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PETROTEC - geotechnical characterization of trench- and slope sediments off Southern Chile: first results

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To understand seismogenesis in shallow parts of subduction zones, it is vital to know about strength and frictional parameters of subducted sediment. For this purpose, PETROTEC, as part of the TIPTEQ-Project, gathers critical data for sediments deposited on the incoming Nazca Plate, the trench and the slope off the southern Chilean coast during the last 5 Ma, and whose equivalents are now being underthrusted into the seismogenic zone beneath the South American continent. Material comes from gravity cores collected during R/V SONNE Cruises SO181, SO102 and SO156, as well as from ODP Leg 141 cores. Sediment strength and frictional properties are determined by triaxial testing, ring shear testing and direct shear testing.

First results from triaxial testing show that Young's moduli are much lower (3-20 kPa) in comparison to diatom-rich muds from equivalent depths in the Japan Trench area (180-240 kPa). Internal angles of friction from ring shear testing, direct shear testing and triaxial testing yielded coherent results. Values from ring shear testing differ depending on material, normal stress and shear velocity, and vary from 9˚ to 34˚. With increasing shear velocity, there is at first a decrease of the internal angle of friction, followed by an increase. Values from direct shear testing range up to 27˚ and angles of friction determined from triaxial testing show values of about 10˚.

In addition to sediment strength properties, permeabilities were determined on the basis of consolidation data during triaxial testing. Values range from 1.0953*10^{-8} to 8.7*10^{-10} m/s. Average permeability is 10^{-9} m/s, an expected value for marine clays to silts.

We discuss possibilities to extrapolate laboratory data (up to 40 MPa effective stress,

equivalent to 1.5 km depth) to upper seismogenic zone conditions (equivalent to 100-150 MPa effective stress).