Geophysical Research Abstracts
Vol. 20, EGU2018-10215, 2018
EGU General Assembly 2018

Rock Garden – sedimentary processes at a supercritical accretionary ridge, Hikurangi convergent margin, New Zealand

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Submarine landslides are important geological hazards for seafloor facilities and may generate tsunamis that can cause substantial coastal damage. Numerous studies have hypothesized that gas hydrates play a major role in controlling slope failure initiation and mass movement processes, but the issue remains controversial. To better understand factors controlling slope destabilization, i.e. especially the interaction of tectonic steepening and gas hydrate transformation, we investigated the frontally accreted ridge Rock Garden of the Hikurangi subduction zone east of New Zealand's North Island during the RV SONNE expedition SO 247. The top of Rock Garden, the exceptional steepness of which has been caused by the subduction of a seamount, is located in about 600-800 m water depth. We drilled altogether three MeBo200 sites each with a depth of 37 m on average. Shipboard measurements of sediment physical properties included undrained shear strength, moisture and density measurements (MAD) and magnetic susceptibility. In the XRF-laboratory Bremen we measured the light elements Al, Si, S, K, Ca, Ti, Mn, Fe in order to gain insight into the paleo-climatic conditions under which sedimentation took place, and the heavier elements Sr, Rb, Zr, Br with a spatial resolution of 1 cm to identify cryptotephra in addition to tephra layers of several cm thickness. With the MSCL (Multi-Sensor Core Logger) we measured magnetic susceptibility, gamma density and p-wave velocity, and also used a novel laboratory approach to measure seismic velocities (p-wave and s-wave velocity) on marine sediments. All these data sets are being used to undertake sediment-tectonic investigations to understand why chemical and physical properties of the two MeBo-cores from the top of Rock Garden, which are only 2 km apart from each other, differ so significantly. Geochemical investigations of the core material GeoB20824-4 suggest that we drilled through a fault. The high lithium content in the sediments of the GeoB20824-2 below 18 m indicates warm source fluids with temperatures about 80°C and a geothermal gradient of 40°C km^{-1}. We use numerical simulation to test if fast fluid flow may have caused this situations. MSCL measurements on cores GeoB20846-1 and GeoB20824-4 reveal that magnetic susceptibility increases over the entire borehole length with . We see maximum values in at the tephra layerssites. Also, the bulk density increases from 1600 kg m^{-3} to 1800 kg m^{-3} with depth. P-wave velocity increases from 1.5 km s^{-1} to 1.6 km s^{-1}. The tephra layers show velocitiesy of up to 1.9 kms^{-1}. The content of chemical elements in tephra layers is characterized by a Zr maximum and a Sr minimum.