# 四国中央部汗見川流域における三波川変成帯の石英微細構造と古応力推定
# Quartz microstructures and paleostress estimates in the Sanbagawa metamorphic belt, Central Shikoku, Japan

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The paleostress estimates for the ductile region of the Earth’s crust largely depends on grain size piezometers of quartz. However, it has long been debated whether extrapolation of experimentally determined piezometric relationships to natural conditions is appropriate. Dynamic recrystallization theories predict temperature-dependent relationships between stress and grain size of quartz, but no systematic works have been made to apply the theories to naturally deformed rocks. We measured grain size of quartz in the Sanbagawa metamorphic belt, using electron back-scattered diffraction (EBSD) mapping, and applied a theory-based piezometric relationship. The samples were taken from the Asemi River route, Shikoku Island, Japan. The metamorphic grades increase northward from the chlorite zone through the garnet zone to the biotite zone and then decrease to the garnet zone. Sampling localities cover all these four zones. Except for the sample taken from the lowest metamorphic grade part of the chlorite zone, quartz shows undulatory extinction, subgrain boundaries, and crystallographic preferred orientations. Small quartz grains occur at the rims of coarse grains and sparsely inside the coarse grains. All the obtained grain size distributions were severely right skewed. The mean and the mode values were not well defined in both linear and logarithmic frequency diagrams because these values vary with the cutoff size. Instead, the grain sizes that occupy the largest area fractions were used for the ‘average’ grain size. The grain size of the largest area fraction ranged between ~20 and ~160 microns. Dynamic recrystallization of quartz is likely concurrent with the peak metamorphism, because grain size increases with increasing metamorphic grades. In addition, quartz fabrics show the top-to-west sense of shear in the south, whereas they indicate mainly top-to-east in the north. Previous geothermometric studies using Raman spectra of carbonaceous materials or the disappearance of pumpellyite yielded peak metamorphic temperatures ranging from ~330 to ~570 ˚C. The obtained stresses increase with decreasing metamorphic grades and reach ~100 or ~250 MPa at their maximum under the assumptions of intracrystalline or marginal nucleation models, respectively. The stress estimates with the marginal nucleation model are similar to or slightly lower than stress values calculated from a quartz flow law under assumptions of the possible plate convergence rate, temperature profile, and ranges of the crustal thicknesses of the subduction zone at the timing of the metamorphism.

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