Advancing Interseismic Coupling Modeling by Incorporating Offshore Geodesy and Rheological Complexity in the Northern Chile Subduction Zone

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During my two-month research stay at the Earthquake Research Institute (ERI), University of Tokyo, I worked with Prof. Yuji Itoh on interseismic deformation and megathrust locking in northern Chile. The main objective of my visit was to advance the interpretation of recently acquired offshore geodetic observations and to incorporate these data into a more realistic numerical modeling framework for the Chilean subduction zone. A major part of my work during the stay focused on the analysis and interpretation of seafloor geodetic data collected offshore the Atacama seismic gap through the IDOOS experiment. These observations, obtained from self-calibrating ocean-bottom pressure gauges, were analyzed together with onshore GNSS velocities to better constrain vertical deformation and the shallow extent of interplate coupling. This work showed the importance of offshore observations for understanding processes that cannot be resolved from land-based geodetic data alone.

In parallel, I developed, together with Prof. Itoh, a 2D viscoelastic finite-element modeling framework using PyLith. During the visit, I worked on building the model geometry, defining the main structural and rheological domains of the forearc, and evaluating how spatial variations in rigidity and viscosity affect the observed deformation field. This required integrating multiple datasets, including GNSS, offshore pressure records, local earthquake tomography, seismic reflection profiles, and bathymetric information.

Another important component of my stay was the implementation of a parameter exploration and optimization workflow. This allowed us to test the sensitivity of the models to locking geometry and rheological properties, and to identify the parameters that best explain both offshore and onshore deformation. The work carried out during the visit also helped refine our interpretation of the role of a subducted seamount in the Taltal segment of northern Chile.

Beyond the research itself, my stay at ERI was highly valuable for strengthening scientific exchange and establishing new collaborations. In addition to my work with Prof. Itoh, I initiated discussions with Prof. Masa Kinoshita on the effects of seamount subduction on forearc structure and seismic segmentation, with Prof. So Osawa on future frictional modeling of the Chilean subduction zone, and with Prof. Shoichi Yoshioka at Kobe University on the integration of thermal modeling into future studies of the seismic cycle.

Overall, the visit was very productive. It allowed me to advance an ongoing research project through new modeling developments, improved interpretation of offshore geodetic data, and the establishment of new international collaborations that will support future joint work between ERI and Pontificia Universidad Católica de Chile.