STRUCTURAL AND METAMORPHIC RELATIONS BETWEEN LOW, MEDIUM AND HIGH GRADE ROCKS, MT FRANKS - MUNDI MUNDI AREA, BROKEN HILL, N.S.W.

by

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PART I

of two parts plus Appendices

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-LIST OF ABBREVIATIONS USED IN TEXT

D_I	first deformation
D_2	second deformation
D_3	third deformation
D_4	fourth deformation
M_I	first metamorphism
M_2	second metamorphism
M_3	third metamorphism
S_o	bedding
S_I	first schistosity visible in the field and axial planar to first generation folds in bedding
S_{IP}	S_I parallel to bedding
S_{IN}	S_I non parallel to bedding
$S_o//S_I$	S_o parallel to S_I
S_IPs	S_I developed in psammite
S_IPe	S_I developed in pelite or psammopelite
S_2	second generation schistosity
S_3	third generation schistosity
S_4	fourth generation schistosity
S_{I-3}	undifferentiated S_I or S_3
S_R	retrograde schistosity occurring within retrograde schist zones
L_I	mineral/aggregate lineation in S_I
L_3	mineral lineation in S_3
L_M	mineral lineation in S_R

ABBREVIATIONS(ctd)

F_I first generation fold

F_2 second generation fold

F_3 third generation fold

F_4 fourth generation fold

F_R fold with S_R axial planar

F_{R+I} fold in S_R

XYZ maximum, intermediate and minimum axes of the strain ellipsoid

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APPENDIX I reprint of paper entitled "Tectonic Relations between the Proterozoic Gawler and Willyama Orogenic Domains, Australia" by Glen, R.A., Laing, W.P., Parker, A.J., and Rutland, R.W.R.
J. Geol. Soc. Aust., 24 (3), 125-150. 1977.

APPENDIX II reprint of paper entitled "The significance of sedimentary structures in the Willyama Complex, New South Wales" by Glen, R.A., and Laing, W.P.
Proc. Australas. Inst. Min. Metall., 256, 15-20. 1975.

APPENDIX III Geometrical analysis of Mt Franks - Mundi Mundi Area in terms of subareas.

APPENDIX IV reprint of paper entitled "Large scale early folding and tectonic levels in the northwestern part of the Willyama Complex, New South Wales" by Glen, R.A.
Geol. Surv. N.S.W. Quarterly Note 31, 4-15. 1978.

SUMMARY

Investigations in the northwestern part of the Willyama Complex centred on the Mt Franks - Mundi Mundi area have established a 4 km thick stratigraphic section of conformable metasediments containing thin horizons of basic volcanics in the lower two-thirds of the sequence. Establishment of this sequence was only possible once it was shown that the dominant lithological layering in metasediments is bedding, and that there has been no mesoscopic transposition during deformation. The metasediments represent a sequence of clay sands deposited in a distal shelf-slope or basin type of environment.

A sequence of deformational and metamorphic events established in these rocks is regarded as an expression of the Middle Proterozoic Olarian Orogeny (c. 1695 - 1520 Ma.) and except for some reactivation of shear zones, predate deposition and deformation of the unconformably overlying Adelaidean sediments.

The important D_1 deformation is a complex, progressive event with pre-S_1 static mineral growth (biotite, andalusite, sillimanite, white mica) and early minor micro-folding recognised before syn-S_1 growth and F_1 folding. An even earlier period of pre-S_1 fabric formation mainly defined by white mica, biotite and ilmenite, is not related to any visible folding and may either represent an earlier discrete event or an early phase of the D_1 event. However, as now defined, minerals outlining this pre-S_1 fabric are related to the D_1 event.

The low, medium and high grade metamorphic zones defined in the field by biotite, andalusite and sillimanite respectively are pre-S_1 in age and predate F_1 folding. The intensity of metamorphism increases with depth so that there is a broad depth control on metamorphism. Relations at the andalusite/sillimanite isograd conform to a Carmichael (1969) type model and reactions took place via an intermediate sericite phase.

The main effect of F_1 folding is the formation of the variably plunging variably oriented Kantappa - Lakes Nob Syncline of regional extent. Only the western limb of this fold is now visible over much of its length. This fold deforms existing metamorphic zones and thus controls the relationship of low, medium and high grade rocks in this part of the Willyama Complex. The orientation of this syncline changes from vertical in the low grade rocks to inclined at depth. The western limb becomes overturned at depth so that subsequent folds are downward facing. There is also a change in fold tightness with depth - from open-tight in the low grades to tight-isoclinal in the high grades, and this is accompanied by a change in S_0/S_1 relations (from core to limb area) from non parallel to parallel. These changes are coupled with a rotation of extension direction (mass transfer direction) from subvertical to inclined and may be explained by original formation and subsequent modification of upright F_1 folds. Later modifications are recorded by open folding and overturning of S_1 - this is ascribed to a final phase of the D_1 event.

Mineral growth in D_1 time resulted in the formation of S_1 varying in grade from muscovite + quartz to sillimanite. S_1 varies from homogeneous to layered, and in the latter case, consists of M + QM layers, the spacing of which is controlled by F_1 microfolding. S_1 formation involved rotation, mass transfer, and volume decrease in M layers and (re)crystallisation.

The D_2 event in this area was of only minor significance. The D_3 event developed in response to NW-SE shortening and resulted in the formation of variably plunging, vertical northeast trending folds. Where SW plunging, these folds lie subparallel to L_1. The nature of the D_3 event is controlled to a large extent by S_0/S_1 relations and folding of S_1 across unfolded S_0 occurs where S_0 lies parallel to the XY plane of the D_3 event. S_3 formed as a muscovite + quartz schistosity by rotation, recrystallisation, mass transfer and mimetic growth.

During the final stages of the D_3 event, north-east trending retrograde schist zones were formed. These were later reactivated during the folding of the Adelaidean. The final phase of the Olarian Orogeny consists of minor D_4 folding and crenulation.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any University, nor does it contain, to the best of my knowledge and belief, any material published or written by any other person except where due reference and acknowledgement is made in the text.

R.A. Glen.

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