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Characteristics of mineralogy and clay fabric on the petrophysical variation of the Southeastern Yellow Sea Mud (SEYSM), Korea

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Velocity (compressional wave velocity) and physical properties were measured according to regular depth intervals for sixteen core sediments collected from Southeastern Yellow Sea Mud (SEYSM), Korea. The velocity for core samples was measured using the pulse transmission technique. Physical properties (water content, porosity, density) were measured using weight-volume method. Shear strength was manually measured by hand-vane apparatus. Overall, the muddy sediments with shells dominate in most cores, but the sandy sediments exist in the some depth intervals. Porosity (75→45%) and water content (90→50%) generally decrease with burial depth due to dewatering caused by overburden pressure. Thus the bulk density shows increasing trend (1.5→1.7 g/cm3) however, the grain density does not reflect regular patterns with depth. That is why grain density is determined depending on mineral composition. The velocity and shear strength generally increase with depth reflecting variation of other physical property data.
The velocity abruptly decreases from 1480 m/s to 1349 m/s, in depth intervals from 310 cm to 400 cm of station P14. This is probably due to shallow gas within sediments and/or degassing cracks caused by escaped gas. Interestingly, porosity and water content below 90 cm depth of station P03 are significantly changed from 57% to 38% and from 55% to 23%, respectively. Also, the bulk density (1.56→2.04 g/cm3) and velocity (1571→1707 m/s) abruptly increase with burial depth. This is probably responsible for difference of sediment texture, caused by significant increase of sand contents. The sediments at stations P11 and P15 is likely more compacted and/or consolidated than those of stations P02, P03, P07, and P14. This is probably due to difference of compaction and/or consolidation after deposition and sedimentary processes related to sea level change. At stations P02, P03, P07, P11, and P15, X-ray diffractions reveal that the major clay minerals are chlorite, illite, chlorite+kaolinite, and kaolinite. Illite was identified as the most abundant clay mineral.
The clay fabric analysis using scanning electron microscopy (SEM) was performed on splitter core samples (at core depth of 10 cm and 290 cm considering physical property data) of station P15. The clay fabric at 10 cm depth shows typical card-house structure and random arrangement of particles. And the clay particles have abundant edge-to-face (EF) and edge to edge (EE) contacts. The sediments at 290 cm depth of station P15 are characterized by decreased porosity (to 58%) and water content (to 36%). And wet bulk density and shear strength are gradually increased (1.65 g/cm3, 11 kPa). Accordingly the clay fabric shows well-oriented arrangements with dominant face-to face (FF) contacts, due to natural sediment compaction caused by overburden pressure.