

SEISMIC IMAGING OF THE SUBDUCTED NAZCA SLAB, NORTH CHILE

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This paper presents a compilation of active and passive seismological data from the northern Chilean subduction zone (20°S-25°S). The results yield a complete seismic image of the downgoing plate and the associated seismic coupling zone.

Kirchhoff PreSDM as well as the CRS stack method have been applied to the offshore CINCA line SO104-13. The upper part of the subducted oceanic lithosphere between sea floor and 15 km depth is characterized by a horst-and-graben structure supporting an approximately 3 km thick coupling zone between the plates (Fig. 2).

The same thickness is observed between 15 and 45 km depth by analyzing the spatial distribution of aftershock hypocenters of the Antofagasta earthquake (1995). The upper boundary of the oceanic crust is marked by these hypocenters (Fig. 2, left) while the lower boundary is imaged by stacked wide-angle reflections (Fig. 2, right).

Moreover, we applied Kirchhoff PreSDM to the onshore ANCORP profile. The prolongation of the upper and lower boundary of the oceanic crust is observed in this image as a double reflection zone between 45 and 60 km. Down to more than 80-90 km we obtain an image of the subducting slab (Nazca reflector). At that depth the hypocenters of local earthquakes deviate significantly from the reflective parts of the slab (Fig. 2).

A similar image could be obtained from the shorter PRECORP profile about 160 km to the south, which also contains elements of the Nazca reflector (Fig. 3). Both profiles show a crustal bright spot, the QBBS (Quebrada Blanca Bright Spot) in the ANCORP profile and the CBS (Calama Bright Spot) in the PRECORP profile. A comparison between the locations of these Bright Spots and the local fault systems does not support the interpretation of the fault systems as deep-reaching fluid ascent paths which border the Bright Spots.

References:

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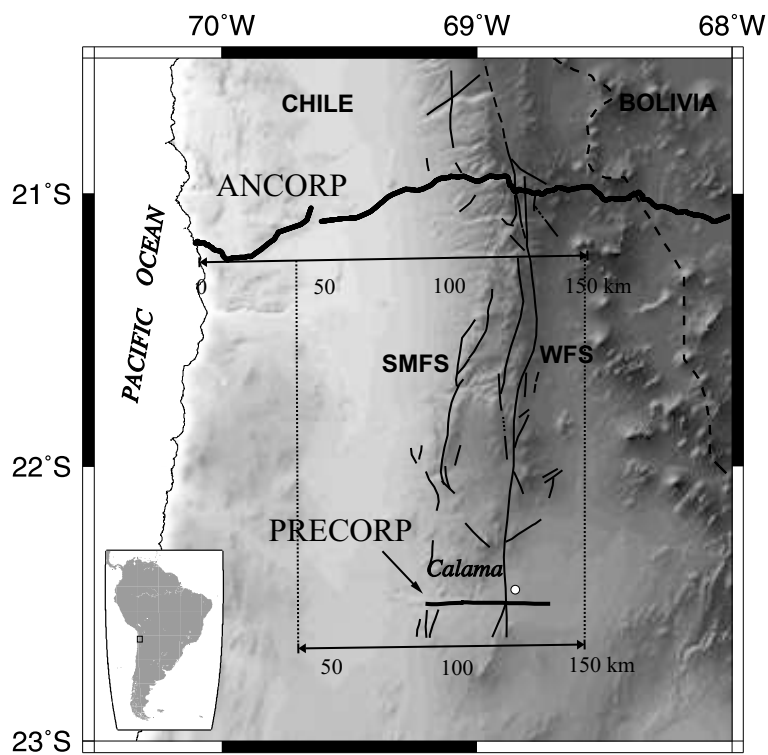
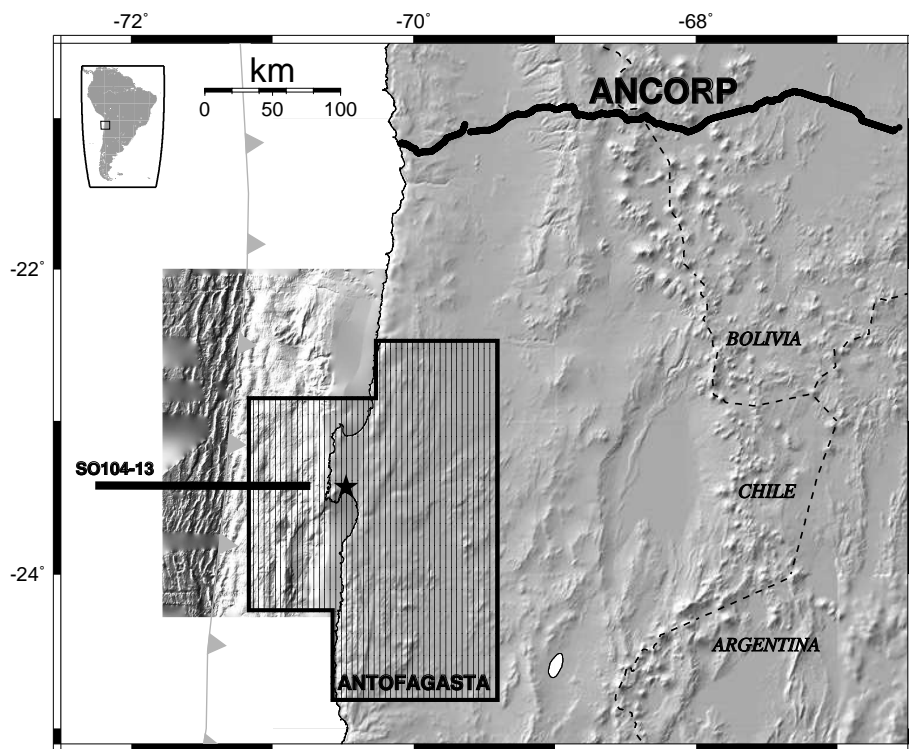


