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Coalescence and Zener pinning of mineral grains in mylonite

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Recently, we have succeeded in demonstrating true superplasticity in geological materials (Hiraga et al. 2010). Superplastic deformation is commonly considered to proceed via grain boundary sliding (GBS) which results in grain switching in the samples. As a result, initial equigranular shape of grains can be remained even after severe deformation of the sample, which is one of the characteristic microstructure of superplastically deformed materials. Further, due to large contribution of intergranular deformation on total strain, development of crystallographic preferred orientation in the materials is not expected either. Thus, it is very difficult to recognize the operation of GBS in microstructure of the deformed rocks. Hiraga et al. (2010) showed coalescence of periclase grains almost perpendicular to the tensile direction after superplastic deformation in forsterie + periclase aggregates, although the paper focused on the deformation enhanced grain growth during superplastic deformation. Here we present more details of the coalescence microstructure and compare it with that of ultramylonite, often considerd to have deformed by GBS creep. We show the microstructures of coalascence of similar mineral phases and Zener controlled grain sizes. Such observations indicate pervasive operation of GBS in the earth's mantle and crust.

Keywords: Mylonite, Grain size, Coaelescence, Zener relation, Superplasticity