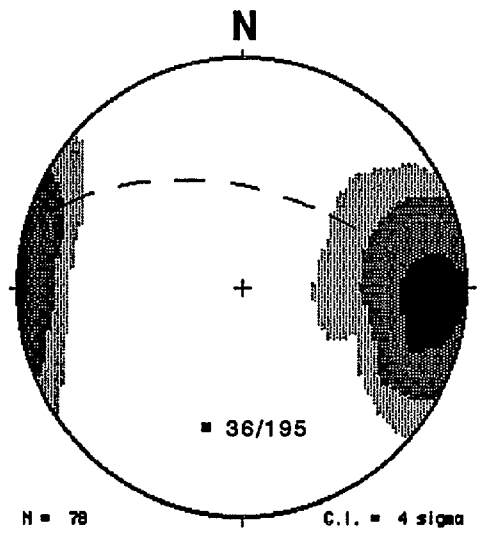
• Pole to kinks

Birkenburn Beds

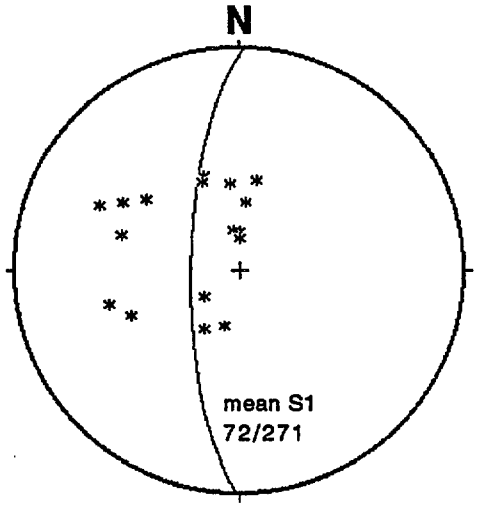
APPENDIX 3 continued



