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EXCURSION GUIDE

WOODLAWN MASSIVE SULPHIDE DEPOSIT

Mark Bouffler

GENERAL ASSEMBLY
SEPTEMBER 1993 - CANBERRA AUSTRALIA

ANCIENT VOLCANISM & MODERN ANALOGUES

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Record 1993/66
Australian Geological Survey Organisation

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Resources: Hon. Michael Lee
Secretary: Greg Taylor

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Executive Director: Harvey Jacka

ISSN: 1039-0073

ISBN: 0 642 19667 2

IAVCEI INTRA CONFERENCE FIELD TRIP B3

WOODLAWN MINE SITE TUESDAY 28 SEPTEMBER 1993

9.00 - 10.00	Arrive on site, meet in Geology Office for one hour talk about history, geology and structure, view plans and discuss.	
10.00 - 12.00	STOP 1	Pit Overview points of interest - black shale in the South and East walls of pit. - 750/790 Faults - foliated sequence of shales and volcanics hosting the deposit.
	STOP 2	730 Bench - Traverse around north pit wall, note 750 Fault Zone and associated structures, dolerite sills intruding the host volcanics and shales.
	STOP 3	685 Bench - traverse cross section of host rock sequence viewing remnants of massive sulphide and cross cutting footwall copper feeder.
12.00 - 1.00	Lunch	
1.00 - 2.00		- Inspect drill core
2.00 - 2.30		- View rehabilitation of waste dump.

INTRA-CONFERENCE FIELD TRIP B3:

WOODLAWN MASSIVE-SULPHIDE ORE DEPOSIT

MARK BOUFFLER

INTRODUCTION

The Woodlawn base metal sulphide deposit, located 50 km S of Goulburn, NSW, (Figure 1) was discovered in 1969 by Jodex Australia Pty Ltd as a result of systematic roadside reconnaissance geochemistry involving the collection of rock chip, stream sediment and B horizon soil samples. Surface geochemical and biogeochemical indications of the base-metal mineralisation are documented by Ryall and Nicholas (1979).

Gossan subcrop and underlying supergene enriched sulphides were mined in 1977/78; mining of primary ore commenced in 1978. The current pit is roughly circular in plan with a diameter of 600m. The lowest bench is 610m above sea level.

During the 10 years of open pit operation, 5 million tonnes of complex ore, grading 1.6% Cu, 4.7% Pb, 12.5% Zn 88 g/t Ag, and 3 million tonnes of copper ore grading 1.5% Cu, 0.5% Pb, 1.7% Zn and 20 g/t Ag were treated in the concentrator.

Since commencement of full scale underground mining in 1987 until June 1993, 3 million tonnes of complex ore grading 1.4% Cu, 4.3% Pb, 10.3% Zn and 96 g/t Ag and 174,000 tonnes of copper ore grading 1.86% Cu, 0.7% Pb, 2.2% Zn and 29 g/t Ag were treated in the concentrator.

As at May 1993 diluted recoverable reserves at Woodlawn stood at 3.3 million tonnes grading 1.8% Cu, 3.5% Pb, 9.9% Zn and 65 g/t Ag. The Mine is owned by Denehurst Limited who purchased the operation from Australian Mining and Smelting Ltd in August 1987.

The notes to follow draw substantially from previous excursion guides by Gilligan et al (1976) and McKay (1983). More detailed accounts of the geology of the Woodlawn region and methods of exploration are published collectively as the Woodlawn Papers in the Jour. of Geol. Soc. of Australia, Vol. 26, 1979, Parts 3 & 4.

REGIONAL & LOCAL GEOLOGY

The regional geological setting of the Woodlawn deposit has been described by Gillian et al (1979). The regional geology is shown in Figures 2 and 3 and the local geology in Figure 4.

Sedimentation in the Woodlawn region commenced late in the Ordovician with deposition of interbedded and cross laminated sandstone and shales. Graptolite-bearing black slate(s) near the top of the sequence serve as useful marker horizons outlining the regional structure. The graptolite fauna indicates a Late Ordovician age (Strusz and Nicoll 1973).

To the east and northeast of Woodlawn sedimentation may have continued into the Silurian, but an Early Silurian age has not been established. Gilligan et al (1979) note that evidence of Early Silurian deformation (Quidongan Orogeny) is difficult to find in this region which has been markedly affected by the later Bowning Orogeny.

