STRUCTURAL INTERPRETATION IN THE
MOUNT WOODS INLIER

By James Finlay

This thesis is submitted in part fulfilment of the Bachelor of Science (Hons.) Degree, Department of Earth Sciences, Monash University.
November 1993
ABSTRACT

The Mount Woods Inlier (MWI) is an Early to Mid-Proterozoic terrane represented by numerous small scattered outcrops of metasediments and granitoids, located approximately 100 km southeast of Coober Pedy, north-central South Australia.

Field mapping of three outcrops reveal the following deformation history:

1. $D_1/M_1$ was a high T, low P event that produced an $S_1$ foliation defined by sillimanite, cordierite ± almandine garnet (Flint and Benbow, 1977).

2. $D_2$ produced folding on scales from microscopic crenulations of $S_1$ to macroscopic folding of metasedimentary units over tens of km. Steep fold axes and variations in fold orientations throughout the MWI appeal to fold interference (ie re-folding), which probably occurred during the subsequent $D_3$ shearing event.

3. $D_3$ was a shearing (+ folding) event that produced discrete zones (100's m long) and a large scale shear zone ($\geq$ 7 km) in the Spire Hills-Skylark Hills area. Kinematic indicators such as Type I S-C mylonite fabrics suggest movement was predominantly strike-slip. The discrete shear zones appear to be the result of strain caused by dextral movement on the large scale shear zone.

Dating of a foliated granitoid interpreted as syn-$D_1/M_1$ at $\sim$1700 Ma and a granite interpreted as post-$D_2$ and pre- to early syn-$D_3$ at $\sim$1580 Ma has constrained the timing of tectonism to within these dates. This deformation is synchronous with $D_3$ of the Kimban Orogeny, the Olarian Orogeny, the Ernabellan deformation of the Musgrave Block, $D_1$ of the Peake-Denison Inlier and deformation and metamorphism in the Karari Fault Zone.
The early high T, low P metamorphism, syn-D1 intrusion of I-type granitoid and subsequent folding show many similarities with the tectonic model of Etheridge et al (1987), in which this sequence of events is produced by rifting-resulting from small scale mantle convection and magmatic underplating-followed by compression due to thermal subsidence and crustal delamination.

Large scale geophysical analysis infers the early granitoid is more widespread than indicated from outcrop and has locally affected F2 fold geometry. Fold interference patterns have been interpreted as the result of D3 shear and refolding. Two broad anomalies have been interpreted as late (1580 Ma) plutons at 1 - 3 km depth. A large east-west shear zone along the northern boundary of the MWI appears related to the ~1700 Ma Karari Fault Zone, however the D3 shear event (1580 Ma) suggests subsequent movement on the shear zone.
# TABLE OF CONTENTS

1. INTRODUCTION
   1.1 PREAMBLE 1
   1.2 AIMS 1
   1.3 METHODS 2
   1.4 LOCATION 2
   1.5 GEOLOGY OF SOUTH AUSTRALIA 2
   1.6 LOCAL HISTORY 5
   1.8 PREVIOUS WORK 5
   1.9 PREVIOUS GEOCHRONOLOGY 6
   1.10 THESIS LAYOUT 7

2. ROCK TYPES
   2.1 INTRODUCTION 9
   2.2 META-SEDIMENTS 9
   2.3 INTRUSIVES 13
   2.4 MIGMATITSES 16
   2.5 COMMENTS 18

3. DEFORMATION, METAMORPHISM AND RELATIONSHIPS
   3.1 SUMMARY 19
   3.2 INTRODUCTION 22
   3.3 STRUCTURAL ELEMENTS 23
      3.3.1 Evidence For Bedding (S0) 23
      3.3.2 D1/M1 24
      3.3.3 D2 25
      3.3.4 D3 29
      3.3.1 Discrete Shear Zones 31
      3.3.2 The Large Scale Shear Zone 31
   3.4 INTRUSIVE RELATIONSHIPS 33
      3.4.1 The Engenina Adamellite 33
      3.4.2 The Balta Granitoid Suite (Red Brick Granite) 37
3.5 DISCUSSION: IMPLICATIONS OF PLUTON - DEFORMATION RELATIONSHIPS

