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Acoustic investigations of a landward facing slope failure off Chile

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Submarine slope failure is known for many different environments all over the world. It is one of the most important mechanisms in shaping continental margins and transporting vast quantities of sediment downslope.

Geophysical data acquired during cruise JC 23, aboard RV JAMES COOK in March/April 2008, and previous cruises cover most of the active Chilean continental margin between 33° and 37°S. Integrated interpretation of multi-beam bathymetric, sub-bottom profiles, side-scan sonar and seismic data allowed identifying a number of slope failures.

The main topic of this project is the morphological and sedimentological analysis of a medium-sized submarine landslide offshore the city of Talcahuano (300 km south of Santiago). In contrast to most other slides along continental margins, this landslide is situated on the landward facing slope of a submarine ridge. The failure is facing towards the east which means landward. This setting has important implications for the associated tsunami wave field (first arrival of positive amplitude).

We measured geometrical parameters of the failure and adjacent slope. The slide affected an area of 16,5 km^2 between ~1060 m and >1700 m water depths. Its is ~6 km long, up to 3 km wide and involved a total sedimentary volume of about 0,5 km3. The failure process was characterized by a single slide event. Therefore, we assume its tsunami potential to be high.

Through the analysis of the data and bibliographic information about the Chilean margin, we analyzed the potential trigger mechanisms for the landslide. Situated on a steep ridge flank, the trigger mechanism is most likely closely related to the formation and evolution of the ridge. The ridge follows an elongated fault zone running app. parallel to the margin. This fault zone has a dextral component which in combination with the faults elongation results in a compressional regime that is superimposed on the overall subduction-related compression and ultimately generated this ridge. Over-steepening (slope angle >6°) of rapidly accumulated sediments (high sedimentation rate) seems to be the most preconditioning factors of this slide. A weak layer may have acted as sliding surface. The most likely trigger is one of the frequently occurring earthquakes in this area.