The Silurian consists of a basal sequence of sandstone, shale, limestone and black slate. This is overlain by acid volcanics grading laterally into fine-grained sediments (tuffaceous shales) which are overlain in turn by, or interfinger with, generally coarse-grained keratophyric rhyolite and acid fragmentals. Relationships between volcanics and sediments are marked by rapid facies changes with interfingering of rock types and gradational contacts.

To the north and northwest of Woodlawn, the mine sequence is overlain by intermediate to basic volcanics, mainly andesite and basalt with abundant pillow lavas and interbedded rhyolitic tuffs and sediments. This sequence is considered equivalent to rocks enclosing the Currawang orebody 10km to the northwest of Woodlawn (Fig 1).

The Silurian sequence is intruded by extensive Lower Devonian dolerite sill like bodies, which locally intrude the ore.

Lower Devonian volcanolithic valley-fill conglomerate, fossiliferous limestone, calcereous sandstone and siltstone unconformably overly the Ordovician and Silurian to the east and north of Woodlawn. The unconformity is exposed on private property to the west of the Crisp Creek bridge 3 km from Tarago.

The geology of the Woodlawn Mine sequence and relationships of the mineralisation have been described by Malone et al (1975), Malone (1979), Ayres (1979), and McKay and Hazeldene (1987). The results of mineralogical and chemical zonation studies of drill core from the mine environs have been published by Peterson and Lambert (1979).

MINERALISATION & GENESIS

The Woodlawn deposit comprises two distinct ore types:

> Complex ore occurs as fine grained, banded, polymetallic massive sulphides and within a hydrothermally altered sequence of shales and volcanics. Pyrite is the major constituent followed in decreasing abundance by sphalerite, galena and chalcopyrite and minor arsenopyrite, tetrahedrite-tennantite, stannite, pyrrhotite and electrum.
>
> Copper ore consists of higher grade copper mineralisation in chlorite schist and lower grade zones of quartz-chlorite-pyrite chalcopyrite veins in silicified volcanics.

Gangue minerals include talc, chlorite, phlgopite, quartz, barite, calcite and dolomite.

Intensely altered talc chlorite schist occurs on the footwall and within the orebody. Elsewhere chloritisation, silicification and sericitisation are variably developed.

The bulk of the mineralisation occurs in three main lenses as shown in Figure 5. Lens A and B (Zone B) have only been mined from underground. Lens C which originally cropped out as a massive ironstone gossan was mined to a depth of 200m from the open pit and is now being mined from underground.

Numerous small pods and lenses of discontinuous mineralisation occur over a strike length of 400m and make up the Lens 3 horizon, about 250m into the stratigraphic hanging wall of the main ore horizon.

The Woodlawn ore systems are developed on the northern edge of a thick extensive pile of calc-alkaline volcanics largely of ignimbritic nature and at least partly sub-aerially deposited. Horizons and localised cells of hydrothermal alteration are developed throughout the pile which contains widespread traces of base metal mineralisation.

The volcanics are flanked to the north by sequences of finer grained volcanic-derived sediments and shales, deposited in basinal sub-structures. Lenses of massive sulphides are developed within these basins which are developed at depth around the central pile and partly interconnected.

The open cut massive sulphide ore lens overlies stringer copper mineralisation to the south where the nature of the mineralisation and geochemical trends suggest a lateral and transgressive supply of mineralising fluids towards localised zones of intense chloritisation and silicification near and adjacent to sub marine venting discharge sites.

The lateral supply of fluid resulted in a metal zonation pattern within each lens which shows higher copper grades at the southern end of the lens and a gradual change to higher silver, lead, zinc, gold, and barium grades towards the north. There is also a distinct layering within parts of the deposit where massive pyrite-chalcopyrite layers up to 8 m thick occur with separate layers of massive banded pyrite-sphalerite-galena up to 15 m thick. Towards the base of the open cut portion of the main ore lens (670RL) the cross cutting footwall copper mineralisation swings to become sub parallel to and eventually concordant with the massive sulphides by 570RL.

