Geophysical Research Abstracts, Vol. 9, 04248, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04248


# Seaward thermal and structural variability along the rupture area of the 1960 Chile Earthquake and its impact on the seismogenic updip limit

**M. Heesemann** (1), I. Grevemeyer (2), H. Villinger (1), E. Flueh (2), M. Scherwath (2), D. Völker (2), E. Contreras-Reyes (2) and the TIPTEQ Research Group

(1) Department of Geosciences, University of Bremen, Klagenfurther Str., 28359 Bremen, Germany, (2) Leibniz-Institute of Marine Sciences, IFM-GEOMAR, Wischhofstr. 1-3, 24148 Kiel, Germany (heesema@uni-bremen.de)

According to current models of great subduction earthquakes, the size of the ruptured zone, and therefore the magnitude of the event, is controlled by the thermal structure of the plate boundary; updip and downdip limits of the seismogenic zone coincide with temperatures of 100 – 150˚C and 350 – 450˚C, respectively. From this point of view, the 1960 Chile earthquake ($M_W$=9.5), which is the largest earthquake ever recorded, was not only an outstanding event in respect to its magnitude. Also, the anticipated variability of the thermal structure of the subducted plate along the ∼1000 km long rupture area (∼37 – 46˚S), due to age variability (∼0 – 30 Ma), is very remarkable.

Being part of the multi-disciplinary and multi-institutional project TIPTEQ (from The Incoming Plate to mega-Thrust EarthQuake processes), we present the correlation of lateral variations in the thermal state of the 1960 Chile earthquake rupture area, estimated by finite element method (FEM) models, with seismic activity. To constrain the FEM models, scarce existing heat flux data were supplemented by 63 successful deployments of violin bow type heat flux probes during RV Sonne cruise 181-1b from December 2004 through January 2005. On the continental slope, additional constraints on the heat flux were derived from abundant bottom simulating reflectors (BSRs) found in seismic reflection data. Active source seismic data provided geometry information for our models, and seismic activity was obtained from local seismological networks along the rupture area.

Geometrically, as the bathymetry deepens gradually to the north, the sediment input appears to be evenly distributed along the trench. The sedimentary thickness at the deformation front is about 2 km everywhere except near the Chile Triple Junction in the south and the Juan Fernandez Ridge in the north. The incoming oceanic crust is about 5 km thick, independent of its thermal state, though seismic velocities indicate increased hydration of oceanic lithosphere for colder regimes. The dip-angle of the subducting plate below the continental shelf varies between 4$^{\circ}$ and 7$^{\circ}$, with slightly steeper angles at colder incoming lithosphere. The overlying continental crust seems strongly deformed towards the trench, though no systematic changes with age are apparent.

As expected, heat flux measurements on the incoming plate generally decrease with increasing age, and most measurements indicate cooling by advection in the upper oceanic crust. Comparing modeled rupture zone temperatures of older incoming oceanic crust in the north with results of successively younger plate, it appears that the seismogenic zone narrows down and the updip limit moves significantly towards the trench. This findings correlate well with the observed regional seismicity.