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Strain Partitioning and Deformation of Forearc Wedges at Obliquely Convergent Subduction Zones: Two Case Studies along the Chilean Margin

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The deformation styles of forearc wedges along a convergent margin are often observed to differ significantly along-strike, despite similar plate kinematic boundary conditions. Here, we focus our analysis of forearc deformation on two regions along the Chilean convergent margin at 20˚ - 24˚S and 37˚ - 42˚S. Both regions are subjected to the oblique subduction of the Nazca plate and backstopped by the Andes mountain chain; however show different patterns of recent deformation.
3D numerical simulation is used to understand how geometries, rheologies and mechanical parameters influence strain partitioning and styles of deformation in the Chilean forearc. The general outline of the model is based on the forearc geometry and boundary conditions as derived from geophysical and geological field data. We examined the influence of different rheological approaches and varying physical properties of the forearc to identify and constrain the parameters mainly causing the differences between the northern and southern study area. The results of the intermediate-scale models (tested by local field data) of this study were compared with large-scale models (tectonically tested) of Andean orogenis.
The rates of deformation obtained from the model simulations and comparison with field data suggest that the subducting Nazca plate and the South American continent should be separated by a relatively weak subducting interface, which was implemented numerically by a contact surface with a low friction coefficient. The analysis of strain partitioning in the forearc wedge showed that simple rheological concepts for the wedge (purely elastic or viscous) cannot represent field observables with acceptable accuracy. The elasto-plastic model wedge accommodates oblique subduction motion

of the Nazca plate more realistically, which allows to compare results with observables and estimate parameters of the model with considerable confidence. The coupling between the subducting Nazca plate and South America as well as the strength of the wedge material were found to have a high influence on the style of deformation. Weaker coupling is predicted for the southern study area than for the northern region which is in agreement with observed accretive styles of mass transfer in the south and erosive mass transfer in the north, respectively.