STRUCTURE

Regional structure is dominated by the Currawang Anticline and Mulwaree Syncline. The Woodlawn Syncline and Pylara Anticline are subsidiary structures between these. Drilling at Woodlawn and a low level airborne caesium vapour magnetometer survey indicate that these structures are dissected and possibly bounded by faulting. Granites intruded the core of the Currawang Anticline and other regional anticlinal structures probably in the Early Devonian.

The Woodlawn orebody is situated in the eastern limb of the Woodlawn Syncline, dominated by N-S open to isoclinal folding, with a well developed west dipping axial plane cleavage. The structural interpretations developed by Malone et al (1975) and Henry (1978) indicate four episodes of deformation. The lower greenschist facies mineral assemblages and pervasive slaty cleavage developed during D3 an D4 (McKay, 1989).

Faulting in the vicinity of the orebody is dominated by NW trending dextral faults within and sub-parallel to the Woodlawn Corridor (McKay 1989). The massive sulphide accumulations provide the only marker horizon giving an average strike of 350^{o} and dip varying from 40 to 80^{o}W, and are occasionally overturned as in Lens A (RL2490).

The three main ore lenses at Woodlawn (Lenses A, B and C) once comprised a single massive sulphide body, estimated to have extended over 850m down dip, 350m along strike and containing in excess of 18 million tonnes of ore. This was fragmented by two major structural dislocations the 750 Fault and the 790 Fault.

The NW trending 750 Fault offsets Lens A from Lens B with an interpreted horizontal displacement of 110 to 120m and an estimated vertical component of 100 to 110m as indicated by metal zonation and isopach reconstruction. The east-west trending 790 Fault dislocated Zone B (Lens A and B) from Lens C, with an interpreted horizontal displacement of 150 to 170m. Limited movement also occurred on numerous smaller faults, joints and fractures within the orebody and host rocks as evidenced by ubiquitous slickensiding or gouge on fracture surfaces.

The orebody is situated in a high strain compression zone with approximately 1300m of lateral shortening (N-S) and 720m of thickening (E-W) due to dextral faulting within the Woodlawn Group (McKay 1989).

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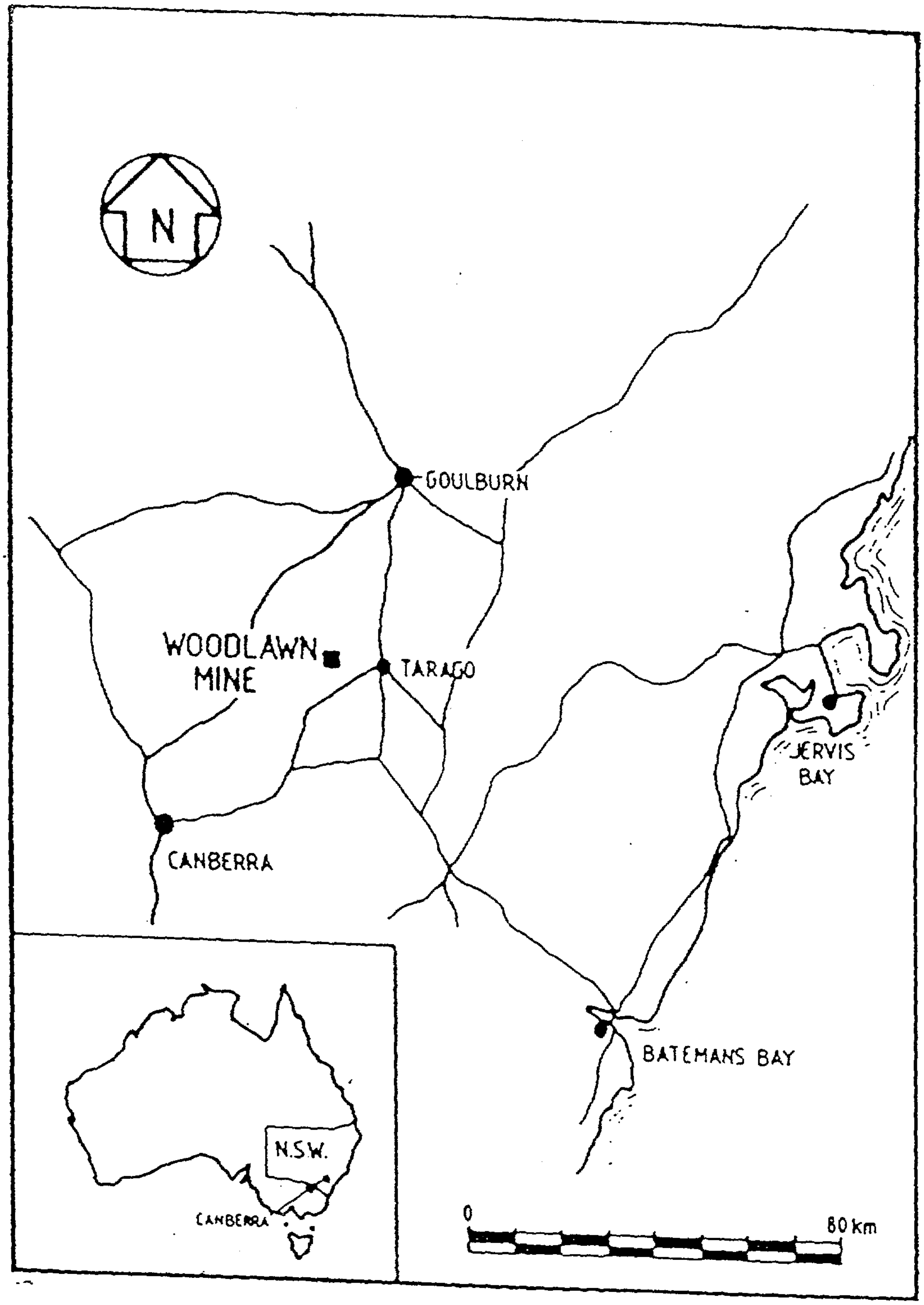

