# The structure and metamorphism of the Irindina supracrustal assemblage on the western side of the Entia Dome, Harts Range, central Australia.

Volume One

by

Robert William LAWRENCE
B.Sc.(Hons), Adelaide

Department of Geology and Geophysics
The University of Adelaide

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# CONTENTS

## VOLUME ONE - RESULTS OF FIELD INVESTIGATIONS

CHAPTER FIVE - THE HARTS RANGE META-IGNEOUS COMPLEX



CHAPTER SIX - THE ORIGIN OF THE HARTS RANGE RUBY DEPOSITS

## SUMMARY

The Irindina supracrustal assemblage of the eastern Arunta Inlier, central Australia, comprises roughly equal proportions of metamorphosed sedimentary and igneous rocks. The former consist of metapelites with lesser amounts of marble, calc-silicate and quartzite. The latter are classified into the Harts Range meta-igneous complex, which consists predominantly of amphibolites and also contains the Entire anorthosite. Ruby deposits occur within the Entire anorthosite.

The igneous origin of amphibolites assigned to the Harts Range meta-igneous complex is confirmed because they have identical major and trace element compositions to uncommon metagabbro boudins. These amphibolites are considered to have recrystallized from submarine basalts. The Entire anorthosite is considered comagmatic with the amphibolites and was intruded into the volcano-sedimentary pile prior to deformation and metamorphism.

Typical crustal trace element abundance patterns occur in metapelites and some calc-silicates. These patterns are attributed to detrital material from a provenance of upper crustal material. Some unusual trace element patterns in some calc-silicates and quartzites (metacherts?) and are attributed to chemical precipitation from sea water.

The Irindina supracrustal assemblage was metamorphosed prior to or during the first deformation ($D_1$) which affected these rocks. Partial melting of basalts produced tonalite veins before metamorphic hornblende formation. Deformation and metamorphism of the basalts and tonalites, during $D_1$, produced

banded amphibolites. Ubiquitous felsic augen in the metapelites formed by partial melting or metamorphic segregation, synchronous with tonalite production, and deformation during $D_1$. $D_1$ resulted in pervasive $S_1$ foliations and $L_1$ mineral lineations, which developed subsequent to or during the main metamorphism.

The conditions of metamorphism during $D_1$ are estimated to be in the range 710-730°C and 6-8 kbar. The estimates are made using modified models for mixing of components within garnet to update existing garnet biotite thermometry and garnet plagioclase sillimanite/kyanite quartz barometry.

Major folds are common in the Irindina supracrustal assemblage and most refold the pervasive $S_1$ foliation with little or no new fabric development. In the ruby mine area $F_2$ is isoclinal and major folds have an amplitude of about 10 km. $F_3$ is represented by an isolated major tight asymmetrical fold. $F_2$ and $F_3$ both trend northeasterly parallel to the $L_1$ mineral lineation. In the Mt Palmer area, 10 km west of the ruby mine area, east-west trending folds are refolded by northeast trending folds. These two fold generations are very tight and are considered to post-date $F_2$ of the ruby mine area, but their timing relative to $F_3$ is unknown.

The microstructural features of post $F_1$ isoclinal to tight folds are similar. In pelitic lithologies $S_1$ biotite has been recrystallized after folding without producing new foliations. $L_1$ sillimanite is kinked and not recrystallized. In amphibolites hornblende appears to form an axial lineation in folded samples, but this lineation is attributed to kinking of earlier grains rather than new mineral growth. Folded

quartz-rich layers in amphibolites contain axial planar foliations due to flattening of quartz and consequential rotation of hornblende.

The deposits of semi-precious ruby from the ruby mine area resulted from metasomatic exchange between anorthosite and ultramafic rock within the Entire anorthosite. During isoclinal $F_1$ folding, ultramafic rock was more competent than anorthosite. Layers of anorthosite in ultramafic rock, produced during $F_1$ isoclinal folding, were the sites of the most extensive metasomatic alteration. Ultramafic rocks comprising olivine, spinel and clinopyroxene had a lower chemical potential for silica than adjacent anorthosite. Silica migration facilitated the formation of $S_1$ hornblende in ultramafic rock and the loss of silica from anorthosite produced altered anorthosite which was relatively enriched in alumina. Ruby formed after plagioclase and hornblende in the altered anorthosites became saturated in alumina. The presence of $S_1$ foliations in the coarser-grained altered anorthosites indicates that metasomatism was complete before the end of the event that produced $S_1$.

The formation of secondary chlorite in the ultramafic rocks caused them to become less competent than anorthosite during $F_3$ folding. Hornblende breakdown during chlorite formation released silica and sodium which resulted in veins of sodic plagioclase within anorthite-enriched anorthosites.