Geophysical Research Abstracts, Vol. 8, 07977, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07977

1 Thermal State of the seismogenic Plate Boundary in Central Chile, 36˚S

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Current models of great subduction earthquakes claim that the size of the ruptured zone, and therefore the magnitude of the event, is controlled by the thermal structure of the plate boundary. It is generally accepted that the updip limit and the downdip limit of the seismogenic zone coincide with temperatures of 100 – 150˚C and 350 – 450˚C, respectively. The thermal state of the incoming plate, primarily depending on its age, is the key factor controlling the thermal structure of the down going plate. Therefore, the 1960 Chile earthquake (M_W=9.5), which is the largest earthquake ever been recorded, was not only an outstanding event in respect to its magnitude. Also, the age variability ($\sim$0 – 30 Ma) of the plate subducted along the $\sim$1000 km long rupture area ($\sim$37 – 46˚S) is very remarkable.

Being part of the multi-disciplinary and multi-institutional project TIPTEQ (from The Incoming Plate to mega-Thrust EarthQuake processes), the objective of the presented study is to determine lateral variations in the thermal structure of the 1960 Chile earthquake rupture area and its correlation with seismic activity. This will be achieved by using finite element method (FEM) models, which will be constrained by heat flux measurements on the incoming plate as well as on the continental slope. Moreover, geometry information provided by seismological networks and seismic reflection data are essential for the numerical modeling.

Since heat flux measurements were very scarce in the working area, an extensive heat flux survey was performed on RV Sonne cruise 181-1b from December 2004 through January 2005. During this survey, 63 successful deployments of violin bow type heat flux probes were performed along five transects, which were laid out perpendicular to the plate boundary. On the continental slope, additional constrains on the heat flux were derived from abundant bottom simulating reflectors (BSRs) found in seismic reflection data. In order to benefit from thermal data obtained during ODP Leg 202 and from heat flux data which was measured in 2003 on the Chilean Navy research vessel Vidal Gormaz, one of these heat flux transect has been located slightly north (36˚S) of the main rupture area of the 1960 Chile earthquake. Currently, geometry information obtained from TIPTEQ seismological networks along the rupture area is still preliminary. Therefore, first thermal modeling efforts, which will be presented, are concentrated on the northern transect offshore Concepción where the geometry of the subduction zone was determined by the Subduction Processes Off-shore Chile (SPOC) Research Group.

This transect is characterized by surprisingly low heat flux values on the $\sim$30 – 32 Ma old incoming plate. Measured heat flux values decrease from $\sim$30 mW/m^2 90 km seawards from the trench to $\sim$20 mW/m^2 at the deformation front, whereas the heat flux predicted by conductive models is $\sim$90 mW/m^2. Consequently, the presented thermal models focus on the processes that cool down the incoming plate and their effect on the thermal structure of the plate boundary in the nucleation area of the Great Chile earthquake.