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Estimating peak temperature experienced by the Sanbagawa belt adjacent to the MTL using Raman spectral analysis

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Coefficients of friction estimated by deformation experiments of fractured rock are largely independent of lithology (Byerlee 1978). Experiments also show most of the energy generated by displacement of the fault is converted into heat, and this shear heating during faulting forms a heat -anomaly close to faults. This relationship allows surface heat-flow to be used to estimate coefficients of friction on major faults. No heat anomaly has been observed along the San Andreas Fault and the estimated coefficient of friction is constrained to be much smaller than that found in experiments (Lachenbruch & Sass, 1980). The cause of this discrepancy remains unresolved. The Median Tectonic Line (MTL) is the largest on-land fault of the Japanese Islands, and could be used for similar studies. However, measurement of surface heat-flow has not been conducted nearby the MTL. Fission track age dating does suggest the effects of some shear heating in the Ryoke belt around the MTL (Tagami et al. 1988). However, the wider distribution of the heat anomaly and detailed thermal structure around the fault are not well known. These data are needed for quantitative modeling. Our study aims to fill this gap in our knowledge by clarifying the peak temperature attained in the Sanbagawa belt near the MTL. A semi-continuous core passing through the MTL was drilled and use of these samples enables us to conduct detailed analysis in key samples. In this presentation we document the structures of the Sanbagawa belt core, and present the results of temperature estimation using Raman spectral anaysis of carbonaceous material.

The boring core with a drilling depth of 600m was obtained by AIST. The core reaches the MTL at the depth of 473.9m and rocks of the Sanbagawa belt are exposed at greater depths. The main rock faces are pelitic schist, basic schist and serpentinite. Fault rocks were divided into five types: Incohesive cataclasite, Cohesive cataclasite, Foliated cataclasite, Brecciated rock, and Less-brecciated rock. The rocks close to the MTL have suffered strong penetrative shearing. At greater depths fault-related strong shearing is localized along discrete zones.

Pelitic rock is the main rock facies of the Sanbagawa belt and it is difficult to use general petrological methods for estimating temperature. Therefore, we used Raman spectral analysis of carbonaceous material (Beyssac et al. 2002). Temperature obtained by this method reveals the peak temperature. We collected 8 strongly sheared samples from near the MTL (depth: 475.0m-476.4m), and 2 weakly sheared samples far from the MTL (depth: 564.1m and 570.1m). The estimated temperatures are 343°C-364°C nearby the MTL, 363°C at the depth of 564.1m and 362°C at the depth of 570.1m. These results show that there is no clear deference between each depth and no correlation with influence of shearing, and we could not confirm the heat anomaly. Therefore, no shear heating was recognized in the Sanbagawa belt nearby the MTL. However, more data are required to examine if a heat anomaly exists on a larger scale. Future studies will also consider the effects of short heating time scales on the Raman methodology and the effects of heat advection.

[Reference] Beyssac O., Goffe B., Chopin C. & Rouzaud J. N. 2002. J. Metam. Geol., 20, 859-71; Byerlee J. 1978. Pure and Applied Geophysics, 116, 615-26; Lachenbruch A. H. & Sass J. H. 1980. J. Geophys. Res., 85, 6185-222; Tagami T., Lal N., Sorkhabi R. B. & Nishimura S. 1988. J.

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