PART I

GENERAL GEOLOGY

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Chapter 1

Introduction

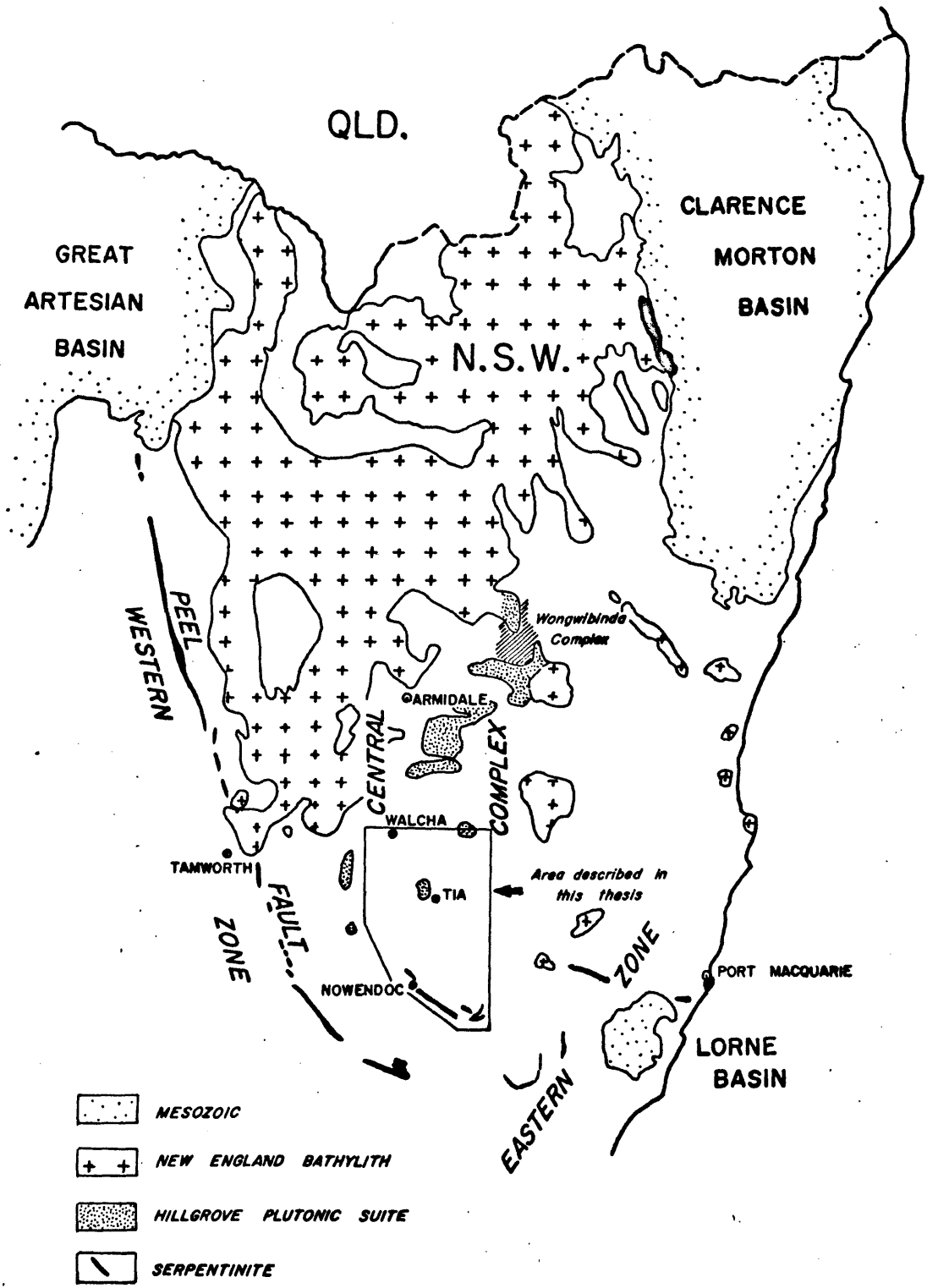
The area described in this thesis, covering about 1500 square miles of the southern New England Tableland, lies within the Central Complex of north-eastern New South Wales, (Voisey, 1959), a belt of strongly deformed Palaeozoic sediments invaded by granitic intrusions of predominantly Permian age (see Fig. 1).

