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Metamorphism and deformation of Kashio mylonites in a ductile shear zone

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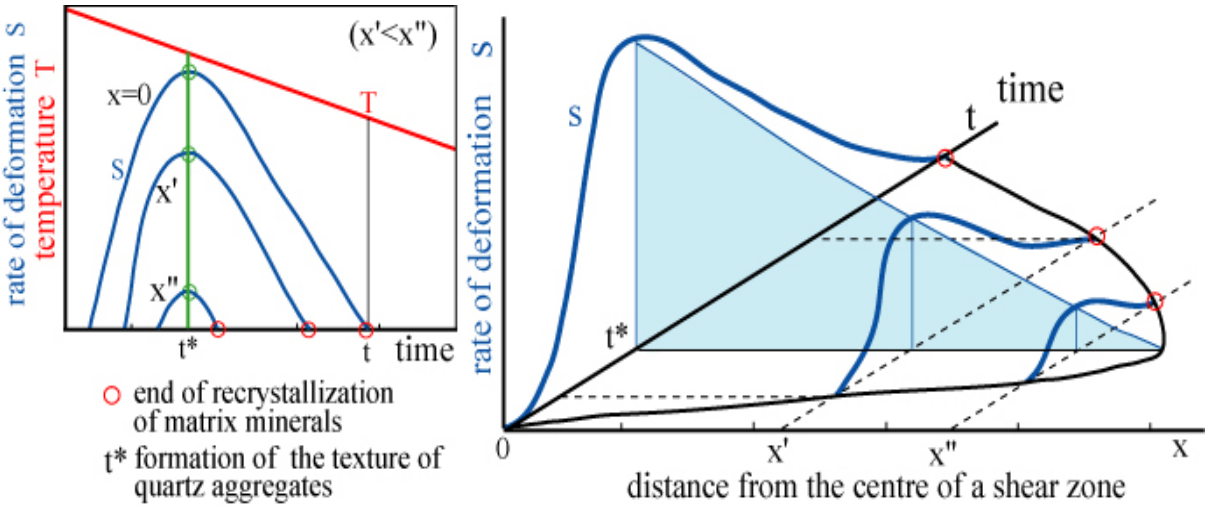

Kashio mylonites are exposed along the Median Tectonic Line in the Takato-Kashio region, central Japan. Grain size reductions of quartz crystals are studied by many researchers in order to evaluate properties of shear deformations in the Kashio ductile shear zone. It is, however, necessary to reveal recrystallization of minerals (= metamorphism) during the formations of mylonites. In this letter, relationships between the metamorphism and rate of shear deformation are discussed on the basis of data of pelitic mylonites described in previous studies [1, 2, 3].

A possible tectonic process in a ductile shear zone

A simple tectonic process is proposed for the formation of Kashio mylonites. The rate of ductile shear deformation (s) was supposed to be increased gradually before the attainment at the maximum value, and then it was gradually decreased. Corresponding to the systematic change of the s-value on time (t), the width of shear zone was gradually increased until the attainment of the maximum s and then it was decreased with decreasing s. The s-value depends on the distance (x) from the centre of the shear zone, as is schematically illustrated in Figure. The s-value at x is assumed to attain its maximum at t* for all the x-values. Temperature was continuously lowered during the formation of the Kashio mylonites.

Metamorphism in a ductile shear zone

The development of a shear zone and recrystallization of minerals occurred by an increase in the rate of ductile shear deformation. It is highly probable that metamorphism took place soon after the beginning of shear deformation (s>0) and ended at the final stage of shear deformation. The end of metamorphism at the location x was shown as an open red circle in Figure. Note that the final metamorphic temperature at the location x is lower for smaller x-value.
Minerals formed under intense shear stresses were partially or wholly replaced by minerals which

were recrystallized under slow rates of shear deformations. The shear deformations of central parts of the shear zone were continued for long times and down to low temperatures in comparison with marginal parts of the shear zone. Hence, fine-grained metamorphic rocks near the central parts of the shear zone may be formed under low temperatures and weak shear stresses.

It is concluded that many ultra-mylonites were formed under low temperatures and low rates of ductile shear deformations. The conclusion is consistent with common occurrences of massive hornfels-like ultra-mylonites in the Ina-Ichinose area [3].

[1] Ono, A., 2002, Geol. Soc. Jpn., no.11, 733.
[2] Ono, A., JpGU Meeting 2008, G122-P004.
[3] Ono, A., JpGU Meeting 2009, K133-P001.

Keywords: Kashio mylonite, shear zone, shear deformation, recrystallization