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Seafloor morphology and wedge mechanics along the submarine Peruvian forearc: insights from morphometry and critical taper analysis

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Oblique convergence between the descending Nazca plate and South America and resulting strain partitioning is regarded as a cause for a transtensional fault system, identified from swath bathymetry data acquired during the GEOPECO campaign, extending for more than 200 km on the lower and middle submarine continental slope off Peru. Normal faults have been observed in the entire submarine forearc up to the shelf and also onshore raising the question of their tectonic significance and their role as a potential stress regime indicator in a convergent margin setting.

Swath bathymetry reveals that the lower slope is locally very rough and suffering from numerous local scale slumping. This observation suggests that the lower slope is at the verge of failure throughout the entire Peruvian margin. The middle and upper slopes have a relatively smooth topography, but still comprise locally steep slopes.

To analyse the mechanics of the Peruvian offshore wedge, we performed a classical critical taper analysis along several transects across the margin for which we have the precise geometry from swath bathymetry, wide angle seismic, and seismology. We identified wedge segments according to the morphological segmentation of the continental slope. Using realistic estimates for the basal and internal friction as well as the basal and internal fluid pressure ratios we find that the lower slope and some unusually steep portions of the upper slope are close to extensional failure whereas the shelf seems to be unconditionally stable. Employing the dynamical wedge con-

cept we suggest that fluid pressure built up during a seismic cycle is the most likely means to oversteepen the lower slope and cause failure, such that it would be in a conditionally unstable state. This may also be locally the case for the middle and upper slope. However, this still leaves it difficult to explain the large number of normal faults. Therefore we include subduction erosion and gravitational collapse of the Peruvian forearc, which has the largest height difference between the trench and the top of the juxtaposed Andes ($>$ 12 km) worldwide, in our discussion of potential causes of normal faulting.