Geophysical Research Abstracts
Vol. 21, EGU2019-11130-5, 2019
EGU General Assembly 2019

Frictional structure of the Chilean megathrust combining seismicity, geodesy, gravity-bathymetry anomalies, morphology and geology.

Diego Molina (1), Andres Tassara (2), Rodrigo Abarca (3), and Daniel Melnick (4)

(1) Programa Doctorado en Ciencias Geológicas, Facultad de Ciencias Químicas, Universidad de Concepción, Concepción, Chile (diegmolinao@gmail.com), (2) Ciencias de la Tierra, Facultad de Ciencias Químicas, Universidad de Concepción, Concepción, Chile, (3) Departamento de Goefísica, Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Concepción, Chilee, (4) Millennium Nucleus: The Seismic Cycle Along Subduction Zones, Chile

Subduction zones are constituded by seismic segments of different extension, which seems to persist at time-scales similar to the seismic cycle. These seismic segments are a manifestation of heterogeneities in the frictional structure of the megathrust and are reflected through the prevalence of seismic asperities and barriers. However, it does not exist a clear comprehension about the nature of these elements, neither the factors that are controlling the frictional structure, and how they may interact and operate during the seismic cycle.

Chile is a perfect natural laboratory to study and unveil the behavior of these factors because of the high rate and large magnitude of megathrust earthquakes. Together with the largest great earthquake ever recorded, The Mw 9.5 Valdivia giant event, three great earthquakes (Mw > 8) have ocurred here during the last decade (Maule 2010, Iquique 2014, Illapel 2015). The slip distribution of these earthquakes has been estimated with great detail using numerical models and geodetic and seismic constraints. Thus, coseismic asperities are well constrained, which give us good insight about the spatial rupture patterns in the megathrust.

Here we attempt to characterize the spatial variability of the frictional structure of the Chilean megathrust in order to determine the role of different potential factors, such as the presence of sediments and fluids at the trench and subduction channel or the geological structure of both plates (crustal faults, lithology, geological units, basins, and acretionary prisms, seafloor roughness, seamounts, fracture zones and dip variations of the subducted slab)

Currently we are generating a complete data base containing seismicity catalogs, geodetic models of inter-seismic coupling and coseismic slip distribution, residual gravity and topography anomalies, and digital geology. After integration and georeferencing all these data, we will generate several quantitative proxies of the frictional structure. As proposed by other authors, we expect that models, such as gravity anomalies, locking degree, or b-value derived from seismicity should independently point to variations in the frictional properties of megathrust. Thus, the integrated study of these proxies is appropiated to understand the seismogenic behavior better.

In a way to accomplish these objetives, we will make a statistical analysis linking different methodologies, which will allow us to estimate the degree of correlation between different proxies to finally produce an integral representation of this frictional structure.

We will use two different statistical analysis to obtain an integral representation from several proxies. The first one will be the decomposition in frequencies of the proxies to study the coherence between them and gain insight on how they may correlate each other in space using Fourier decomposition. In the other hand, applying principal component analysis (PCA) to the same proxies, we will decompose the same fields in normal modes to attempt to unveil which of those modes are related to the frictional structure.

Finally through quantitative tools, this image will be compared with several geological features of fore-arc, aiming to understand how much the many geological elements are influencing such structure.