Two major subdivisions have been made within the regionally metamorphosed rocks of this area, (see Map 1). Multi-folded, poly-metamorphosed rocks, herein named the Tia Complex underly a major portion of the area. These are intruded by a relatively small foliated pluton, the Tia Granodiorite, which occupies a more or less central position within these metamorphosed rocks and belongs to the Hillgrove Plutonic Suite of Binns et al (1967). In this respect the Tia Complex resembles the Wongwibinda Complex (Binns, 1966) lying some 70 miles to the north-north east.

The other major subdivision consisting of sheared greywackes, slates and quartzites with some basic lavas occupies the area north-east and east of the Tia Complex.

FIG. I.

Based on the Geological Map of N.S.W. (1962)
with Tertiary Basalt omitted for clarity.



Progressive regional metamorphism in part of this area is spatially associated with granitic intrusions of the Moona Plains district, located in the north-east corner of the mapped area. These rocks show a much simpler structural and metamorphic history than that of the Tia Complex, and are separated from the latter by zones of major faulting.

A zone of serpentinite intrusions belonging to the Great Serpentine Belt of N.S.W., (Benson, 1913), herein named the Nowendoc Ultrabasic Belt, forms part of the south west boundary of the Tia Complex. In addition, much of the area mapped is covered by flat-lying Tertiary basaltic lavas.

The area mapped may also be split into two physiographic subdivisions. The northern half consists of undulating open grazing country with only scattered timber. The southern half of the area is much more rugged and very thickly timbered, with only limited accessibility. The boundary between these two is roughly coincident with the watershed of two of the major river systems of the area. The northern system feeds into the Apsley River, which has cut a very deep gorge (up to 2500' deep) along its course to within 12 miles of Walcha. The southerly flowing system joins the Nowendoc River

south east of the mapped area. In addition, the headwaters of a westerly flowing system cut across the western boundary of the mapped area, e.g. the Cobrabald, Ingleba and Macdonald Rivers. It is notable that the remnants of the horizontal Tertiary basaltic lavas are concentrated along the watershed separating these three river systems.

Faults

Several major fault zones cut through the area. Their nature and structural significance will be discussed in more detail in Part II, Chapter (7), however it is appropriate to discuss them briefly at this stage as they are important to the subdivision of the metamorphic rocks outlined below.

The Nowendoc Fault constitutes the western to south-western boundary of the Tia Complex, and at its southern end is associated with the serpentinite intrusions belonging to the Nowendoc Ultrabasic Belt. It separates the lithologies of the Tia Complex from a sequence of unmetamorphosed Permian(?) mudstones, sandstones, tuffs, conglomerates and pebbly mudstones, (the Glen Morrison Beds).

Parallel to the eastern edge of Mapl, the Yarrowitch Fault separates metamorphosed lithologies on the west

from unmetamorphosed sandstones, mudstones, pebbly mudstones and limestones in which Permian macrofossils have been found, (the Peters Creek Beds). The Mummel River Fault system and the Tiara Fault system combine to separate the Tia Complex from the other metamorphosed lithologies of the area.

The Netherton Fault, the Double Hut Fault and the Walcha Fault are important in relation to the proposed subdivision of the metamorphic rocks, but are of less regional significance than those described above.

None of the overlying Tertiary basalts have been displaced by any of these faults. This contrasts with the observations of Binns (1966), who found evidence in the Wongwibinda district that later movement along the basement faults in some cases also displaced the overlying Tertiary basalt.

