

THE UNIVERSITY OF ADELAIDE

S-TYPE GRANITE FORMATION AT VIVONNE
BAY, KANGAROO ISLAND

by SIMON F. MITCHELL B.Sc.

November, 1990

**S-TYPE GRANITE FORMATION
AT VIVONNE BAY, KANGAROO ISLAND**

Simon F. Mitchell, B.Sc.

**SI-5316-6326-III
KINGSCOTE 1:250000 SHEET
VIVONNE 1:50000 SHEET**

**Thesis submitted as partial fulfilment
of the Honours degree of Bachelor of Science**

**University of Adelaide
Department of Geology and Geophysics**

October, 1990

TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	LOCATION, REGIONAL GEOLOGY AND PREVIOUS WORK	2
3.	LITHOLOGICAL DESCRIPTION	4
3.1.	THE GRANITES	4
3.2.	THE MIGMATITIC METASEDIMENTS	8
3.3.	SUMMARY OF LITHOLOGICAL RELATIONSHIPS	10
4.	STRUCTURAL DESCRIPTION	11
4.1.	DEFORMATION PHASES	11
4.2.	MIGMATITIC FABRICS	13
4.3.	SUMMARY OF STRUCTURAL DESCRIPTION	14
5.	METAMORPHISM	16
5.1.	MINERALOGY OF THE VIVONNE BAY SECTION	16
5.2.	MIGMATISATION	17
5.3.	SUMMARY OF METAMORPHIC FEATURES	18
6.	GEOCHEMISTRY	20
6.1.	OBJECTIVE	20
6.2.	GEOCHEMISTRY OF THE GRANITE-MIGMATITE	20
6.2.1.	Introduction	20
6.2.2.	CLASSIFICATION OF THE VIVONNE BAY SECTION GRANITES AND COMPARISONS WITH THE L.F.B.	21
6.2.3.	S-TYPE GRANITE TEST	22
6.2.4.	SOME GENERAL TRENDS	22
6.3.	ISOTOPE ANALYSES	24
6.4.	GEOCHEMICAL MODELING	25
6.4.1.	PARTIAL MELTING OF THE METASEDIMENTS	25
6.4.2.	MASS BALANCE TEST	26
6.4.3.	TRACE ELEMENT DISTRIBUTION TEST	27
7.	INTERPRETATION AND CONCLUSIONS	29
	ACKNOWLEDGEMENTS	31
	REFERENCES	32

List of Tables and Figures

- Table 1 Selected Microprobe Analyses of Mineral Compositions from the Vivonne Bay Migmatite-Granite
- Table 2 Selected Migmatite-granite analyses from Vivonne Bay and the Lachlan Fold Belt
- Table 3 Isotope Data for the Vivonne Bay Section
- Table 4 Results of the Least Squares Residual Model
- Table 5 Result of Trace Element Distribution Test
-
- Figure 1 Generalised Relationships Between The Vivonne Bay Lithologies
- Figure 2 Deformation History of the Vivonne Bay Section
- Figure 3 Sketches of Structural Features
- Figure 4 Mineral Assemblages Across a Simplified Section of Vivonne Bay
- Figure 5 Major Element Chemistry
- Figure 6 Trace Element Chemistry
- Figure 7 Isotope Analyses
- Figure 8 Trace Element Distribution Results
-
- Plate 1 Photomicrographs of the Migmatite Fabrics and Structural Features of the Vivonne Bay Section
- Plate 2 Photomicrographs of Thin Section Features of the Vivonne Bay Section

ABSTRACT

Demonstrating a genetic association between a granite and the surrounding country rock by field relationships is usually difficult. However, wave cut platform exposures at Vivonne Bay, Kangaroo Island, display a variety of granites, each of which has evolved under different but related processes. Both field relationships and geochemical analyses were used to describe the granite-migmatite association and allow the processes of formation to be assessed.

There are five major granite lithologies recognised along the Vivonne Bay section, viz; biotite granite, garnet granite, leucocratic granite, felsic granite and porphyritic granite. Field relationships indicate that the leucocratic granite, felsic granite and garnet granite are small (<200m) intrusives, while the porphyritic granite is a kilometre scale intrusion which forms the "core" of the section. The small scale (<200m) biotite granite is intimately associated with a biotite metasediment and granitised metasediment (or subgranite). The level of metamorphism of the metasediments is very high, reaching migmatite grade in most parts of the section, and is proportional to the proximity of the porphyritic granite core.

Geochemical analyses indicate two major trends. The first trend suggests the intrusive granites form a fractionation relationship and the second trend implies that the biotite granite is the product of partial melting of the metasediments. Mass balance modeling and an analysis of the trace element distribution reinforced the suggested trends. This study concluded that the granites at Vivonne Bay represent four different stages in melt evolution;

Stage 1: Unsegregated partial melting of the metasediments producing a subgranite

Stage 2: Metre scale segregations of partial melt from the metasediments producing a biotite granite

Stage 3: Kilometre scale pluton accumulations of biotite granite melts producing a porphyritic granite

Stage 4: Fractionation from the porphyritic granite producing a garnet granite.