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Edited by Ulrich Riller & Paul Göllner

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geodetic observations in Central Chile, where two large earthquakes occurred: Maule in 2010, Mw=8.8, and Illapel in 2015, Mw=8.3. We propose a model that considers the motion along both interfaces of the brittle subducting slab as the sources responsible for the movement of the crust in the different periods of the earthquake cycle. Using standard inversion techniques, we provide a consistent framework of the kinematic displacement during each period of the earthquake cycle. We show that during the interseismic period prior to Maule and Illapel earthquakes, two patches of slip-rate on the lower interface are determined. These patches are located just below the future hypocenters. Since the interseismic period corresponds to the loading process and the coseismic to the unloading process, it is interesting to note that the area where loading is stronger corresponds to the area where unloading is also strong. Furthermore, we show that the Maule earthquake causes a significant displacement on the lower interface, just below the epicenter of the future Illapel earthquake to the north, a few years later. We speculate that the interaction between motion along both interfaces are the key to understand the evolution of stress and the occurrence of earthquakes at subduction zones. This framework improves the understanding of the observed loading and unloading processes, and potential triggering between subduction earthquakes.

Subduction kinematics in the years before and after the 2014, Iquique Mw 8.1 Earthquake, Chile from de-noised GPS trajectories and joint slip-strain models.

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Over 5 years have passed since the April 1st 2014 Mw 8.1 Iquique earthquake in Northern Chile, during which time we have captured the relaxation processes of this large event with both seismic and geodetic instruments of the Integrated Plate boundary Observatory Chile (IPOC). While there exist some Iquique afterslip models that use GPS and InSAR recorded ground motions, we have not yet explored the spatiotemporal interplay between afterslip, aftershocks, and mantle relaxation. Furthermore, several studies that have explored the seismic and geodetic variations leading up to the event have come to different conclusions: At this point it remains unclear as to whether the gradual failure of the asperity starts accelerating just a few weeks or several months before the mainshock.

Here we will show the results of applying the Greedy Automatic Signal Decomposition (GrAtSiD) algorithm to the IPOC continuous GPS stations, along with the associated kinematic models of the uncoupling and relaxation processes. With GrAtSiD, we are able to automatically separate the seismic and aseismic signals in the GPS time series, as well as being able to remove most of the seasonal oscillation. We will first describe the features of the decomposed GPS velocities and then present models of the plate-interface kinematics and mantle relaxation, for periods both before and after the earthquake. For the kinematic modeling we will show our progress with state-of-the art models that simultaneously solve for strains in cuboid volumes and slips on faults. While this modeling approach suffers computationally from the need to solve a tremendously large model space, the advantage is that it eliminates the model bias introduced by the traditional approach of relaxing coseismic stresses in a pre-defined arrangement of elastic and viscoelastic model blocks.

The Miocene foreland basins of Northern Patagonia: sediment transfer systems from the Southern Andean to the Atlantic shelf

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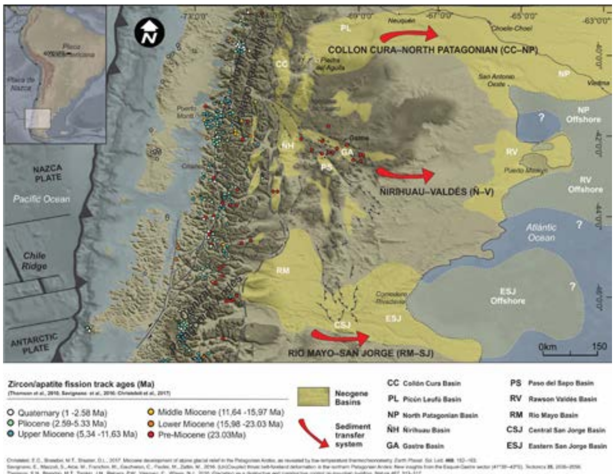
Unravelling the effects of external controls on the stratigraphic record of a region, as well as the determination of how they impact in the dynamics of a sedimentary system is nowadays a critical gap to solve in geosciences. This issue is challenging because it not only involves the net depositional parts of the systems, but also, implies the understanding of the dynamic interplay between erosion, sediment transfer, and deposition as well as temporary storage, and long term preservation of the sediments, from source to sink.

