Heterogenous quartz LPO development and strain partitioning in Median Tectonic Line mylonites

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During ductile deformation within fault zones, the process of dislocation creep can result in the formation of a lattice preferred orientation (LPO) in deforming minerals. The strength and rheology of the continental crust are thought to be primarily controlled by the strength of quartz, and therefore quartz LPO development has been acknowledged as a fundamental control on plate boundary processes within the crust. Overprinting of previously developed LPOs may occur during accumulation of strain or due to changes in deformation conditions (kinematics, temperature, stress, strain rate). Deformation temperature and kinematics are often inferred to have changed during the history of many large fault zones, evidenced by overprinting of quartz LPOs. However, these fabrics are typically found to be consistent on the outcrop scale.

This study focusses on the Median Tectonic Line (MTL) in SW Japan, which is the largest onshore fault in Japan, having a deformation history dating back to the Cretaceous, with segments of the fault still active today. Previous studies, focussed on the broad zone of mylonitisation that occurs to the north of the MTL, identified type-1 cross girdles, Y-maximum, rhomb-max (rhomb plane oriented parallel to the foliation), and Z-maximum quartz c-axis fabrics (Sakakibara, 1996; Shimada et al., 1998). They inferred that the variation in dominant LPO reflects changes in deformation temperature during evolution of the fault zone, with mid-temperature fabrics (e.g. Y-maximum) observed in the north and low-temperature fabrics (e.g. type-1 cross girdle) found in the south, closer to the MTL. Okudaira & Shigematsu (2012) came to a similar conclusion from analysis of mylonitic borehole samples from the hanging wall of the MTL. In addition, they described random quartz c-axis fabrics within ultramylonites adjacent to the fault.

In our investigation, we aim to characterise the distribution of quartz LPO fabrics within a narrow zone (less than 1 km) to the north of the MTL where significant brittle overprinting has taken place (Takeshita et al., this session). In the study area in Mie Prefecture, we have found distinct quartz LPOs preserved on a small scale, including Y-maximum, Z-maximum, rhomb-maximum, type-1 cross girdles, and single girdles, as well as random fabrics within the fine-grained quartz in ultramylonite samples. Within one thin section of weakly fractured mylonite, we observe type-1 cross girdles, single girdles, Y-maximum and Z-maximum quartz c-axis patterns within different patches of recrystallised quartz. This previously undescribed small-scale quartz LPO variation implies heterogeneous overprinting and/or strain partitioning during deformation. Mechanisms which were likely responsible for this process will be discussed and the results placed within the framework of crustal deformation in SW Japan.

Keywords: Fault rheology, LPO, Deformation

