BATHYMETRIC AND SEISMIC EVIDENCE FOR A REGIONAL STRIKE SLIP FAULT SYSTEM (ASF) ALONG THE SUBMARINE FOREARC OF CENTRAL CHILE AND ITS POTENTIAL LINK TO THE GENERATION OF GIANT EARTHQUAKES

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INTRODUCTION

A very relevant current theme in convergent margin studies is related to the seismogenic zone and the potential generation of destructive earthquakes and tsunamis, which may affect densely populated coastal areas.
Previous subduction zone studies emphasized the connection between regional faults and the rupture areas of big earthquakes (e.g., Cheng and Wang, 2001; Park et al., 2002).

Recently acquired swath bathymetry revealed a kilometric scales trike slip fault -named as the "Antuvilu System Fault" (ASF)-, along the submarine forearc (around 33°30'-37°S). ASF is nearly parallel to the margin, trending generally NNE-SSW. A set of structures with an oblique tendency (NNW-SSE) with respect to the main fault is also identified (Fig.1).

Those bathymetric evidences are consistent with fault geometries observed in reflection seismic lines (Contardo et al., 2008), characterized by positive flower structures, which evidence strike slip faults with a predominant transpressive style. However, a less frequent transtenssive style is also observed (around 35-35°30´S). Here, we emphasize on the potential seismogenic activity of the ASF).

