Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS29-P12 Room:Convention Hall Time:May 24 16:15-17:30

Seismogenic fault lubrication by graphite: Evidence from graphite-bearing pseudotachylyte and cataclasites

Yoshihiro Nakamura[1*], Satish-Kumar Madhusoodhan[2], Tsuyoshi Toyoshima[2], Junji Akai[2]

[1]Graduate School of Science & Technology, Niigata University, [2]Department of Geology, Faculty of Science, Niigata University

We report the occurrences of basal-slip graphite derived from pseudotachylyte in the upper sequence of Hidaka metamorphic belt, Hokkaido, Japan. Melt-induced textures such as biotite microlites, shell textures of Fe-oxide, spherulites and vesicles in Fe-oxide are observed in the graphite-bearing pseudotachylyte. These matrix have two important features. Firstly, hydrous minerals, biotite and muscovite, have completely disappeared and albite, quartz and oxide minerals including graphite have survived as fragments. These results suggest that pseudotachylyte was generated at least above 650 - 700 degree Celsius by dehydration melting of biotite and muscovite. Secondly, graphite shows lower degree of graphitization than those in the cataclasite, and is closely associated with other oxide minerals along the shear planes, and their aggregations have striation and smooth surface. In particular, the deformed graphite in the pseudotachylyte matrix records valuable information of degree of graphitization during seismogenic faulting. However, the Fe-oxide spherules have formed in the matrix by the oxidation during melt-quenching, where a part of original graphite might have been converted to CO_2 by oxidation. In the Micro-Raman spectroscopy and XRD study, graphite in the pseudotachylyte show amorphization by basal slip. The Lc values decrease from over 40 nm to 9-15 nm and the scatter plots between R1 ratio and G band FWHM display a different trend with higher R1 ratios than that in the host rocks. In addition, HRTEM observations indicate that microstructures are mainly observed in interlayer delamination of stacking. Moreover, carbon isotopic composition of graphite in both host rocks (delta ^{13}C = -24.8 to - 25.9 per mil) and pseudotachylyte-bearing cataclasite (delta^{13}C = - 22.5 to - 27.8 per mil) show clearly biogenic isotope signatures, and considered to have formed through metamorphism and deformation process of organic matter in sedimentary rocks. Thus, these data suggest that the differences of crystal size by slip rate might be the driving force of deformation process.

Therefore, the presence of small amount of graphite by residual assimilation during frictional melting has the potential for fault lubrication. Our finding of deformed striated graphite is a direct evidence of fault lubrication on the slip surface during seismogenic faulting.

Keywords: pseudotachylyte, graphite, frictional melting, amorphization, lubrication