

J. FOSDY

**THE RATHJEN GNEISS:
CONSTRAINTS ON THE TECTONIC HISTORY OF THE
KANMANTOO GROUP AROUND SPRINGTON, SOUTH
AUSTRALIA.**

by

Tania L.A. Madigan

Thesis submitted as partial
fulfilment for the Honours
Degree of Bachelor of Arts

Department of Geology,
University of Adelaide,
November 1988.

TABLE OF CONTENTS

ABSTRACT.....	3
1 INTRODUCTION.....	4
1.1 AIMS AND OBJECTIVES	4
1.2 GEOGRAPHICAL LOCATION AND SETTING.....	4
1.3 PREVIOUS GEOLOGICAL INVESTIGATION	4
1.4 REGIONAL GEOLOGY.....	5
2. LITHOLOGIES	6
2.1 INTRODUCTION	6
2.2 THE RATHJEN GNEISS	6
2.3 THE BIOTITE RICH METASEDIMENTS.....	6
2.3.1 THE BIOTITE SCHIST.....	7
2.2.2 BIOTITE GNEISS.....	7
2.2.3 MIGMATITES	7
2.4 TALC ROCK.....	7
2.5 CALCSILICATE GNEISS	8
2.6 ALBITIZED PHYLLITE.....	8
2.7 EPIDOTE GNEISS	8
2.8 EPIDOTE APLITE.....	9
2.10 LEUCOGABBRO.....	9
2.11 AMPHIBOLITES	10
3. STRUCTURAL HISTORY.....	11
3.1 INTRODUCTION	11
3.2 DEFORMATION AT SPRINGTON	11
3.4 THE STRETCHING LINEATION.....	12
4. ORIGIN OF THE RATHJEN GNEISS.....	14
4.1 INTRODUCTION	14
4.2 EVIDENCE OF GENESIS.....	14
4.2.2 GEOCHEMICAL CRITERIA.....	16
4.2.3 CONCLUSIONS.....	17
5. GEOCHEMISTRY AND PETROLOGY OF GABBROS	18
5.1 INTRODUCTION	18
5.2 GABBRONORITE.....	18
5.3 LEUCOGABBRO.....	20
5.4 CONCLUSIONS.....	20
6. METAMORPHISM.....	21
6.1 INTRODUCTION	21
6.2 AMPHIBOLE-PLAGIOCLASE EQUILIBRIA	21
6.3 INTERPRETATION OF DATA.....	24
6.4 CONTROLS ON MELTING IN PELITIC MIGMATITES.....	25
6.5 CONCLUSIONS.....	26
7. GEOLOGICAL SYNTHESIS	27
7.1 INTRODUCTION	27
7.2 A RELATIVE CHRONOLOGY OF DEFORMATION AND METAMORPHISM IN THE KANMANTOO.....	27
7.3 SIGNIFICANCE OF THE STRETCHING LINEATION AT SPRINGTON.....	28
7.4 THERMAL CAUSES OF BUCHAN ZONE METAMORPHISM AT SPRINGTON.....	28
7.5 CONCLUDING DISCUSSION	30
ACKNOWLEDGEMENTS	31
REFERENCES	32
APPENDIX 1.....	37
APPENDIX 2.....	44
APPENDIX 3.....	49
APPENDIX 4.....	50

LIST OF TABLES, FIGURES AND PLATES

A. Tables

1. Rathjen Gneiss geochemistry
2. Gabbonorite geochemistry
3. Pressure estimates

B. Figures

1. Locality Map
2. Map of Rathjen gneiss stretching lineation
3. Rathjen gneiss granitic norms
4. Comparative spidergram of Rathjen gneiss to syn and post Delamerian granites
5. Comparative biotite analyses of Kanmantoo Group rocks
6. Spidergram of gabbonorite
7. Spidergram of Black Hill samples
8. Amphibole-plagioclase phase diagram
9. Schematic X_{Ab} vs. $X_{Na(A)}$ plots
10. X_{Ab} vs. $X_{Na(A)}$ plots of rocks from mapped area
11. X_{Ab} vs. $X_{Na(A)}$ temperature plot
12. Plagioclase miscibility diagram
13. Comparative Fe vs. Mg plots for migmatites
14. Comparative Fe vs. Mg plots for migmatites, Rathjen gneiss and biotite schist
15. Relative deformational and metamorphic chronology

C. Plates

1. Metamorphism of Kanmantoo after Preiss, 1987
2. Lithologies
3. Photomicrographs
4. Structural evidence
5. Intrusive nature of the Rathjen gneiss

ABSTRACT

The Rathjen gneiss in the vicinity of Springton in the Mount Lofty Ranges is shown to be fundamentally important to our understanding of the metamorphic and deformational history of the Southern Adelaide Foldbelt. Field and geochemical criteria are used to prove conclusively that the Rathjen gneiss is a metamorphosed intrusive. A prominent N-S trending stretching lineation particularly well developed in the Rathjen gneiss indicates previously unrecognized N-S tectonic transport early in the history of the Delamerian Orogeny. Amphibole-plagioclase equilibria in the mapped area indicate metamorphic conditions ($\sim 700^{\circ}\text{C}$, < 5 kbars) consistent with the results of studies in nearby areas (e.g. Sandiford et al., in press), although the errors associated with these constraints are large and therefore the comparison tenuous. These temperatures are clearly in excess of those expected to be reached by crustal thickening and erosion and require some other heat source. Evidence of magmatic activity is abundant in the area with the Rathjen gneiss; a previously unidentified gabbro and leucogabbro and amphibolite dykes all being capable of supplying additional heat to the area through various stages of the metamorphic history.