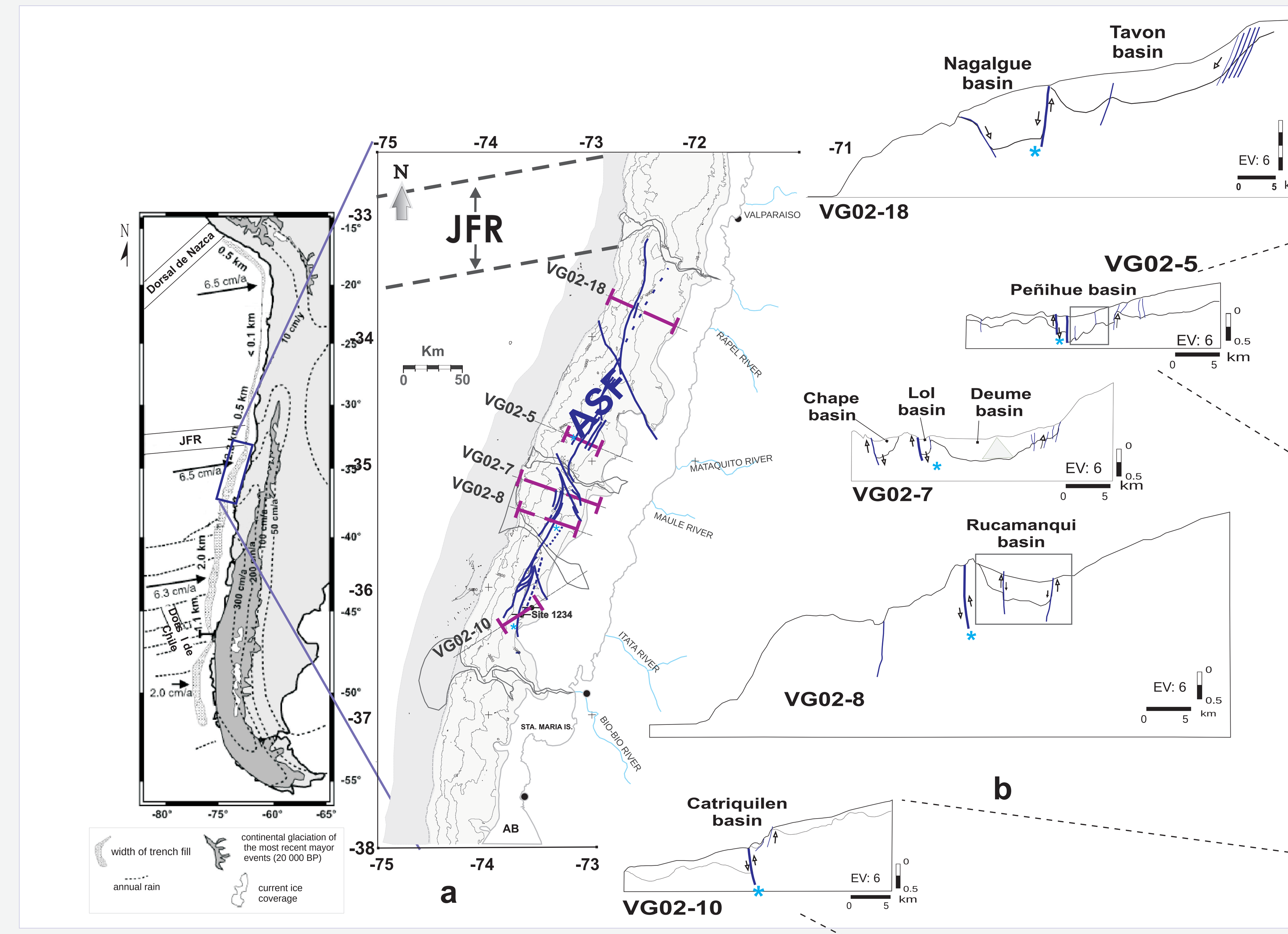


Fig.1a: Segment of the accretionary margin of South Central Chile (between 33°30′ and 37°S) showing the structural pattern of the Antuvilu system Fault (ASF). The general NNE-SSW trend of the main structure is composed of several ramifications; a second trend in NNW-SSE direction is also observed. b: Interpreted sections of seismic lines showing bounding faults controlling slope basins. The small stars indicate faults linked with ASF. Modified from Contardo et al., (under submission).