Subdivision of the Rocks of the Mapped Area

Initial subdivision of the metamorphosed rocks of the area into the Tia Complex and the less structurally complex lithologies by the Tiara and Mummel River Faults is mentioned above. The deformed and metamorphosed lithologies are also separated by the Nowendoc and Yarrowitch Faults from less deformed, unmetamorphosed Permian (?) successions to the west and east of the mapped area, see Map 1.

Within the metamorphosed rocks the further subdivision outlined below is largely based on the recognition of blocks of contrasted lithologic character, typically bounded by faults. The position and relationship of all these subdivisions is shown in Map 1.

The Tia Complex

Three further subdivisions are proposed within this major structural unit:

1. The Oxley Metamorphics
2. The Wybeena Metamorphics
3. The Brackendale Metamorphics

These are intruded by the Tia Granodiorite and are bordered in part by the Nowendoc Ultrabasic Belt. Within the latter, four further subdivisions are proposed:

1. The Nowendoc Serpentinites
2. The Cooplacurripa Serpentinites
3. The Kangaroo Tops Serpentinite
4. The Mummel River Serpentinite

Additional subdivisions

Within the area north east and east of the Tiara and Mummel River Faults, the following additional subdivisions within the sheared and metamorphosed rocks are proposed:

1. The Karinya Metamorphics

2. The Lochaber Greywackes

3. The Woombi Greenstones

4. The Agnes Greywackes

The name Garibaldi Complex is proposed for a small composite igneous intrusion that has been deformed and metamorphosed along with the lithologies of the Agnes Greywackes. Names have already been proposed for the individual granitic intrusions of the Moona Plains area by Hobson (1970). The name Linden Hill Adamellite is given to a tiny igneous pluton situated in the north west corner of the mapped area.

Comments on the above Stratigraphic Nomenclature

It is emphasized that the nomenclature above is proposed on only an informal basis to assist in the description of the rocks and their relationships within the mapped area. Each subdivision is essentially a discrete structural, metamorphic or lithologic unit, in most cases bounded by faults. The term Metamorphics to describe some of these subdivisions is felt to be more appropriate than, for example, Units or Blocks. The terms Greenstones and Greywackes to describe other subdivisions is based on their dominant lithology.

Stratigraphical aspects of the Central Complex are at present poorly understood, but three major assoc-

iations are currently recognized, (Binns et al, 1967).

1. Woolomin-type lithologies consisting of greywackes, siltstones, slates and phyllites with cherts, jaspers and altered basic lavas. The Woolomin Beds just east of Peel Fault at Attunga have been shown to have a Silurian age, (Chappell, 1961; Hall, 1963).

2. Greywackes, siltstones and argillites with interbedded conglomerates and pebbly mudstones. Fossils from several widely scattered localities suggest this association is of Carboniferous to Permian age, (Binns et al, 1967).

3. Conglomerates with sandstones, mudstones and acid volcanics of the Tilbuster area just north of Armidale. These are also of Permian age, (Binns et al, 1967; McKelvey and Gutsche, 1969).

Although no palaeontological evidence exists on which to base definite correlations, it will be argued on lithological grounds that the first two of these associations are represented within the Tia Complex and the other metamorphosed lithologies of the mapped area.

Chapter 2

GENERAL GEOLOGY OF EACH SUBDIVISION

Introduction

In this chapter, the main characteristics of the subdivisions proposed in Chapter 1 are briefly outlined and their relationship and possible correlation discussed.

Subdivisions of the Tia Complex

The Oxley Metamorphics

This subdivision occupies the largest area of those proposed and its lithologies show a wide range in metamorphic grade. It is predominantly laminated and highly folded siliceous schists and phyllites, with interbedded metamorphosed basic rocks, cherts and jaspers.

