



**The influence of bulk rock MnO on garnet development in
metamorphic rocks of andalusite-staurolite grade;
Kanmantoo, South Australia.**

By

Wade J. Bollenhagen

This thesis is submitted as partial fulfillment for the
Honours degree of Bachelor of Science .

Department of Geology and Geophysics
University of Adelaide
November 1993

National Grid Reference (SI-54) 6627-I
6727-IV 1:50000

ABSTRACT

An outcrop of meta-pelitic schist from near the township of Kanmantoo, South Australia, was chosen to demonstrate the effect that increased bulk MnO content has on metamorphic assemblage development.

From bulk composition and petrological analyses it is observed that the presence of small amounts of MnO in high X_{Fe} pelitic rocks correspond with the development of garnet. The incorporation of Mn into the KFMASH model system describes the existence of garnet with andalusite and staurolite that KFMASH does not predict.

Furthermore it shown that modal abundances of garnet are proportional to bulk MnO rock contents, enhancing the prediction that MnO causes an expansion of all garnet-bearing assemblages. This allows for the description of the numerous appearances of the garnet mineral in rocks that have calculated temperatures and pressures, for which it is not predicted to exist at.

CHAPTER 1. Introduction.....	1
CHAPTER 2. Geology of the KANMANTOO Area.....	3
2.1. Geological Background.....	3
2.2. Metasediments of the Kanmantoo Area.....	3
2.2.1. Structure.....	4
2.2.2. Metamorphic considerations for the Kanmantoo.....	4
2.3. KFMASH Model Predictions for mineral assemblages.....	5
CHAPTER 3. Mineral Assemblages and Bulk Compositions of Meta- pelitic Rocks of Kanmantoo, South Australia.	
3.1. Introduction.....	7
3.2. Bulk Composition of sample space.....	8
3.2.1. Variations in the sample space.....	8
3.2.2. Composition Variation within the Assemblages.....	12
3.3. Mineral Chemistry	
3.3.1. Mineral Variations across the sample space.....	13
3.3.2. MnO partitioning amongst minerals.....	18
3.4. Comparison of mineral assemblages and bulk composition.....	19
3.4.1. Discussion of data.....	19
3.4.2. Conclusion.....	22
CHAPTER 4. Distribution of MnO in garnet across the sample space	
4.1. Andalusite-staurolite assemblage.....	23
4.2. Andalusite-staurolite-garnet assemblage.....	23
4.3. Staurolite-garnet assemblage.....	26
4.4. Summary.....	32
CONCLUSIONS.....	33

ACKNOWLEDGEMENTS

REFERENCES

APPENDICES

A - MAPS TO LOCALITIES

B - PETROLOGICAL ANALYSES

C - PROBE ANALYSES

D - BULK COMPOSITIONAL ANALYSES

LIST OF FIGURES

Figure 1:-Southern Adelaide Fold Belt

Figure 2:-Metamorphic Grades of Southern Adelaide Fold Belt, plus locality of field site

Figure3:-Kanamntoo Syncline

Figure4:-P-T pseudo-section

Figure5:-P-T pseudo-section

Figure6:- X_{Fe} of sample space

Figure7:- X_{Mn} of sample space

Figure8:- X_{Al} of sample space

Figure9:- X_{Mg} of sample space

Figure10:- X_{Mn} vs $Fe/Fe + Mg$

Figure11:-T- X_{Fe} diagram

Figure12:-AFM diagrams

Figure13:-AFMn diagrams

LIST OF GRAPHS

Graph 1a:-Distribution of garnet across sample space

Graph 2a:-Distribution of andalusite across sample space

Graph 3a:-Distribution of staurolite across sample space

Graph 2:- Comparison of garnet and bulk MnO content

Graph 3:- Distribution of MnO (in garnets) across sample space

Graph 4a:- MnO profile across garnet

Graph 4b:- MnO profile across garnet

Graph 4c:- MnO profile across garnet

Graph 4d:- MnO profile across garnet

Graph 4e:- MnO profile across garnet

Graph 4f:- MnO profile across garnet

Graph 4g:- MnO profile across garnet

Graph 4h:- MnO profile across garnet

Graph 4i:- MnO profile across garnet

Graph 4j:- MnO profile across garnet

Graph 4k:- MnO profile across garnet

Graph 4l:- MnO profile across garnet

LIST OF TABLES

Table 1:-Bulk composition of samples

Table 2:-Modal proportions

Table 3:-Mineral formulas