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Superplastic rock deformation accompained with grain boudary sliding and dynamic grain growth

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Recently, we have succeeded in demonstrating superplasticity of forsterite system (Hiraga et al. 2010). Microstructure of the deformed samples exhibits the coalescence of secondary grains (periclase and pyroxene) perpendicular to the tensile direction, which is well explained by grain switching as a result of grain boundary sliding. Coalescence of the grains promotes reduction of the numbers of the secondary grains, which are the pinning phase for grain growth of the first phase, so that grain growth of the both phases occurs with this process. We quantify the growth and coalescence based on laws of Zener and dynamic grain growth. The results indicate that 80% of the first phase involved in a single grain switching event and the largest numbers of coalesced grains correspond to the numbers estimated from the numbers of switching events from total strain of the sample. This analytical method is applied to granite origin ultramylonite revealing rock strain of at least larger than 2.

Keywords: superplasticity, grain boundary sliding, dynamic grain growth, mylonite