Geophysical Research Abstracts, Vol. 9, 04865, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04865
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Compaction tests of deep sea sediments at elevated temperatures: implications for the mechanical properties of subducting sediments

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Along convergent margins, underthrust marine sediments undergo rapid loading and temperature increase. Besides consolidation diagenetic processes may also affect the mechanical properties of those sediments. Moreover, pore pressure transients, triggered by consolidatic and diagenetic processes, further influence the mechanical behavior. In addition to core samples, laboratory compaction testing is commonly accepted to provide insight in the development of mechanical properties during subduction. So far, standard consolidation tests have been conducted mostly at room temperature, thus neglecting the increasing temperature during subduction. Here, we report results of long-term compaction tests up to PT conditions similar to the upper seismogenic zone to characterize the influence of temperature effects on the mechanical properties of subducting sediments. Remoulded samples of the main lithologies in the Nankai Trough (Japan) were loaded up to 70MPa at 20˚C, 100˚C and 150˚C.

The majority of the samples show an almost similar e vs σ' relationship for the different lithologies (smectite-, illite- and quartz/tephra-rich), with e being the void ratio and σ' being the mean effective stress. While the slope of the e vs σ' relationship appears temperature independent, the consolidation line is shifted along the e-axis to lower values for e with increasing temperature. This discrepancy can be considered as a temperature dependency in the pre-consolidation pressure. From the porosity vs σ' relationship, a similar trend can be observed, leading to less porous samples with increasing temperature. However, it seems this trend does not affect hydraulic conductivity (k). Noticeable variations of k can be observed only between the different lithologies, which most likely arise from the differing grain sizes. Hence, the

quartz-rich samples display a higher permeability whereas the clay-rich samples are less permeable. In conclusion, these tests have shown that temperature influences the consolidation of marine sediments. The porosity and void ratio development has significantly been affected, which may also have an impact on other properties such as shear strength. For future testing it has to be considered to employ heated consolidation tests for the studying of deeper subducted sediments.