DEFORMATION AND METAMORPHISM OF THE AILEU FORMATION,

EAST TIMOR.

by

R. F. Berry (B.Sc. Hons.)

SCHOOL OF EARTH SCIENCES

FLINDERS UNIVERSITY OF SOUTH AUSTRALIA

May 1979

TABLE OF CONTENTS

				page	
Tab	le of	conte	ents	i	
Lis	List of figures				
List of tables					
List of plates					
Abstract					
Acknowledgements					
T •	INTR			*	
	1.1	Pream		1	
	1.2	Propo	sed model for the tectonism of Timor	3	
	1.3	Desig	n and limitations	12	
	1.4	Previ	ous work	14	
		1.41	The Aileu Formation	14	
		1.42	Other rock groups	16	
	1.5	Data	collection	16	
2.	THE AILEU FORMATION			19	
	2.1	Litho	logy	19	
		2.11	Data	19	
		2.12	Discussion	26	
	2.2	Igneo	us petrology	31	
	2.3	.3 Structural analysis		47	
		2.31	Mesoscopic studies	47	
		2.32	Macroscopic interpretation	68	
	2.4	Metam	orphism	80	
		2.41	Introduction	80	
		2.42	Mineralogy	81	
		2.43	Microstructures	112	
		2.44	Assemblages and facies	131	
		2.45	Summary	145	
	2.5	Fault	- S	146	
	2.6	2.6 The are of metamorphism		155	
		2.61	Radiometric dating	155	
		2.62	Discussion	163	
	2.7	Summa		163	
		the search mode	- 1	±00	

page

APPENDICES

1.	Analytical techniques	323	
2.	Supplementary tables and figures of petrological data	325	
3.	The Barique Formation	339	
4.	Computer programmes	349	
5.	Observed lithology	361	
6.	Calculations supporting Section 4.43	368	
SELECTED BIBLIOGRAPHY			

LIST OF FIGURES

Figure

Tithelogy of the Dili Menstute eres. Ract Miner	in back
Lithorogy of the Dill-Manatulo area, East Timor	pocket
Eastern Indonesia	2
Towns and villages of Timor	4
Schematic representation of the models proposed for the the structure of Timor	6
Interpretive cross-sections of East Timor - Thrust Model	8
Interpretive cross-sections of East Timor - Melange Model	9
Interpretive cross-sections of East Timor - Autochthonous Model	11
Aileu Formation - igneous sample locations	37
Aileu Formation - major element variation diagrams	41
Aileu Formation - triangular variation diagrams	43
Aileu Formation - immobile trace element discriminatory diagrams	45
Lower hemisphere equal area projections of all structural data from the Aileu Formation	51
Aileu Formation - mean S ₁ orientations	52
Aileu Formation - mean S ₂ orientations	55 [`]
Aileu Formation - mean F ₂ orientations	56
	Lithology of the Dili-Manatuto area, East Timor Eastern Indonesia Towns and villages of Timor Schematic representation of the models proposed for the the structure of Timor Interpretive cross-sections of East Timor - Thrust Model Interpretive cross-sections of East Timor - Melange Model Interpretive cross-sections of East Timor - Autochthonous Model Aileu Formation - igneous sample locations Aileu Formation - major element variation diagrams Aileu Formation - triangular variation diagrams Aileu Formation - immobile trace element discriminatory diagrams Lower hemisphere equal area projections of all structural data from the Aileu Formation Aileu Formation - mean S ₁ orientations Aileu Formation - mean S ₂ orientations Aileu Formation - mean F ₂ orientations

ABSTRACT

A 10 km wide coastal strip of the Aileu Formation was mapped in detail. This section of the north coast of Timor lies 70 km south of a recently active island arc and was chosen as a potential type example of the deformation style in an arc-continent collision zone. In addition a brief study was made of the petrography and chemistry of altered igneous rocks from this coastal strip and igneous rocks of a similar age from other regions in East Timor.

The Aileu Formation is composed of metamorphosed shales, siltstones and arenites with minor limestones and basites. The metamorphic grade of this formation is zoned from lower greenschist facies in the southwest to upper almandine-amphibolite facies in the east. Five structural phases are recognised. The first generation is a cleavage or schistosity which predates the single prograde metamorphism. No folds were found associated with this foliation and its significance is unknown. The second deformation phase occurred in the Late Miocene. It syn- and post-dates the prograde metamorphic event, produced tight folds and transposed the compositional layering and early cleavage on all scales. The last three deformation phases produced open to gentle macroscopic folds. Correlations with structural data from other formations suggest the third and fourth phases occurred in the Late Miocene and the fifth deformation occurred in the Early Pleistocene. The major high angle faults, which form the boundaries of the Aileu Formation, were also active in the Early Pleistocene.

The amphibolites and altered dolerites of the Aileu Formation are transitional, in composition, between alkaline and tholeiitic basalts. Permian and Mesozoic basalts and dolerites from other regions in East Timor include both alkaline and tholeiitic compositions. All these igneous rocks are characteristic of continental rift valleys and ocean islands. However the associated sedimentary rocks were deposited on a continental shelf or slope. There is no evidence that the Aileu Formation or the Permian and Mesozoic formations were not formed on the Australian continental margin.

The geology of Timor is consistent with its evolution as a rift valley in the Late Palaeozoic and Early Mesozoic, and a trailing margin from the Cretaceous to the Early Miocene. Structural data suggests a Late Miocene arc-continent collision. There has been post-orogenic uplift and minor additional deformation in the Plio-Pleistocene. Comparison of Papua New Guinea with Timor suggests that the mobile belt in arc-continent collisions is characterised by medium pressure metamorphism, relatively coherent deformation style, and a short history of orogenic activity. Little evidence of thrusting or imbrication has been uncovered and their importance as deformation processes in this environment remains speculative.

xi

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any University; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

R. F. Berry.

ACKNOWLEDGEMENTS

The writer is indebted to Dr. A.E. Grady for advice and encouragement throughout the planning and execution of this project. He also wishes to express his gratitude to Dr. M.J. Abbott, Dr. F.H. Chamalaun, Mr. D. Flint, Mr. R. Flint, Professor D.H. Green, Mr. S. Harley, Mr. G. Jenner, Dr. J. Sunderland and Dr. R. Varne for their advice and criticism of various sections of the thesis work. Broken Hill Proprietary kindly provided copies of internal reports and the writer especially wishes to thank B.H.P. staff who provided encouragement during the 1974 field season.

The local authorities in Dili, East Timor made this study possible by providing accurate topographic maps and access to aerial photographs. The XRF analyses were done at the Department of Geology and Mineralogy, University of Adelaide with the invaluable advice of Dr. R.W. Nesbitt. The radiometric age dating was carried out by the Australian Mineral Development Laboratories, Adelaide. Mr. I. Dyson prepared the rock thin sections studied during this project. This work was supported by a Commonwealth Postgraduate Research Award.

xiii