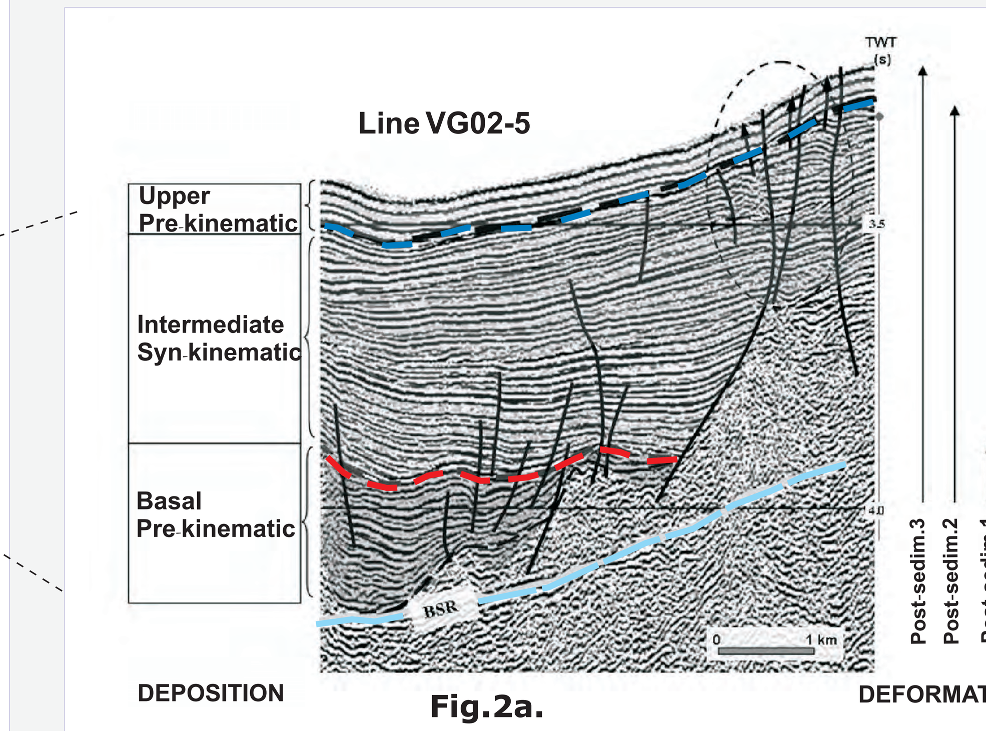
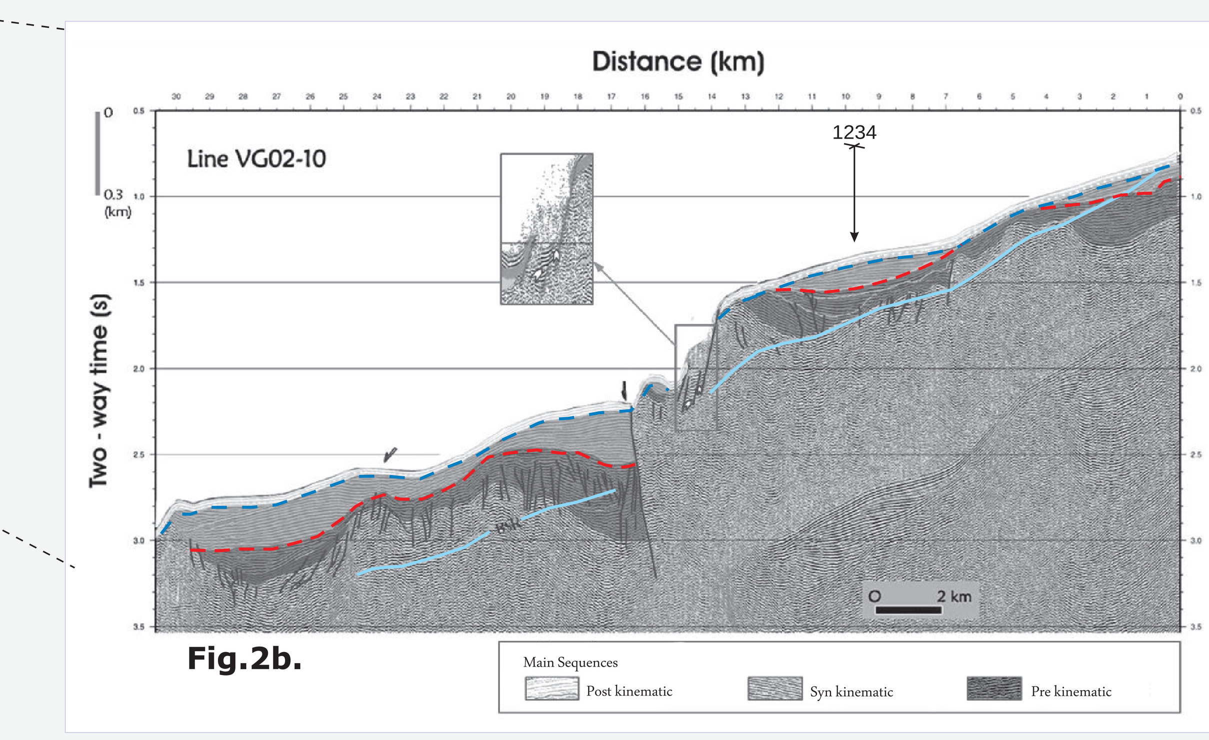


Fig.2a: Flower structures point to current transpressional activity, associated with tectonic inversion and differential uplift of the accretionary prism.

Fig.2b: The architecture of the sedimentary infill (middle Pleistocene to Holocene) evidences three main distinctive seismic sequences, identified as basal pre-kinematic, intermediate syn-kinematic, and upper post-kinematic units (BSR: Bottom Simulating Reflection). Figure taken from Contardo et al, (2008).



Submarine slope basins mostly are half-grabens controlled by subvertical bordering faults (with reactivation) (Figs. 1, 2), governing differential uplift and subsidence. Some local sediment sources and consecutive downlaps represent past reactivation of bordering faults. Evidence for active faulting is inferred from escarpments affecting the sea floor and discontinuous and displaced BSR in the sedimentary sequence, e.g., at ~36°S (Fig.2b.).