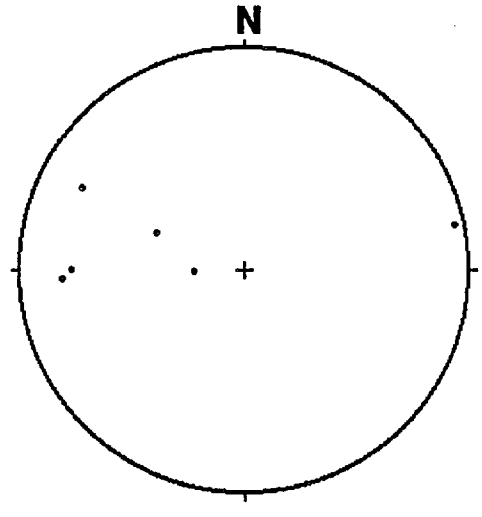
• Pole to S0



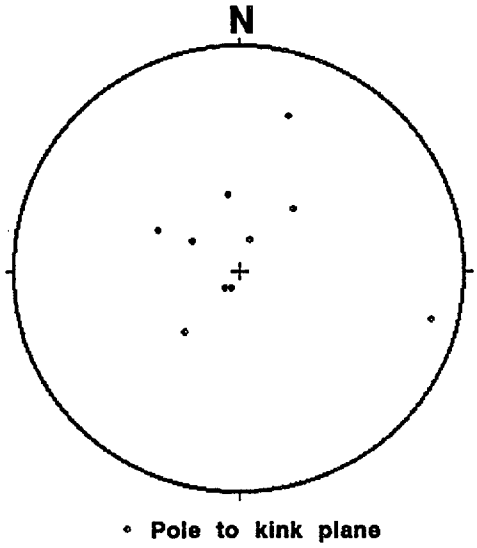
Poles to S1



* Elongation lineation



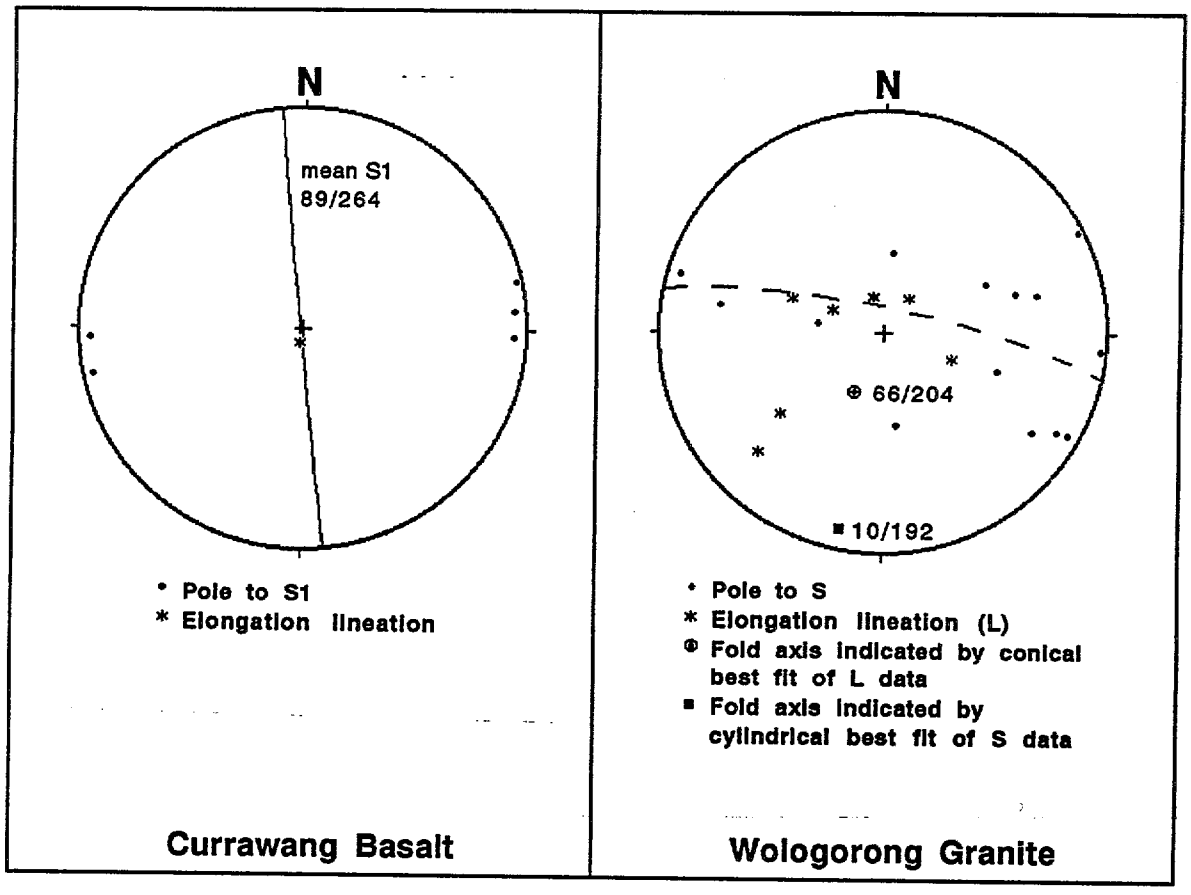
