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Structure and Neotectonics of the Southern Chile Forearc 35°S – 40°S

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The Southern Chile Forearc exhibits an extreme level of neotectonic deformation. On-land studies have documented a pronounced segmentation in the region 36°S – 41°S. However, information on the seaward continuation of the individual segments towards the Chile Trench is rare, as direct observations end at the coastline and are replaced by a less dense set of marine geophysical data. In this study we use swath bathymetric data combined with high and low-frequency reflection seismic data as well as results from heat-flow measurements to: (A) map and identify active deformation structures and investigate their spatial distribution, and (B) analyse the factors controlling segmentation along the Southern Chile Forearc.

Considering the region 35°S to 40°S we found evidence for a division into four major segments; Concepcion North, Concepcion South, Nahuelbuta, and Tolten (from North to South). Within all four segments, the lower continental slope is dissected by distinct margin-parallel thrust ridges overlying active landward-dipping thrust faults, indicating the presence of an active accretionary prism. The middle and upper slope, however, shows major differences between the four segments. The Concepcion North Segment is dominated by a large margin-parallel thrust ridge. The Concepcion South Segment shows large up to 600 m high north–south aligned normal fault scarps highlighting east-west extension. The change from thrust to normal faulting domains is accompanied by a drastic decrease in surface heat-flow by a factor of up to four. Further south in the Nahuelbuta Segment, east-west trending active thrust ridges indicate north–south compression of this part of the forearc. Shortening in this segment is not only limited to the middle and upper slope, but includes the entire marine forearc and occurs perpendicular to the direction of plate convergence. In the southernmost Tolten Segment the middle and upper continental slope shows no signs of compressive or extensional deformation.

For the factors controlling segmentation our data suggest that when considering the whole forearc variations in the overriding plate such as the position of continental fault zones are responsible for the large scale tectonic segmentation. The east-west oriented shortening structures in the Nahuelbuta Segment (perpendicular to the direction of plate motion) probably originate from the collision of the Chiloe Microplate with a marine buttress situated below the Concepcion South Segment. The Chiloe Microplate represents a 1000 km-sized forearc sliver, which is kinematically decoupled from stable South America along the Liquine-Ofqui and Lanalhue Fault Zones. The important transition from wholesale forearc compression to extension observed between the two Concepcion segments, however, is more likely related to plate boundary processes, i.e. different degrees of coupling and/or friction in the plate boundary itself.