FIG. 1. Woodlawn Mine Location Map

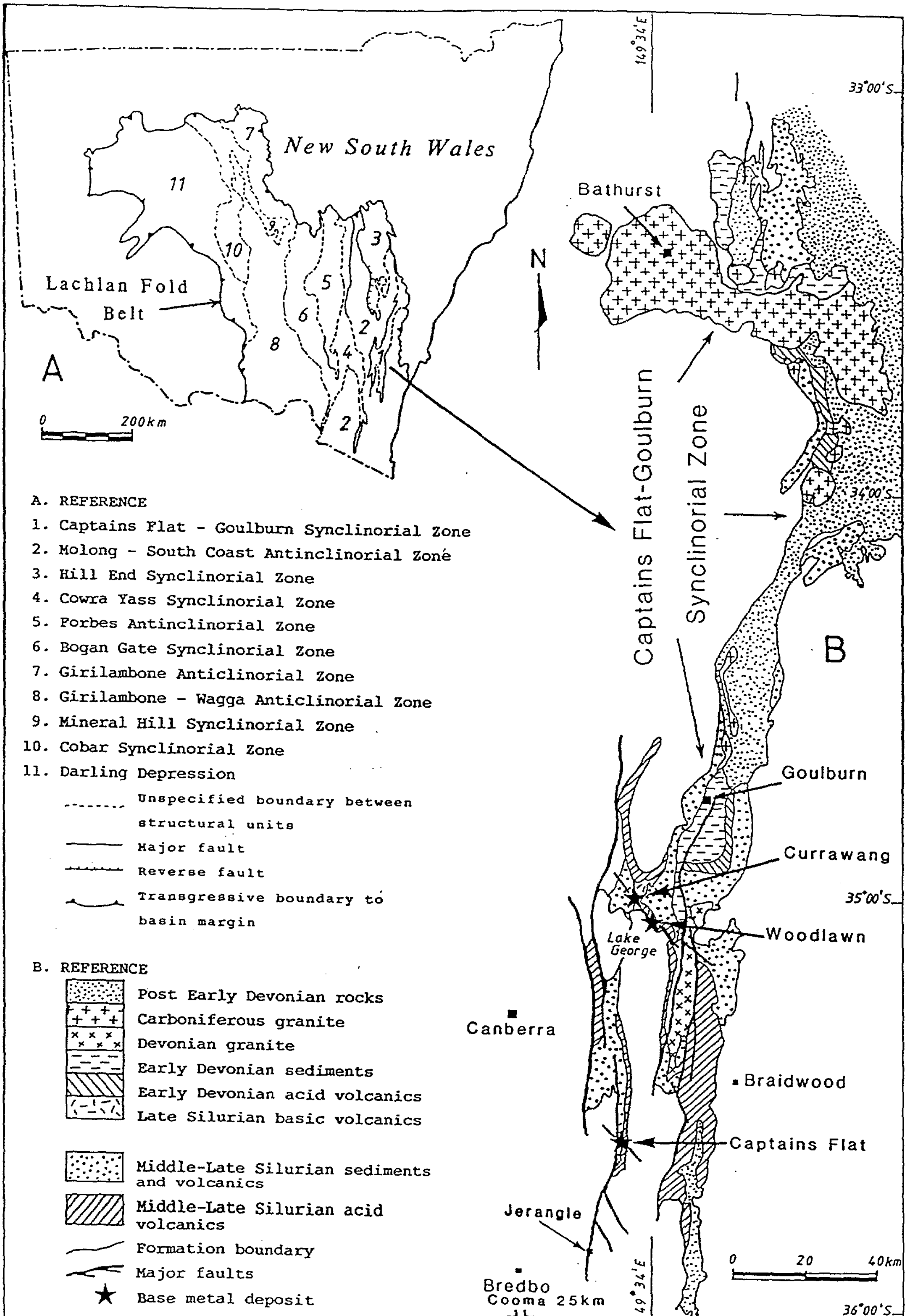

Fig. 2 A - Structural units within the Lachlan Fold Belt (after Scheibner, 1974).