Figure 1: Top: Location of the offshore profile SO104-13, the onshore profile ANCORP, and the area of the Antofagasta aftershocks. Bottom: Location of the onshore profile PRECORP and the local fault systems (SMFS: Sierra-de-Moreno-Fault-System, WFS: West-Fissure-Fault-System).

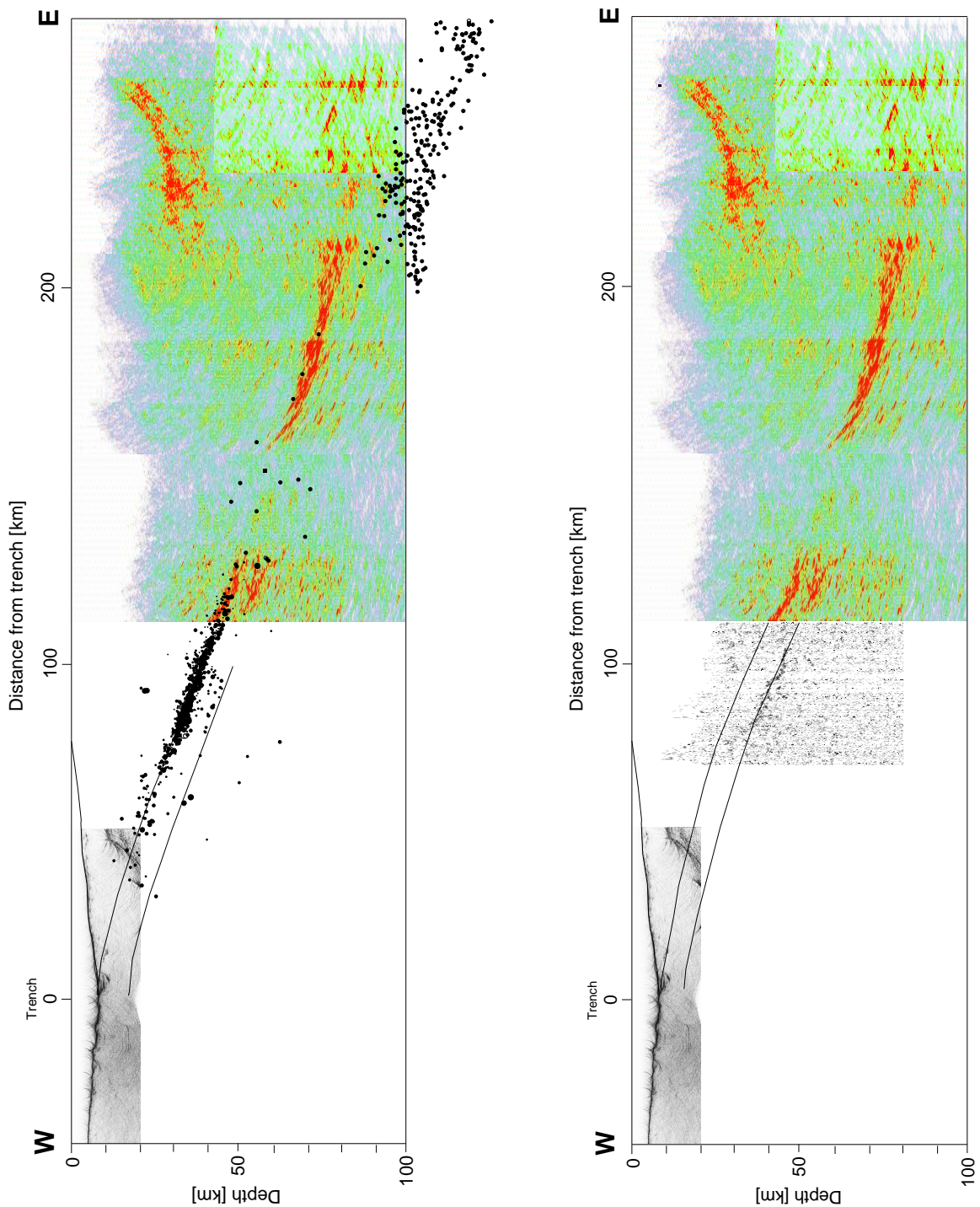


Figure 2: Compiled image of the subducted slab: offshore CINCA profile around trench between seafloor and 20 km depth with horst-and-graben structure; hypocenters of the Antofagasta earthquake marking the upper boundary of the oceanic crust (left), and stacked wide-angle reflections marking the lower boundary (right); ANCORP profile with prolongation of these boundaries, the Nazca reflector and the Quebrada Blanca Bright Spot; below 80-90 km the signature of the Nazca reflector is blurred and the local seismicity is offset by about 10 km.

