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On the relationship between lithospheric strength and ridge-push transmission in the Nazca plate

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The lithospheric strength of the Nazca plate is estimated based on thermal and rheological models. The integrated strength is then used to assess the effective ridge-push transmission of the plate towards trench. We used heat flow, geoid height and bathymetric data along a 5000 km long transect between the East Pacific Rise and the South American continent to constrain the thermo-mechanical structure of the Nazca plate. The results indicate that the overall strength of the Nazca plate, as expected, resides in the cold geothermic part of the lithosphere. However, the likelihood of the plate to transmit ridge-push and effectively contribute to the force balance required to assist plate motion depends on age and spreading history of the plate. The integrated lithospheric strength of the Nazca plate, for ages less than 45 Ma, is comparable to ridge-push force exerted on a plate of the same age. The ridge-push force at this stage may not be transmitted across a plate. Part of the Nazca plate, which is older than 45 Ma, however, exhibits lithospheric strength higher than the ridge-push force. It is, therefore, more likely that this part of the plate transmits ridge-push and assists plate motion, because older lithospheres, owing to their high density and cold geothermic conditions, are relatively strong. Apart from the age, the spreading rate of a plate influences the relation between the integrated lithospheric strength and ridge-push force. It is more likely that slowly spreading oceanic plates transmit ridge-push and assist plate motion, because the strength of a plate under such conditions is higher than the ridge-push force. Whereas the integrated strength of a fast-spreading oceanic plate is comparable to ridge-push force, and it is, therefore, less likely that the stresses are transmitted across a plate and contribute to the force balance needed to assist plate motion. The stresses under such conditions could dissipate into local deformation.