• Pole to S2



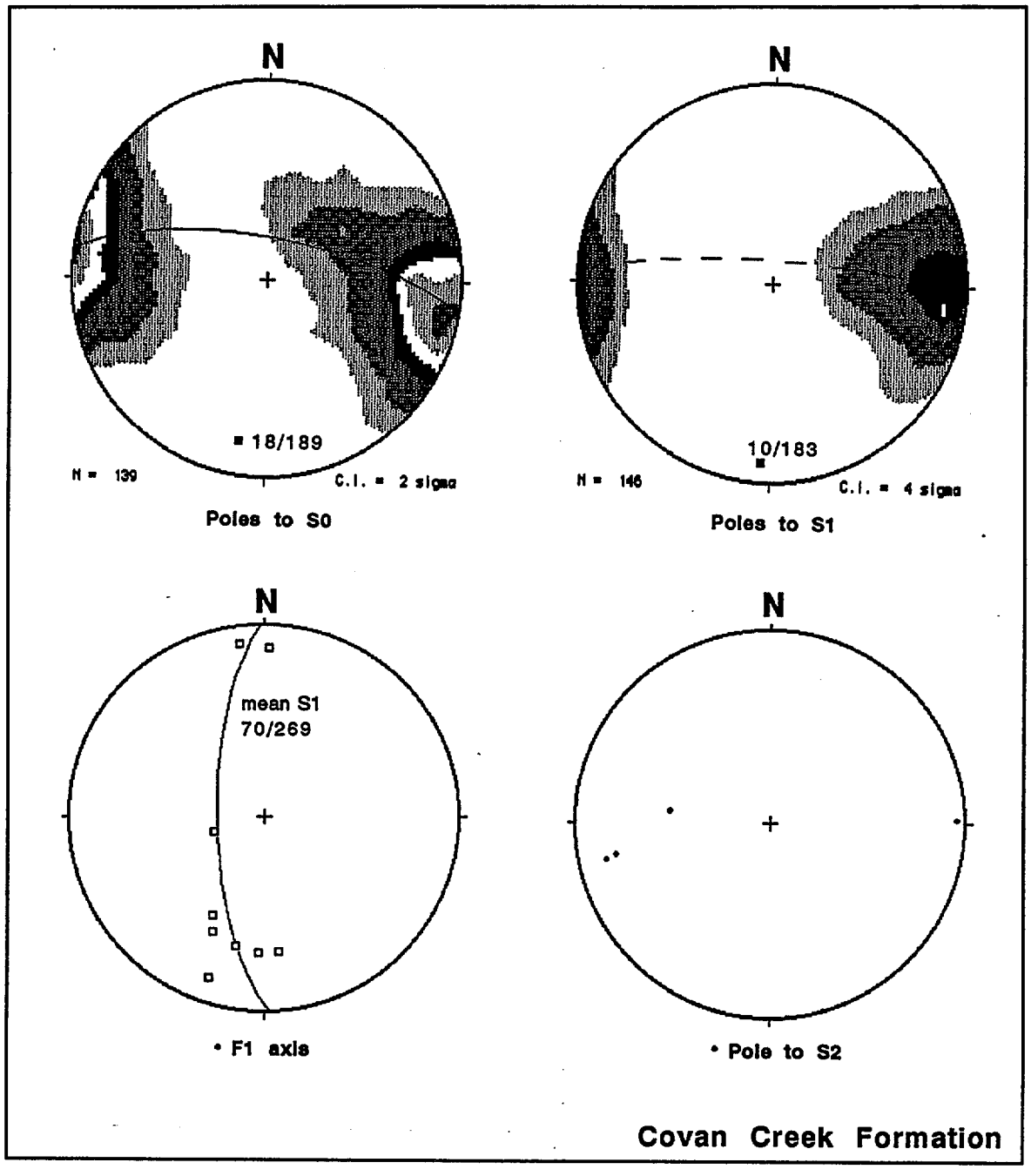
• Pole to kink plane

Woodlawn Volcanics

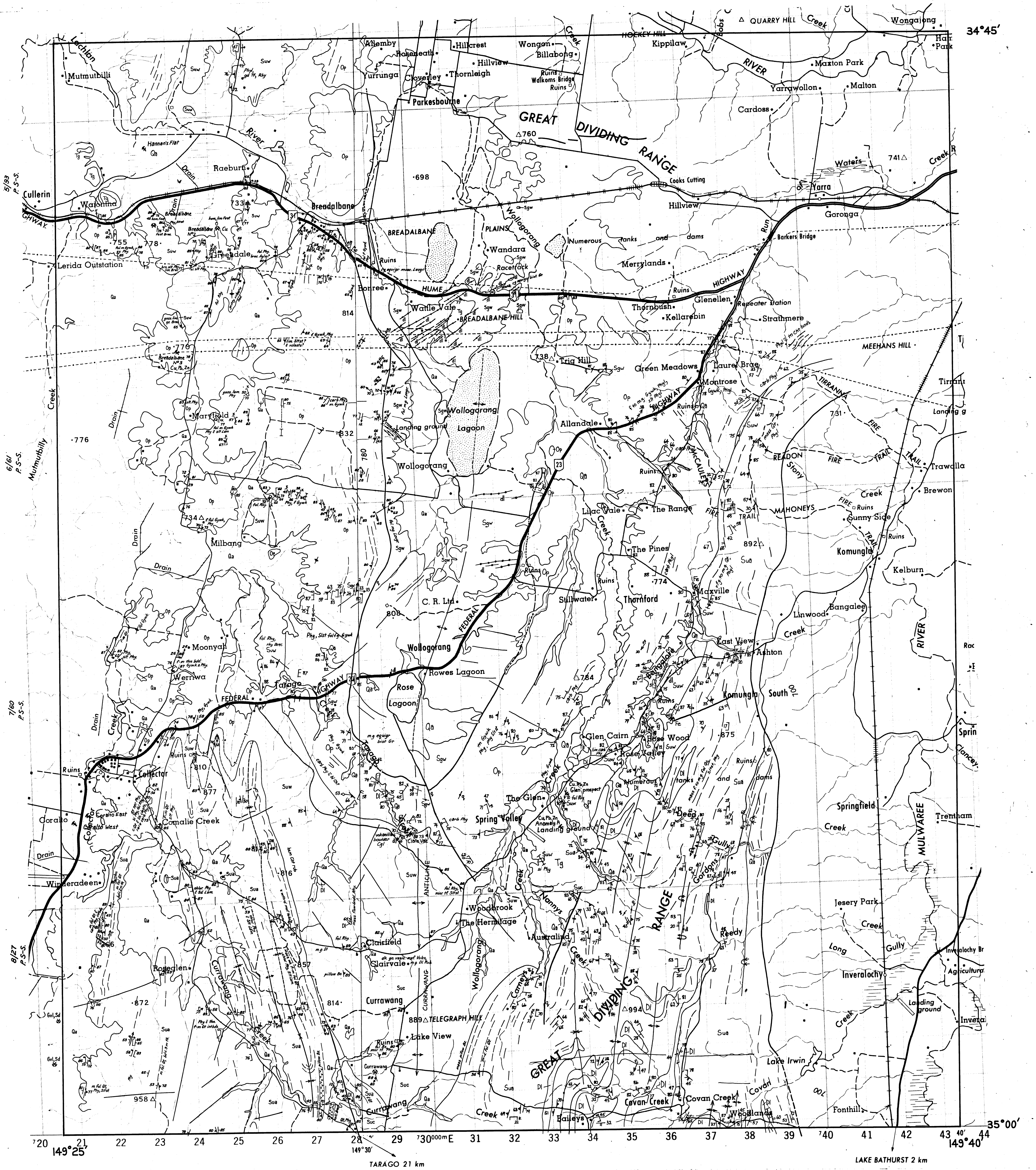
APPENDIX 3 continued

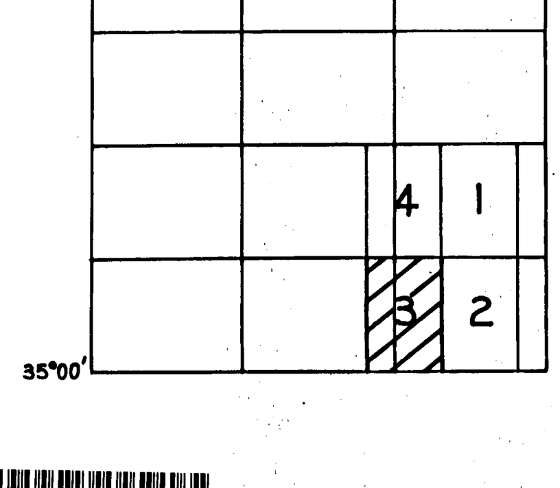


APPENDIX 3 continued



GOULBURN 250K SHEET
1:50 000
STUART-SMITH
1986-





GOULBURN TROUGH (Goulburn 1:250 000)

