Prescribed factor of major and trace elements composition presumed by the borehole core sample of Nobeoka thrust

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Megasplay faults branching from plate boundaries at subduction zones are thought to be important sources of earthquakes generating tsunamis. The Nobeoka Thrust is the low-angle thrust which subdivides the Shimanto Belt in Kyushu into the northern (Cretaceous and Paleogene) and the southern (Paleogene to Neogene) subbelts, and is an exhumed analogue of an ancient megasplay fault. The hanging wall and the footwall of the Nobeoka Thrust show difference in lithology and metamorphic grade, and their maximum burial temperatures estimated from vitrinite reflectance analysis are 320~330°C and 250~270° C, respectively. Assuming this temperature gap was made by fault displacement, the total displacement is estimated to be approximately 10 km (Kondo et al., 2005).
Borehole core samples penetrating through the Nobeoka Thrust were collected by the Nobeoka Thrust drilling project (NOBELL) in 2011. Since then, various studies using the borehole core have been performed. In this research, we performed major and trace element composition analysis for each depth of the borehole core collected by the NOBELL, and aim to clarify the nature of fluid-rock interaction along the fault core of the Nobeoka Thrust.
Major and trace element compositions across the principal slip zone (PSZ) of the Nobeoka Thrust were analyzed 38 samples by XRF (Rigaku ZSX) and ICP-MS (Agilent 7700x ICP-MS) respectively, installed at Kochi Core Center (Kochi University/JAMSTEC). As a result of principal component analysis (PCA) on the results of the major element compositions, a decrease in Si and Na with an increase in K is found in the PSZ. This suggests the possibility of hydrothermal alteration reaction (albite to illite) during the faulting process. Fukuchi et al. (2014) showed that the illite crystallinity nearby the PSZ of the Nobeoka Thrust could be affected by hydrothermal alterations in addition to mechanical comminution. We also carried out XRD analysis by using samples for chemical composition analysis. Although quantitative change in abundance of illite was not confirmed, disappearance of albite was detected in the PSZ.
Almost all the elements fluctuated largely just above the PSZ. This observation can be ascribed to high-temperature fluid-rock interaction occurred just above the PSZ, because some of the trace elements sensitively react with high-temperature water. However, more carefully, large abundance of elements characteristic in carbonate minerals (Ca, Mg, Fe, Mn and Sr) occurred at the upper part of the PSZ, while positive anomaly of Cs peak was observed 3 cm below the carbonate-enriched depth. Such discordance in depths of anomalies in each element suggest the existence of more complicated reactions occurred within the PSZ.
Through this study, several effects of fluid-rock interaction during faulting process have been clarified. To strengthen the scope of the findings in this study, it would be beneficial to perform a cross-section analysis of the borehole sample. This will enable us to understand the detailed changes of the element and mineral composition that occurs during faulting.

