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Textures of water-rich mud sediments from the continental margin offshore Costa Rica (IODP expeditions 334 and 344)

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During sedimentation and burial at continental margins, clay-rich sediments develop crystallographic preferred orientations (textures) depending on the ongoing compaction as well as size distribution and shape fabrics of the grains. Such textures can control the deformational properties of these sediments and hence the strain distribution in active continental margins and also the frictional behavior along and around the plate boundary. Strain-hardening and discontinuous deformation may lead to earthquake nucleation at or below the updip limit of the seismogenic zone. We want to investigate the active continental margin offshore Costa Rica where the oceanic Cocos plate is subducted below the Caribbean plate at a rate of approximately 9 cm per year. The Costa Rica trench is well-known for shallow seismogenesis and tsunami generation. As it is an erosive continental margin, both the incoming sediments from the Nazca plate as well as the slope sediments of the continental margin can be important for earthquake nucleation and faulting causing sea-floor breakage. To investigate texture and composition of the sediments and hence their deformational properties we collected samples from varying depth of 7 different drilling locations across the trench retrieved during IODP expeditions 334 and 344 as part of the Costa Rica Seismogenesis Project (CRISP). Texture analysis was carried out by means of synchrotron diffraction, as only this method is suitable for water-bearing samples. As knowledge on the sediment composition is required as input parameter for the texture data analysis, additional X-ray powder diffraction analysis on the sample material has been carried out. Samples for texture measurements were prepared from the original drill cores using an internally developed cutter which allows to produce cylindrical samples with a diameter of about 1.5 cm. The samples are oriented with respect to the drill core axis. Synchrotron texture measurements were conducted at the ESRF (European Synchrotron Radiation Facility) in Grenoble and the DESY (German Electron Synchrotron) in Hamburg. Samples were measured in transmission mode perpendicular to their cylinder axis with a beam diameter of 500 μm. Measurements were taken from 0 to 175° in 5° steps resulting in 36 images from a 2D image plate detector. Measurement time was in a range from 1 to 3 seconds. Due to the different, low symmetric mineral phases a large number of mostly overlapping reflections results. Such data can only be analyzed by the Rietveld method, in our case implemented in the software package MAUD (Materials Analysis Using Diffraction). Preliminary results show distinct textures depending on the composition and the origin of the samples, i.e. on drilling location and depth, which may be critical for strain localization and faulting of these samples. The results are also important for the analysis of experimentally deformed samples from the same drill cores which showed structurally weak and structurally strong deformation behavior during triaxial compression.