The metamorphosed basic rocks are abundant throughout a wide belt extending from south-east of Nowendoc towards the eastern margin of the granodiorite, but are less common elsewhere in this subdivision. The majority of these basic horizons are thought to be essentially lavas, as they are almost always accompanied in outcrop by a chert or jasper horizon to which they are invariably parallel. In

addition, textures resembling those of basic lavas, with relic clinopyroxenes, are characteristic of the low grade metabasic rocks. No pillow structure is found in these horizons, but this is not surprising in view of the deformation and metamorphism which they have undergone.

The horizons of schist and phyllite are completely reconstituted, with no sign of any surviving bedding structures.

The Wybeena Metamorphics

This subdivision occupies a relatively narrow fault-bounded belt striking NNW from the Oxley Metamorphics. The lithologies of this subdivision are the same as the Oxley Metamorphics, however they exist as a separate fault-bounded block and are therefore recognized as a separate subdivision.

Amphibolites are abundant in the southern part of this subdivision, occurring as numerous, often narrow horizons, again accompanied by quartzite bands. These metabasic horizons are absent from the northern part of this subdivision, however structural unity can be demonstrated throughout, (see Part II).

The accompanying schists and quartzites are similar to those of the Oxley Metamorphics, consisting of layered and highly folded schists and massive

cherts and jaspers which are usually stained by iron and manganese oxides.

The Brackendale Metamorphics

The lowest grade representatives of this subdivision include deformed greywackes, siltstones and shales, with some conglomeratic horizons. A well developed cleavage is characteristic, and bedding remnants are transposed. The pebbles in the conglomeratic horizons have been strongly flattened parallel to this foliation.

With increase in metamorphic grade, these rocks yield layered siliceous biotite schists, and adjacent to the Tia Granodiorite they tend to become migmatitic. Progressive metamorphism of the Brackendale Metamorphics is well displayed along the Walcha-Nowendoc road.

It is notable that basic volcanic horizons and metacherts and jaspers are completely absent from this subdivision.

The Tia Granodiorite

This sub-circular intrusion has been emplaced into the highest grade metamorphic rocks. It occupies approximately 21 square miles of which about 7 square miles are covered by Tertiary basalt. It is homogeneous and is characterised by a weak to moderately developed

foliation. This intrusion is discussed in much more detail in PartIV.

The Nowendoc Ultrabasic Belt

This belt extends intermittently over about 23 miles, and is usually no more than one mile wide. Abundant growth of "black-boy" or "grass-tree" (Xanthorrhea) has taken place on the serpentinite outcrops.

The Nowendoc Serpentinite

This intrusion is about 5 miles long and up to one mile wide. Partially serpentinised peridotite is an important phase of this intrusion, and several bodies of gabbroic and doleritic rock are included in the serpentinite. This intrusion is the subject of a fairly detailed petrologic study and is discussed in Part V.

The Cooplacurripa Serpentinites

These four serpentinite intrusions are located southeast of Nowendoc, parallel to the Nowendoc Fault. These are predominantly schistose serpentinite and composite rock consisting of angular to rounded massive serpentinite inclusions in a schistose matrix. Altered gabbroic inclusions are also relatively common. Massive chert and jasper bars form a thin wall between the serpentinite and the Nowendoc Fault and Permian

sandstones and conglomerates south west of this fault.

The Kangaroo Tops Serpentinite

This contains strongly schistose serpentinite with scattered massive serpentinite inclusions. This intrusion is joined to the Mummel River Serpentinite by a series of narrow serpentinite slices within a connecting fault.

The Mummel River Serpentinite

Mapping of this body was only of reconnaissance nature, but it was established that it has a complex outcrop pattern, and is composed of schistose serpentinite and composite rock rich in inclusions of massive serpentinite. Its southern contact is against undeformed Permian lithologies.

The Other Subdivisions

The Karinya Metamorphics

This refers to a succession outcropping along Stoney and Wilson's Creek north-east of the Tiara Fault. It is characterised by numerous amphibolite horizons, which are typically massive and unfoliated, and interbedded metamorphosed greywackes, siltstones and slates. Quartzites are also prominent members of the succession. The metasedimentary lithologies have undergone little reconstitution, and contain transposed bedding remnants.