B - Regional geology of the Captains Flat - Goulburn Synclinorial Zone (after Gilligan, 1974).

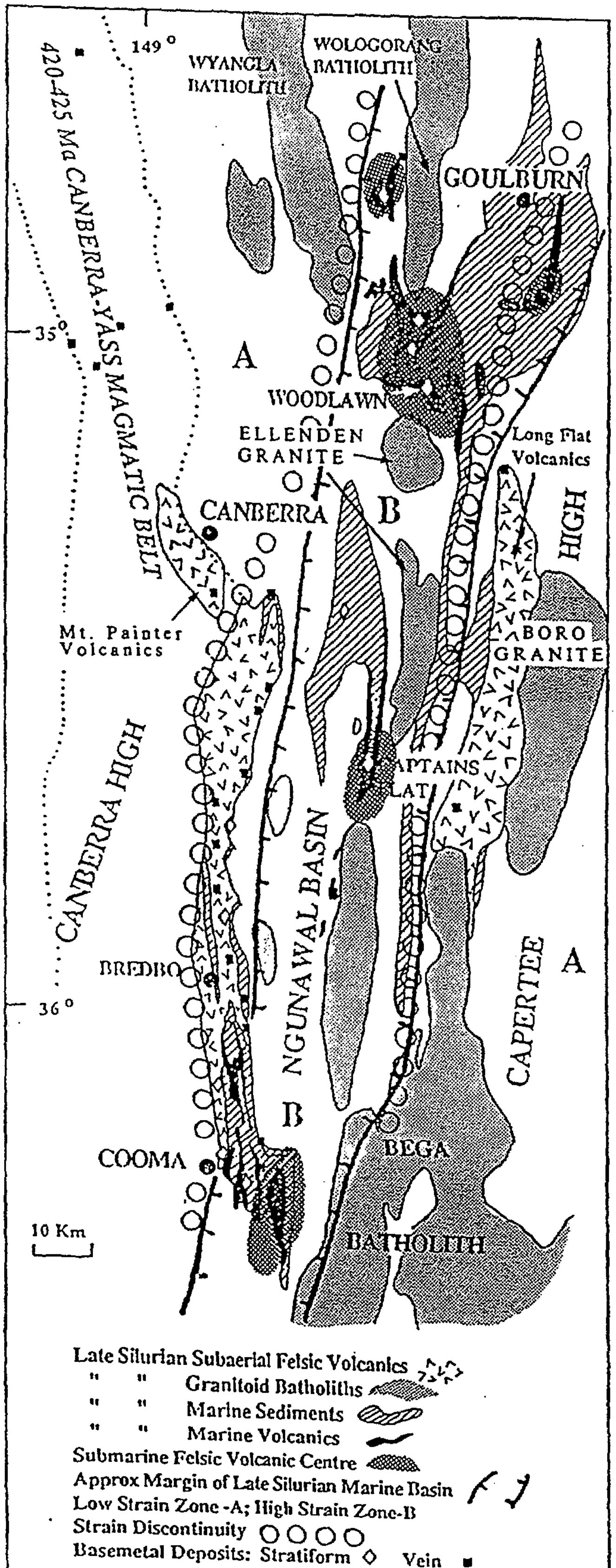

Fig.3

The Late Silurian Ngunawal Basin (modified after Bain et al., 1987).