The kilometric scale ASF seems to be an active and dynamic structure, controlling slope basins and forearc morphology. Further, it could also play an important role for seismicity, as it located in the close proximity to the rupture area of the 2010 Maule earthquake. Surface projection of the fault plane from slip distribution allows visualizing the location and length of the rupture zone (Fig.3a,b).

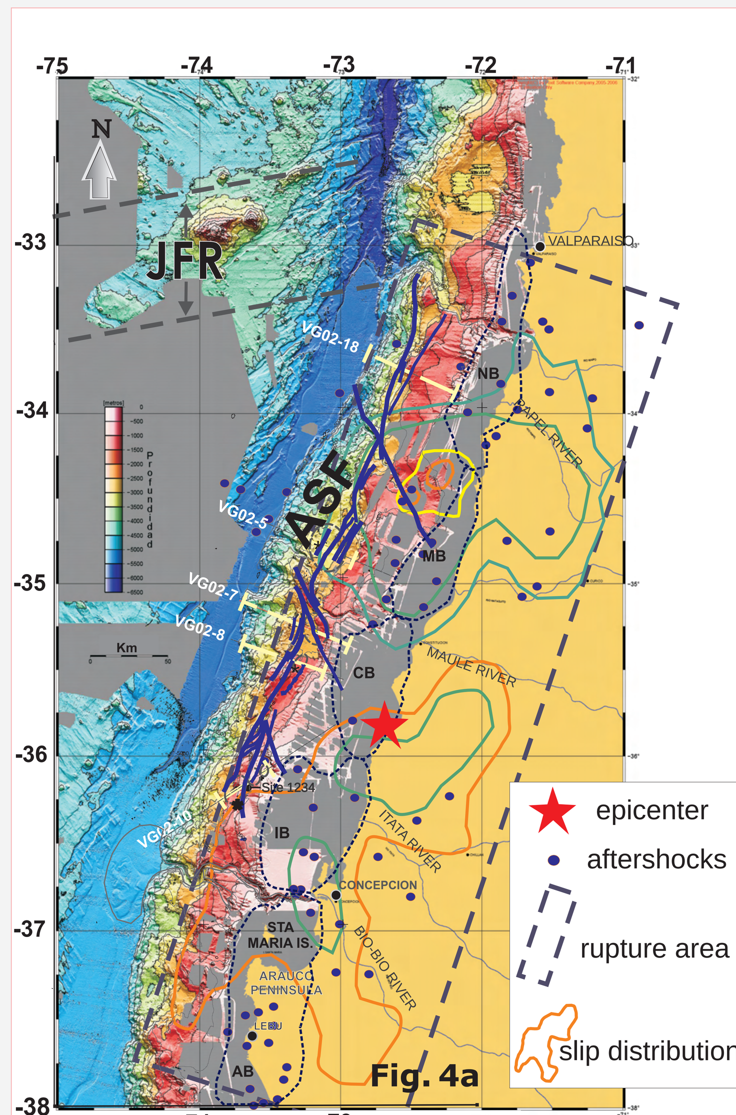


Fig.3a Bathymetric map showing the regional strike slip fault (ASF), along the submarine forearc.

