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Minerals on the verge of fracturing: fluid inclusions observed in minerals within kink bands

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Sambagawa metamorphic belt is a high pressure intermediate type metamorphic belt exposed along the south-west Japan. The peak pressure condition of the metamorphism is known at least to be 0.4 to 0.5 GPa at the lowest metamorphic grade rocks (chlorite zone). Outcrops of the chlorite zone rocks of the Sambagawa metamorphic belt in Chichibu, Saitama prefecture, often show abundant veins. Veins are the evidence of how the rocks have cracked and deformed during exhumation, most likely at the seismic depth. This study first investigated the orientation of veins and kink-bands found in an outcrop of the chlorite zone rocks. The similarity of their orientation indicated that at least some of the kink-bands are possibly the predecessor of the cracks and veins. Several kink-bands gradually changed into veins, which seems to support the view. Observation of the thin sections of the rocks in and out of one of the kink-bands revealed that quartz contained fluid inclusions in a large amount within the kink-band (between the two axial planes of the kink-band). Most of the fluid inclusion bubbles were were aligned in the similar orientation as the axial plane. More than a hundred lines of fluid inclusion bubbles were observed in a $0.5 * 0.5$ mm2 area between the two axial planes of the kink, whereas very few fluid inclusion was observed in quartz outside the kink-band. It is possible that the alignment of the fluid inclusions in quartz shows the beginning of the brittle deformation in rocks quenched. Kink bands observed in the outcrops of the Sambagawa metamorphic rocks in Chichibu (Saitama, Japan) may exhibit the minerals on the verge of fracturing.

Keywords: Sambagawa metamorphic belt, crack, vein, kink band, fluid inclusion