3.5.1 D1/M1 Fabric Formation, High Temperature Metamorphism and Syn-Deformation Adamellite Intrusion
3.5.2 Origins of D2 Fold Geometry

4. GEOCHRONOLOGY

4.1 Summary
4.2 Introduction
4.3 Location of Samples
4.4 Results
4.5 Sample Selection
4.6 Correlates

5. LARGE SCALE COMBINED GEOLOGY & GEOPHYSICAL INTERPRETATION

5.1 INTRODUCTION
5.2 GEOPHYSICAL DATA
  5.2.1 Magnetic Stratigraphy
  5.2.2 Magnetic Image
5.3 INTERPRETATION
  5.3.1 Preamble
  5.3.2 The Spire Hills - Skylark Hills
  5.3.3 Mount Woods
  5.3.4 The Mirage Hills
  5.3.5 Adjacent Areas- Plutons At Depth
  5.3.6 Large Scale Structural Geometry
6 REGIONAL TECTONIC SYNTHESIS

6.1 INTRODUCTION  57
6.2 The Gawler Craton  57
6.3 Willyama Domain  57
6.4 The Karari Fault Zone  59
6.5 The Musgrave Block  59
6.6 The Ammooradinna Inlier  60
6.6 The Peake-Denison Inlier  60
6.7 Integration of Tectonic History and Structural Geometry  61

6 CONCLUSIONS  63

REFERENCES

APPENDIX  Sample Details
List of Figures

Figure 1.1 Pre Cambrian provinces of South Australia 3
Figure 1.2 Outcrop map of Mt. Woods Inlier 4
Figure 2.1 Folding in the Banded Iron Formation, Mt Woods 10
Figure 2.2 Meta-conglomerate overlain by sandstone interbeds, Spire Hills 11
Figure 2.3 Sedimentary Xenolith in Adamellite, Central Spire Hills 13
Figure 2.4 Gneissosity in Mirage Gneiss 14
Figure 2.5 Equigranular Red Brick Granite, South Central Spire Hills 15
Figure 2.6 Banded Iron Formation in the Balta Migmatite (melt), South Central Spire Hills 17
Figure 3.1 Time event diagram 21
Figure 3.2 Sedimentary layering in Banded Iron Formation, North west Spire Hills 23
Figure 3.3 Photomicrograph of Banded Iron Formation, North west Mt. Woods 24
Figure 3.4 Inclined F₂ folds in Banded Iron Formation, North west Mt. Woods 25
Figure 3.5 Structural map of Mt. Woods 26
Figure 3.6 3D schematic diagram of layer at Mt. Woods 27
Figure 3.7 Structural map of Spire Hills 28
Figure 3.8 Rootless folding in migmatite sample 29
Figure 3.9 Shear sense diagram 30
Figure 3.10 Type I S-C shear fabrics in adamellite, North east Spire Hills 30
Figure 3.11 Large shear zone, North west Skylark Hills 32
Figure 3.12 Representation of foliation through xenolith 34
Figure 3.13 Photomicrograph (PPL). Biotite defining foliation in the Engenina Adamellite, Spire Hills 35
Figure 3.14 Photomicrograph (XPL). Engenina Adamellite, Skylark Hills 35
Figure 3.15 Random orientation of phenocrysts within Engenina Adamellite, west Skylark Hills 36
Figure 3.16 Well defined phenocrysts in Engenina Adamellite, south Skylark Hills 36
Figure 3.17 Photomicrograph (PPL). Fibrolite cross cutting biotite in migmatite, southeast Spire Hills 38
Figure 3.18 Migmatite hand specimen from southeast Spire Hills 39
Figure 3.20 Geotherm diagram 40
Figure 3.21 Etheridge model for magmatic underplating 43
Figure 3.21 Magnetic stratigraphy 50
Figure 5.2 Effects of High Pass Filter 51
Figure 3.3 Magnetic Image 52
Figure 3.4 Depth of Balta pluton 55