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Change in physical properties of sediments in seismogenic depth along subduction zone: The Cretaceous Shimanto Belt

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Changes in physical properties of Sediment along seismogenic subduction interface is important because lead to understand rock strengthening, dewatering and dehydration processes, and mechanisms seismogenesis. The purpose of study is to understand changes in physical properties of sediment with depth along seismogenic subduction interface. The study area is in the Cretaceous Shimanto Belt, western Kochi, southwest Japan using elastic wave velocities combining with paleo-thermal structures. The velocities dependends on porosity basically, but elastic velocities are more seinsitive in the cahnge with depth than that for porosity. In addition, elastic velocities are useful to discuss the aspect ratio of pore geometory with the change in physical properties. Therefore, we focused on the elastic velocties to examine the change in physical properties.

The Cretaceous Shimanto Belt along the eastern coast of Tosa Bay, Shikoku, SW Japan is composed of multiple melange zones and coherent zones. Paleo-temperature estimated from vitrinite reflectance represents a linear increment from north to south in the temperature from about 150?C to 230?C and sharply decreases at the middle part of study area to about 150?C again. Then the paleo-temperature increases again to the south in the footwall. The boundary is interpreted as a fossil mega-splay fault (Sakaguchi, 1999) or Out of sequence thrust (OST). 11 sandstone and 5 mudstone from hanging-wall, and 6 sandstones and 4 mudstones from footwall were analyzed.

The ultrasonic P- and S-wave velocity measurements were conducted under drained condition with constant pore pressure (1MPa) and varying confining pressure to control effective pressure. The effective pressure ranges from 5 to 65MPa with 5MPa intervals. In the following, we used 1) maximum velocities at the highest effective pressure in each sample (Vmax), 2) the differences in velocities with range of effective pressure (dV), and 3) vitrinite reflectance (VR) at the sampling point to discuss the correlations between them.

No correlation was identified between Vmax and VR in sandstones, but we can see a positive correlation between them in mudstones. There is a positive correlation between dV and VR in sandstones, but no correlation was observed in mudstones. Finally, Between Vmax and dV, the positive correlation was seen in Vp but no correlation was identified in Vs for sandstones, whereas the negative correlation was observed in Vs and no correlation was identified in Vs for mudstones. The results shows reverse relationship between sandstones and mudstones in the correlations between Vmax, dV and VR.

The reverse relationship between sandstones and mudstones suggests that evolutions of physical properties for them are totally different along a seismogenic subduction interface. Sandstones were completely lithifed before seismogenic zone and the change in porosity with depth was not identified in the area. On the other hand, lithification of mudstones progressed with depth in a seismogenic zone. dV depends on a relative amount of anisotropic pore. The volume of anisotropic pore increases in sandstone with depth, whereas the volume in mudstones does not change with depth. The correlations between Vp and dVp for sandstones, and between Vs and dVs suggests that the anisotropic pore orients along foliations or bedding of sediments.

Keywords: accretionary prism, velocity, change in physical properties