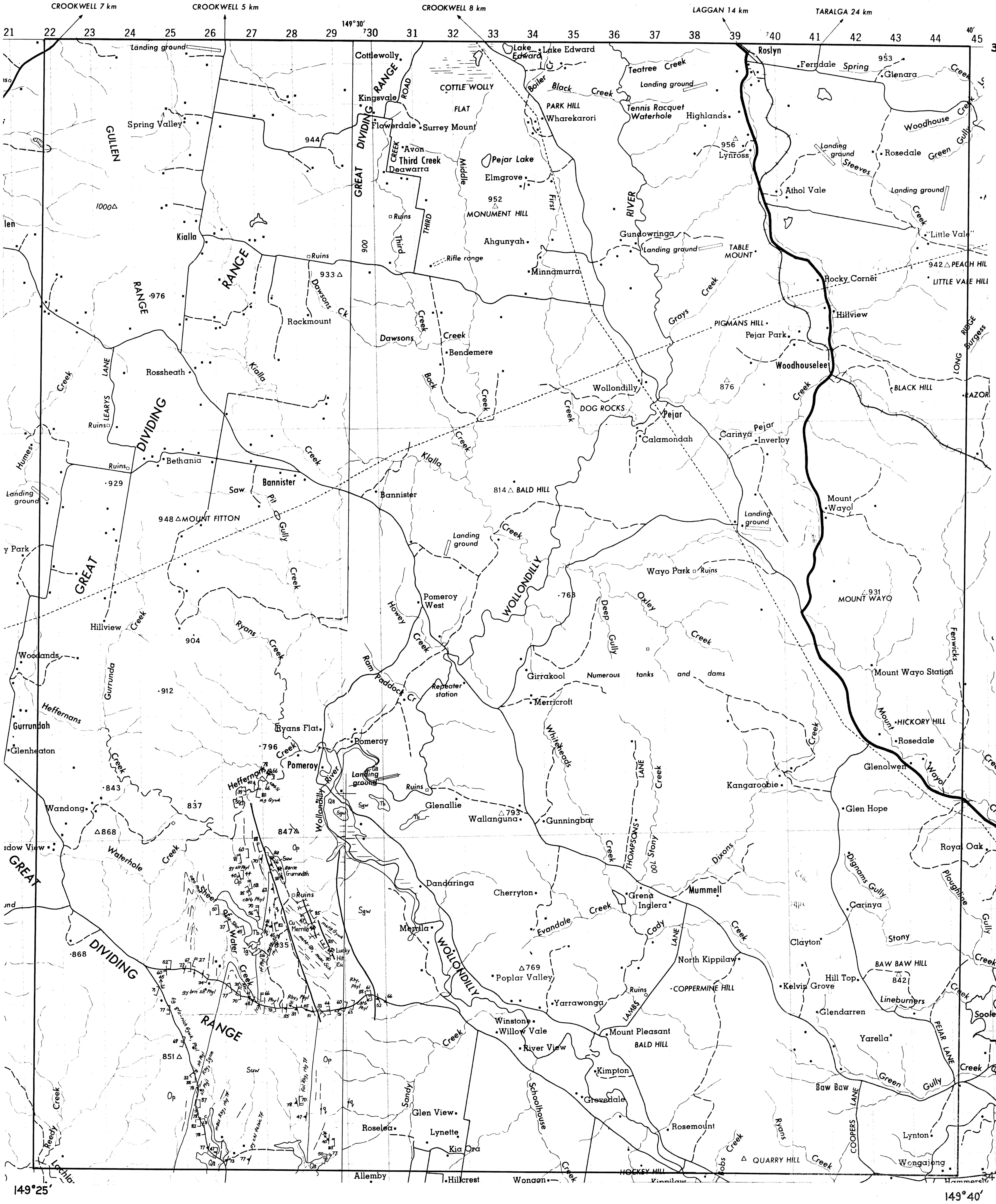
Geology 1986 P.G. Stuart-Smith

Compiled 1986 J. Stirzaker, 1991 P.G. Stuart-Smith

Scale ~ 1:50 000

Compiled by the Bureau of Mineral Resources, Geology and Geophysics, as part of the policy of Government to assist in the exploration for and development of mineral resources.

Goulburn 250K sheet
1:50 000
Stuart-Smith
1986-



GOULBURN TROUGH (Goulburn 1:250000)

Geology 1986 P.G. Stuart-Smith

Compiled 1991 P.G. Stuart-Smith

Scale ~1: 50 000