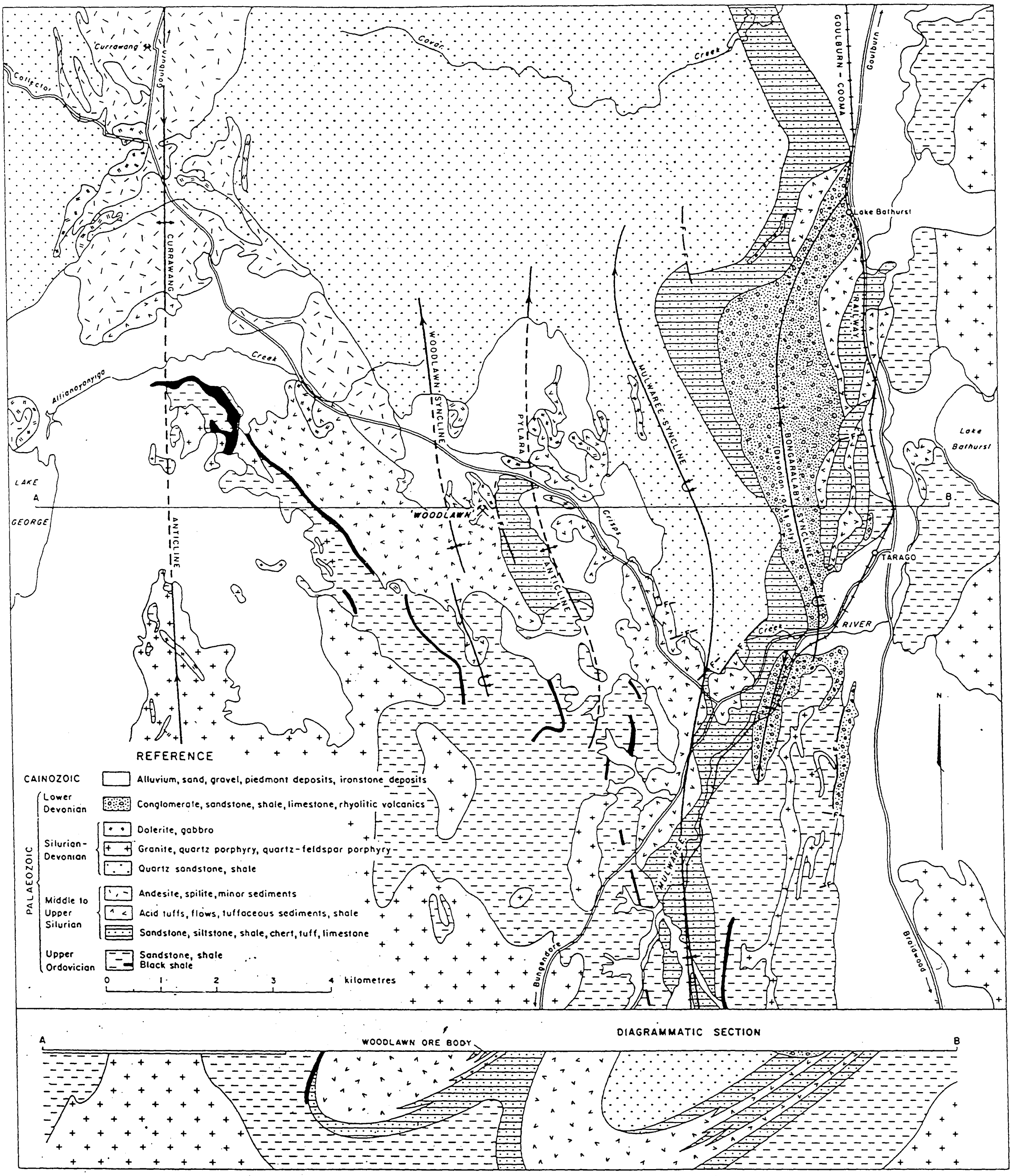

Fig. 4. Geology of the Woodlawn area.

