Paleo-stress analysis in coherent zone, an exhumed Cretacesou accretionary complex, Shimanto Belt, in Konan city and Geisei villege, Kochi prefecture, SW Japan

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Stress state in a subduction zone can be exchanged between reverse-fault and normal-fault regimes with an earthquake cycle. A similar change in paleostresses has been also obtained in some exhumed accretionary complexes (e.g., Hashimoto et al., 2014). However, most of previous studies in exhumed accretionary complexes cover only mélange zones exposed to the coastline. Therefore, in this study, we examine the paleostress change in a coherent zone. In order to investigate a spatial relationship, we analyzed the paleostress in the coherent zone adjacent to a mélange zone.

The study area is in Konan City, Yasu Town and Geisei Village in Kochi Prefecture, Southwest Japan where the Cretaceous northern Shimanto Belt is cropped out. The geology of the study area is composed of the coherent and mélange zones in the northern and the southern sides, respectively. The coherent zone consists mainly of alternating layers of sandstone and mudstone. The strike and dip of bedding are about N 37 °E and 75 °S, respectively. The age of the coherent zone has been reported as Cenomanian–Campanian (100 Ma–72 Ma) from microfossils (Taira et al., 1988). As a result of the micro-fault analysis, six stress state (stress 1, 2, 3, 4, 5, and 6) were obtained. Four stresses (stress 1, 3, 5, and 6) could be reasonbale because many unique faults, which are micro-faults with misfit angle of less than 30 degree only in individual stress state, are found. Stress 2 and stress 4 are not treated as reasonable stress solutions because the number of the unique fault is small. Stress 1 and stress 3 are the reverse-fault stress regimes. Stress 5 is obscured for fault types. Stress 6 is a normal-fault stress regime.

In order to constrain stress magnitude, stress polygon was employed. Furthermore, a liner function between SHmax and Shmin can be obtained from the estimated paleo-stress, which can be drawn in the stress polygon. Sv is calculated from density and paleo-maximum depth (5.5 km from vitrinite reflectance). Stress magnitude would be constrained from the overlapping area between the stress polygon and the liner function. According to the results, the stress for the reverse fault regimes is larger than that for the normal fault stress regime. In addition, assuming that the reverse fault changed to a normal fault, the validity of the difference of shear stress (stress drop) was examined. The stress drop is estimated from the difference in the radius of Mohr circles ((SHmax - Shmin) / 2) between the normal fault and the reverse fault stress regimes. The stress drops between stress 1 (reverse fault) and stress 6 (normal fault) ranges, and stress 3 (reverse fault) and stress 6 (normal fault) range 1.8-14.0 MPa and 43 - 63 MPa, respectively. Susan L. et al. (2018) showd the distribution of stress drops from geophysical observations in trench type earthquakes rangeing approximately 0.01–100 MPa. The stress drops obtained from our results are consistent with the range of 0.01-100 MPa. Therefore, it is possible for our results to be related to earthquake cycles.

In conclusion, we would like to emphasize that the exchange of stress accompanying earthquake cycles occurs even in the coherent zone as the same as that observed in mélange zones based on the differences in stress magnitude between the reverse and normal fault stress regimes and the reasonable range of stress drop. The interpretation that the exchange of stress observed in the mélange zone and also in the coherent zone implies that the exchange in stress state could be recorded after the mélange zone were located adjacent to coherent zonet. In other words, it is suggested that the micro-faults we examined in this study were activated within an accretionary wedge at the critical stress states.

Keywords: Paleo-stress analysis, accretionary complex, Shimanto Belt