There is obviously a strong contrast between

the structural style of these rocks and that of the adjoining Tia Complex.

The Lochaber Greywackes

The greywackes, siltstones and slates of this subdivision occur in a NW-SE trending belt parallel to the Karinya Metamorphics. Metamorphosed basic volcanic horizons are absent in this subdivision, however meta-cherts and jaspers are still important members of the succession.

The Woombi Greenstones

The lithologies of this subdivision are best exposed along the Tia River, just on the western side of the Mummel River Fault. Massive greenstones, in which the original doleritic or porphyritic basaltic fabric is visible, are major members of the succession. These are accompanied by cleaved siliceous mudstones and fine grained greywackes, and horizons of laminated quartzite.

The Agnes Greywackes

This subdivision is predominantly greywacke with some slaty horizons. The greywackes are often strongly foliated, especially in the vicinity of the faults bounding this subdivision. Lenses and pods of altered igneous rock are rare members of the succession. These are light coloured, of an acid to intermediate aspect, quite different to the basic volcanic horizons

found in some of the other subdivisions. Quartzites and basic volcanic horizons are not found in this subdivision.

The Garibaldi Complex has intruded these lithologies and undergone deformation and metamorphism along with the enclosing greywackes. This is a heterogeneous intrusion, containing rock types ranging from gabbros to adamellites and some granophyres. Patches of gabbroic pegmatite are relatively common in the basic parts of the Complex. All the rocks of this intrusion have been deformed and the original igneous minerals have been partially replaced by low grade metamorphic assemblages.

In the northern part of this subdivision, all the lithologies have been regionally metamorphosed, with the rocks of highest metamorphic grade associated with the granites at Moona Plains.

Unmetamorphosed Permian

The Glen Morrison Beds

These rocks lack the penetrative deformation that characterises the above subdivisions. The dominant lithologies consist of lithic sandstones and tuffs, siltstones and shales. Pebbly mudstones are also common members, and at Nowendoc, a thick horizon of coarse conglomerate is part of this succession.

South-east of Nowendoc, Permian fossils have been found in rocks apparently continuous with these lithologies, W. Mayer Pers. Comm.

The Peters Creek Beds

This subdivision is found east of the Yarrowitch Fault. Coarse, well bedded sandstones and siltstones with interbedded pebbly mudstones are the dominant lithologies. Many of the pebbly mudstones are calcareous and a single interbedded horizon of relatively pure limestone was discovered. The Permian macrofossils:

Deltopecten sp.

Trigonotreta sp.

were found in the pebbly mudstones.

This subdivision has also undergone relatively little deformation compared with the nearby Agnes Greywackes.

Relationship and Correlation of these Subdivisions

The three lithological associations that have been recognized in the deformed Central Complex of New England were outlined in Chapter 1. Two of these associations appear to be present within the Tia Complex and the other subdivisions of the mapped area.

An appreciable proportion of the metamorphic terrain contains amphibolites and quartzites, which are the metamorphosed derivatives of basic volcanics and

cherts and jaspers. In the Tia Complex these are interlaminated with siliceous schists, whereas in other subdivisions greywackes and slates are the associated lithologies. These subdivisions within the mapped area are tentatively correlated with the Woolomin Beds, suggesting a Mid-Palaeozoic age for the Oxley Metamorphics, the Wybeena Metamorphics, the Karinya Metamorphics and Lochaber Greywackes, and the Woombi Greenstones.

Other subdivisions of the metamorphosed rocks consist of conglomerates, greywackes, siltstones and slates with no quartzites or metamorphosed basic volcanics. These lithologies are tentatively correlated with the Upper Palaeozoic lithologic association, suggesting an Upper Palaeozoic age for the Brackendale Metamorphics and the Agnes Greywackes.