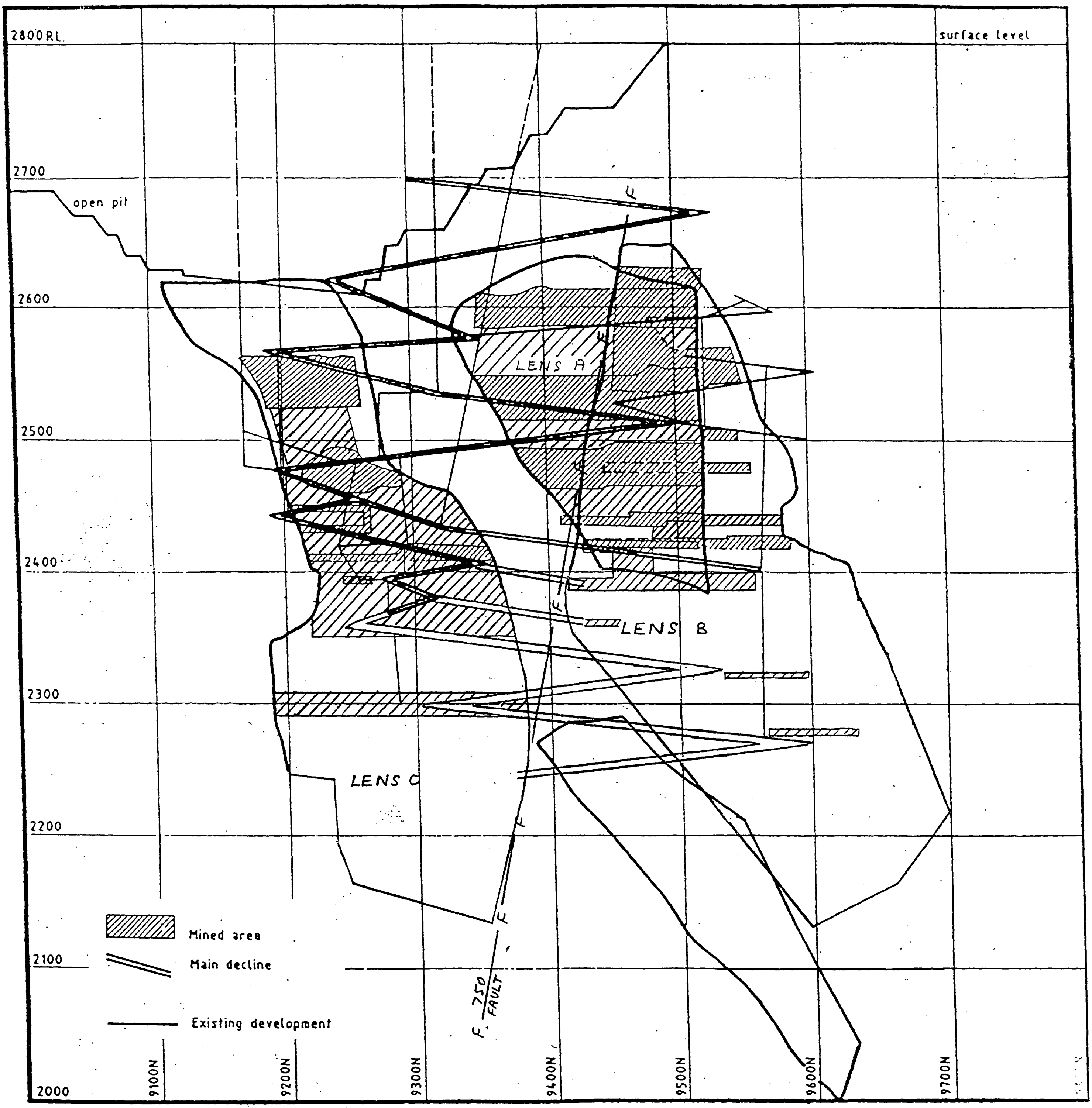

FIG. 5 - Woodlawn Mine Longitudinal Section (looking West)

Updated and modified after FITZGERALD & SINGER 1990
"Ore Reserve Estimates the Impact on Miners and Financiers" AIMM