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Two types of quartz deformation microstructures and CPOs in Ho-oh granite mylonites

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The Ho-oh granite in the southern Alps is known to be mylonitized along the Itoigawa-Shizuoka Tectonic Line. We found a marked difference in deformation microstructure and crystallographic preferred orientation of quartz between granite mylonites adjacent to the fault outcrop across the Don-Doko creek and those along a trail to the north.
Subgrains developed in quartz grains in the granite mylonites along the trail indicate sufficient recovery. Dynamically recrystallized grains are similar in grain size and structure to subgrains, suggesting dynamic recrystallization of quartz by subgrain rotation. Quartz c-axes are aligned along a girdle with its axis slightly oblique to the mylonitic lineation, with a maximum in the direction subparallel to the mylonitic foliation and subperpendicular to the lineation. This pattern of quartz c-axis preferred orientation is intermediate between the single girdle pattern developed at low temperatures and the Y-maximum pattern developed at moderate temperatures. It is estimated that the transition in pattern of quartz c-axis preferred orientation from the former to the latter occurs at 350 to 450 degrees Celsius. Mylonitic deformation there therefore likely occurred at those temperatures. Development of subgrains and dynamic recrystallization by subgrain rotation in quartz are also consistent with those temperatures.
In contrast, quartz grains in the granite mylonites along the Don-Doko creek exhibit strong undulose extinction and poorly developed subgrains, indicating poor recovery. Subgrains observed are as large as 100 microns in size, whereas dynamically recrystallized grains observed along irregular grain boundaries are as small as 5 to 10 microns in size. These suggest dynamic recrystallization of quartz by grain boundary bulging. Quartz c-axes are preferentially oriented subperpendicular to the mylonitic foliation, which is a pattern developed at low temperatures. Together with poor recovery and bulging recrystallization of quartz, mylonitic deformation there likely occurred at relatively low temperatures, probably around 300 degrees Celsius.

Keywords: Ho-oh granite, mylonite, quartz, deformation microstructure, crystallographic preferred orientation