MYLONITE DEVELOPMENT IN THE WOODROFFE THRUST, NORTH OF AMATA, MUSGRAVE RANGES, CENTRAL AUSTRALIA

VOLUME 1

by

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SUMMARY

The mylonitization of amphibolite and granulite facies acid gneisses lying respectively east and west of the Woodroffe Thrust, central Australia has been studied in detail in an area fifteen kilometres north of Amata. The macro, meso and microstructural effects of mylonitization on the structure of the country rock to either side, and the further development of the mylonitic rocks was examined. The microstructural study was confined to the major constituents within the rocks examined i.e. quartz, feldspar and mica. The development of host and new grain fabrics, and the angular relationships between host and new grains, and adjacent new grains, for quartz, was also studied in some detail.

The schistosity within the mylonitic rocks is axial plane to folds of country rock layering and schistosity, on both sides of the main mylonite belt. This is most apparent in the amphibolite facies gneisses east of the Woodroffe Thrust as they have been strongly penetrated by the mylonitization. Intrafolial folds of the mylonitic schistosity which refold the above folds, are also produced such that the axial planes of the later folds are parallel to the mylonitic schistosity outside them. Both the mylonitic lineation and the axes of these folds bend through large angles in the plane of the mylonitic schistosity. This phenomenon occurs on all scales, and there is evidence to suggest that it causes ductile rotation of relatively unmylonitized blocks several kilometres long of amphibolite facies acid gneiss (sitting within the mylonite) relative to one another about an axis normal to the mylonite schistosity.

The microstructural development of the mylonites is described in terms of ductile deformation and recrystallization. The only brittle

deformation present occurs about, and associated with, pseudotachylite formed on the granulite facies acid gneiss margin to the mylonitic rocks. The pseudotachylite forms as a late stage event and is often discordant with and intrusive into the mylonitic schistosity. It is thought to be a product of fusion after brittle failure due to an increased strain rate. Significant differences in recrystallization microstructures occur from the granulite to the amphibolite facies side of the mylonite zone (i.e. from west to east). The subgrain and new grain size in quartz and feldspar, the new grain size in mica, and the degree of recrystallization relative to strain is far greater on the amphibolite facies side. Subgrains were seen in highly deformed mica on the granulite facies side but not on the amphibolite facies side. In quartz, the nucleation sites for new grains differ across the zone with new grains growing on host grain edges on the amphibolite facies side but on host grain edges and deformation band boundaries on the granulite facies side. The nucleation mechanisms in quartz and feldspar include bulge, subgrain growth and coalescence, and in quartz on the amphibolite facies side, involve considerable subgrain rotation. The nucleation mechanisms in mica may involve subgrains on the granulite facies side but not on the other side.

Host grain - new grain angular relationships (from c - axes) for quartz also differ considerably from side to side across the main mylonite zone. On the granulite facies side there is an extremely strong angular relationship between host grains and new grains directly adjacent to them. On the amphibolite facies side there is no such relationship but instead a near-uniform angular distribution of new grains about the host. There is also a considerable difference in the fabric development relative to the degree of strain. On the amphibolite facies side of the main mylonite zone the mylonite fabric is strongly developed within host grains with very little strain, whereas, on the granulite facies side the same degree of preferred orientation is not attained until there has been considerable strain. New grains also develop the mylonite fabric during syntectonic growth with relatively less strain on the amphibolite facies side. Hence there must be a radical difference in the combination of slip and climb systems operating from side to side across the main mylonite zone. These differences in nucleation, degree of recrystallization relative to strain and combination of slip and climb systems operating, can only be a result of a difference in the rate of climb of individual dislocations and/or the number of dislocations able to climb. The only significant chemical difference between the granulite and amphibolite facies acid gneisses which is known to affect dislocation generation and movement in such a way is the higher water content in the amphibolite facies acid gneiss. The only other factor which might be involved is a strain rate difference (which of course could be dependent on the water content difference).

The fabric, petrographic and chemical evidence suggests that the granulite and amphibolite facies rocks were initially in contact before or during the early stages of mylonitization at a point east of the Woodroffe Thrust where the microstructure shows an ultimate degree of development. The tectonic significance of this is discussed.