The Northern Patagonia has an extensive and superbly exposed Neogene Andean foreland sediment record extending from the foot of the Southern Andes to the Atlantic shelf. This sediment transfer system is strongly linked to the Neogene orogenic growth of the Andes and was synchronously associated with the development of profuse magmatism, a major climate change from wet to dryer conditions, as well as important relative sea level changes. Based on a multidisciplinary approach, which includes new structural, stratigraphic, geomorphological and geochronological dataset together with previous surface and subsurface regional surveys, three Miocene sediment transfer systems that connected the Andes with the Atlantic Ocean through more than 600 km were reconstructed. From north to south (45–48°S) these transfer systems are: Collón Cura–North Patagonian basins system, Ñirihuau–Valdés basins system and

Rio Mayo–San Jorge basins system (Fig.1).

Stratigraphic correlations along the sediment transfer systems indicate a continuous sedimentary record during the Miocene for the Collón Cura–North Patagonian and the Río Mayo–San Jorge basins system. However, for the Ñirihuau–Valdés system, an important hiatus is registered in the distal zone during the middle Miocene (i.e., Rawson-Valdés Basin). This stratigraphic gap is interpreted as a consequence of middle-term sediment transient storage in the foreland region during the middle Miocene associated with block uplift and the configuration of closed-basins. Thus, during the Miocene sediment transfer systems functioned as both fully connected and unconnected systems between the Andes and the Atlantic Ocean. Finally, although more studies are needed to refine and improve the chronostratigraphic framework of the Miocene sediment transfer systems, early results of this work show some relevant issues related to the origin of environmental signals and their propagation through time and space.



The Central Andean double seismic zone: seismological constraints on the processes within

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Subduction zones worldwide show a common pattern where earthquakes occur in two slab-parallel planar structures, so-called double seismic zones. One plane is located below the plate interface, within the oceanic crust or mantle, the other one, separated by a few to tens of kilometers, inside the slab mantle. The processes that cause earthquakes to occur in this particular geometry at intermediate depth are highly debated.

Temporary local seismic networks and the permanent regional IPOC network facilitated the detailed observation of the Central Andean double seismic zone. The ANCORP 96 active source seismic deep sounding experiment allowed correlation of detailed structural images with seismicity patterns. Here, we summarize our recent efforts to characterize the petrophysical properties and the stress state of the subducting slab from seismological observations.

The plate interface of the Central Andean subduction zone becomes activated in weak thrust faulting events down to a depth of 50-km and appears as a sharp reflector. At 50-km depth the coupling zone ends, the reflectivity pattern of the plate interface broadens characteristically and the slab is under tension. The upper seismicity plane consists of seismic events that likely activate outer-rise bend-faults. It has a homogeneous lateral extent. The P- to S-wave velocity ratio is indicative of metamorphosed oceanic crust.

The lower plane of seismicity is laterally heterogeneous on a scale of tens of kilometers. Differential stresses are low in the updip portion of the slab and increase along the subduction pathway with no apparent signature of reactivation of inherited structures. At the commence of the lower plane of seismicity we find a high P- to S-wave velocity ratio that is indicative of the presence of a connected network of fluid-filled vein-like pores. Along the ANCORP profile the places where the lower plane of seismicity is present correlate with an increased seismic reflectivity above, which we interpret as the signature of fluids escaping into the overlying slab mantle.

At 100-km depth, seismicity and seismic reflectivity increase strongly within the slab. Above, a prominent reflectivity structure is visible which connects the top of the slab with the magmatic arc and fosters the interpretation that this is the place where major slab de-volatilization occurs.