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# Change in stress state in an on-land accretionary complex : implication for large stress drop with subduction earthquake

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Stress state in subduction zone is one of critical information to understand wedge architecture controlled by physical properties of wedge, friction on decollement, and fluid pressure ratios within and below wedge. Accretionary complexes are developed mainly by horizontal compressional stress in subduction zone, which indicates that the wedge development occurs under compressional critical state. Major geological features have been reported such as fold and thrust, and duplex structure. However, not only the compressional features, but also the bedding parallel extensional features such as normal faults are also recognized within accretionary complex. Because those extensional features are not commonly expected in subduction zone, we have not paid much attention on such extensional features. Recently, the extensional aftershocks were identified after the Tohoku-Oki earthquake suggesting that the stress state can be switched from horizontal compression to extension in subduction zone with seismic cycles. Because accretionary complex should be experienced by numerous number of earthquake events, such stress switch can be also recorded within accretionary complexes. That means that the normal faults within accretionary complexes are also possible to be related to the stress switch with seismic cycle. The purpose of this study is to understand the relationships between reverse and normal faults in on-land accretionary complex, whether the activations of reverse and normal faults can be expected in the same pressure-temperature conditions.

The study area is Kayo Formation in the Shimanto accretionary complex in Okinawa Island. Beautiful outcrops are well exposed along coastline. Paleomaxim temperature from vitrinite reflectance has been reported by previous study ranging from about 250-300?C. Fold and thrust structures of more than 50 m width are well observed. Within the fold and thrust zone, normal faults of 10 m width are also identified. On the basis of careful observations, horizontal thrusts cut normal fault in some areas, which suggests that the normal faults was activated before thrusting. Normal faults also cut the reverse fault in some places. The cross-cutting relationships suggest that the normal and reverse faults were activated in a short period.

To estimate the pressure temperature conditions of reverse and normal faults, fluid inclusion analysis was conducted. Both reverse and normal faults are accompanied by shear veins composed of quartz. Only water inclusions were observed in the veins. The homogenization temperature for the veins from reverse and normal faults ranges from about 165 ?C to about 235?C and modal value ranges from about 175?C to about 195?C. There is no difference between the fault types. Density of water calculated to range from about 0.87 to about 0.89 on the basis of the homogenization temperature. Combining with the isochore lines (equal-density line in pressure vs temperature space) and the paleomaximum temperature of 250-300?C from vitrinite, paleo-maximum pressure ranges from about 140MPa to 190MPa, which is corresponds to the geothermal gradient of about 40-50?C/km. As describe above, the cross-cutting relationship between normal and reverse faults suggest that the their activations were in a short period enough to consider a constant geothermal gradient. Therefore, the same homogenization temperature of fluid inclusion between veins from reverse and normal faults indicates that the both faults were activated under the same pressure-temperature conditions. This result also suggests that the coexistence of reverse and normal fault in accretionary complex can reflect the stress switch by stress drop with seismic cycles similar of that observed in Tohoku-Oki earthquake.

Keywords: Accretionary complex, stress, temperature pressure conditions, fluid inclusion