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Thermal Regime of the Chilean Subduction Zone at 38°S and 43°S: modeling Results and Implications for Seismicity

D. Voelker (1), I. Grevemeyer (1), J. He (2), K. Wang (2), M. Heesemann (3)

(1) Leibniz-Institut für Meereswissenschaften an der Universität Kiel (IFM-GEOMAR), Wischhofstr. 1-3, D-24148 Kiel, Germany (dvoelker@ifm-geomar.de, igrevemeyer@ifm-geomar.de) (2) Pacific Geoscience Centre, Geological Survey of Canada. 9860 West Saanich Road, Sidney, B.C, Canada (3) Universität Bremen, Mailbox 330440, D-28334 Bremen, Germany

Results of a Finite Element Simulation of the thermal structure of the Chilean subduction zone along two profiles perpendicular to the coast are presented. The profiles extend from below the coast into the backarc region and enclose the seismogenic coupling zone. The first profile is situated at 38°15'S (latitude of the Arauco Peninsula), in line with a number of geophysical profiles of the TIPTEQ project, the seismological network ISSA 2000 as well as on- and offshore seismic experiments of the SPOC 2001 project. It crosses the initial hypocenter of the May 1960 (Mw=9.5) mega thrust earthquake. The second profile is situated at 43°10'S (latitude of Isla de Chiloe) and fits with the TIPTEQ South experiment (TIPTEQ corridor 2) which conducted sea floor heat flow measurements, wide angle seismic reflection experiments and a regional seismological network.

The temperature fields and heat flow curves were obtained using a 2D Finite Element Code of He and Wang which incorporates conductive heat transport, frictional heating at the decollement, heat transport by mantle wedge convection and radiogenic heat production. The first-order parameters for the temperature structure which distinguish both profiles are the model geometry and the thermal state of the incoming Nazca Plate, which basically is a function of its age (off Chiloe 15My, off Arauco 30My).

Most of the model's boundary conditions such as material properties and rheologies and the distribution of radiogenic heat sources constrained indirectly by a number of geophysical studies. A discussion, justifying the parameter sets used, is given.

The temperature distribution along the plate interface has fundamental implications for the stress pattern and spatial as well as temporal distribution, magnitude and type of earthquakes. The downdip limit of thrust earthquakes is generally considered to be a function of the temperature at the plate interface. On the other hand mineral phase transitions within the downgoing plate, which are triggered by changing PT conditions are made responsible for earthquake activity at intermediate depth ($>$30 km). As those phase transition reactions are partly exothermic, they contribute to the heat balance as heat sources which further complicates matters. We try to offer some first results on the role of phase transitions in this respect and discuss our results against the most recent results of the seismological datasets provided by the TIPTEQ group.