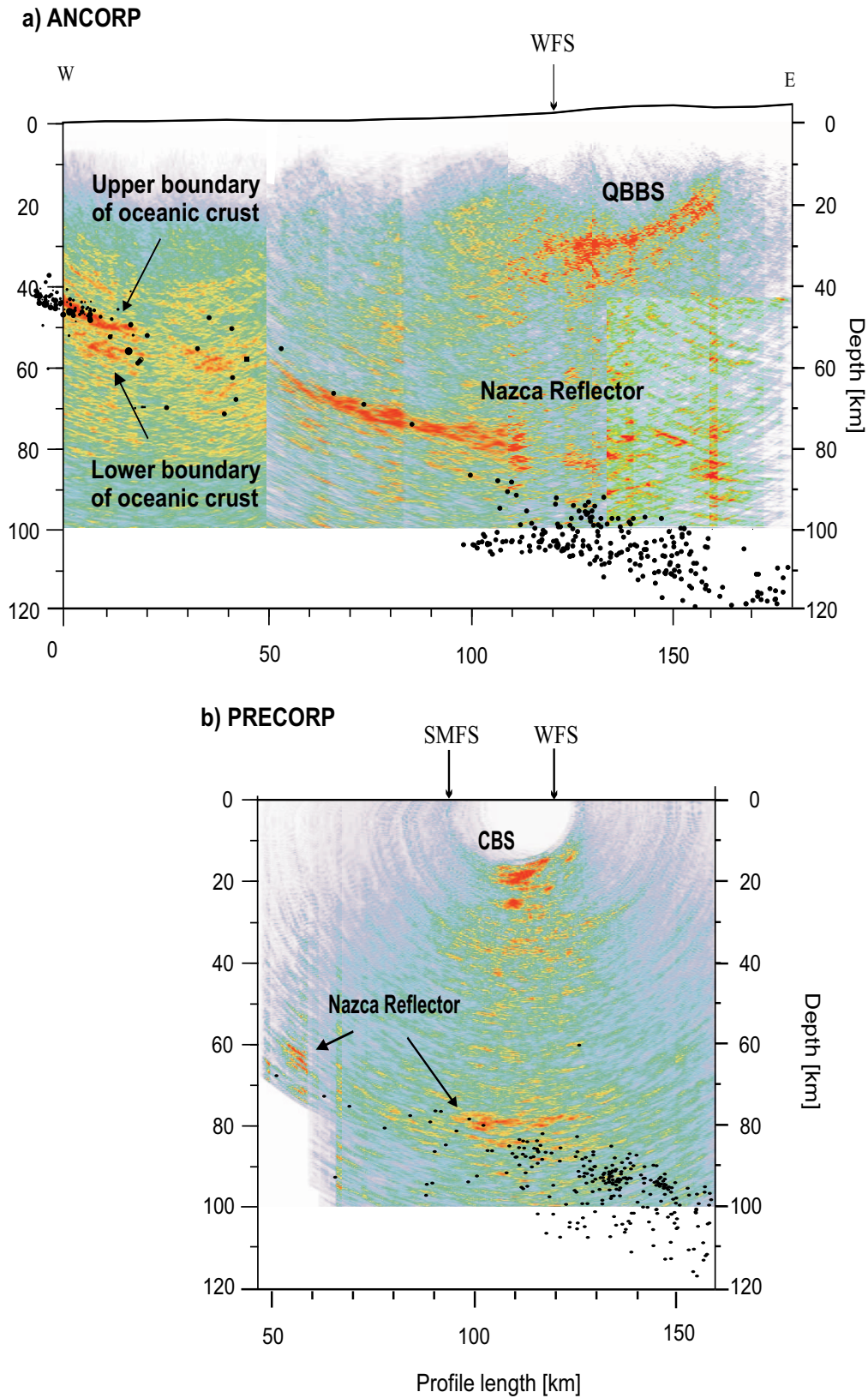


Figure 3: Comparison of ANCORP (top) and PRECORP (bottom) profile. Both show elements of the Nazca reflector, and a crustal Bright Spot (ANCORP: QBBS, PRECORP: CBS). The West-Fissure-Fault-System (WFS) marks the left boundary of the QBBS (ANCORP) while the CBS (PRECORP) appears between the Sierra-de-Moreno-Fault-System (SMFS) and the West-Fissure-Fault-System.