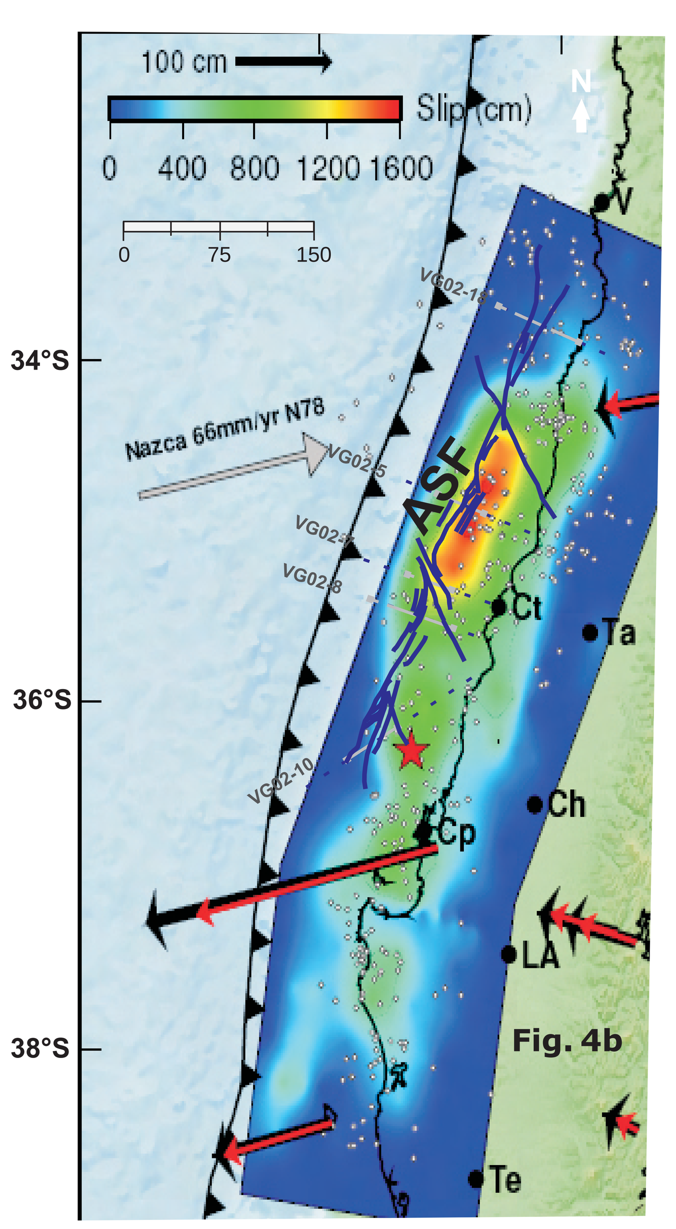


Fig. 3b Coseismic slip model for the 2010 MW 8.8 Maule Chile earthquake, taken from Sladen et al. (2010).

Seismological and geodetical data (Sladen et al., 2010; Tong et al., 2010) indicate that the 8.8 Mw Chilean earthquake, which occurred on February 27th 2010 ruptured very close to the ASF structure. It is observed that the area of highest slip would be also limited by a set of NNW-SSE trending structures.

Several questions can be raised from these observations, e.g., could such a strike slip fault represent a rheological limit across the accretionary prism? Then it might be also a boundary for rupture propagation.

Should we look for similar regional structures along the entire margin which may represent potential seismogenic faults? Has this fault been active during the earthquake?

A close integration between morphological, geological and kinematical features of the submarine forearc structures, with newly generated seismic and geodetic information will be crucial to better understand the nature and dynamic processes of this regional fault (ASF), linked to the generation of potential giant earthquakes.

References
Contardo, X., Cembrano, J., Jensen, A., Díaz-Naveas. J. 2008. Tectono-sedimentary evolution of marine slope basins in the Chilean forearc (33°30'–36°50'S): Insights into their link with the subduction process Tectonophysics, doi:10.1016/j.tecto.2007.12.014.
Contardo, X., Kukowski, N., Cembrano, J. Controls on the formation of slope basins along the south central Chilean convergent margin: Insights from scaled sandbox simulations (submitted to Tectonophysics).
Tong, X, Sandwell, D., Luttrell, K., Brooks, B., Bevis, M., Shimada, M., Foster, J., Smalley, R., Jr.,5 Parra, H., Báez, J., Soto, Blanco, M., Kendrick, E., Genrich, J., Caccamise, D. 2010. The 2010 Maule, Chile earthquake: Downdip rupture limit revealed by space geodesy GEOPHYSICAL RESEARCH LETTERS, VOL. 37, L24311, doi:10.1029/2010GL045805,

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