EGU22-1979
https://doi.org/10.5194/egusphere-egu22-1979
EGU General Assembly 2022

Extensional tectonics at oceanic transform plate boundaries: evidence from seafloor morphology

Yu Ren[1], Jacob Geersen[2], and Ingo Grevemeyer[1]
[1]GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany (yren@geomar.de)
[2]Institute of Geosciences, University of Kiel, Kiel, Germany

Oceanic transform faults are among the most prominent morphologic features in ocean basins, offsetting mid-ocean ridges by tens to hundreds of kilometers. Since the inception of plate tectonics, transform faults have been assumed to be simple, two-dimensional strike-slip, conservative plate boundaries, where lithosphere is neither created nor destroyed. This concept nurtured an over-simplified understanding of oceanic transform faults for many decades. New advances in seafloor mapping revealed that the morphology of oceanic transform faults is difficult to explain exclusively by strike-slip faulting and differential thermal subsidence. We compiled ship-based bathymetric data of 94 oceanic transform faults, and parameterized their morphological characteristics (e.g., length, width, depth, etc.) using quantitative geomorphologic methods. A prominent feature of most oceanic transform plate boundaries is a deep valley extending along the active transform fault. Our statistical analysis indicates that these valleys are generally deeper and wider at slow- and ultraslow-slipping rates than at faster slipping rates. However, the key feature that governs structural variability, seems to be age-offset across a transform fault rather than spreading rate. While the correlation between transform morphology and spreading rate turns out to be rather weak, our statistical results consistently show that transform valleys get deeper and wider with increasing age-offset. The surface deformation pattern observed therefore supports the tectonic extension scaling with age-offset predicted by recent geodynamic simulations (Grevemeyer et al., 2021). Furthermore, at small age-offsets (< 5 Myr), scatters especially in the depth of transform valley increase, indicating that small-age-offset transforms corresponding to weak lithospheric strength are easily affected by secondary tectonic processes, such as nearby hotspots and changes in plate motion. Now, five decades after Wilson (1965) published his seminal paper on transform faults, our quantitative submarine geomorphologic study emphasizes that oceanic transform faults are not simple conservative strike-slip plate boundaries, but that tectonic extension is an integral process affecting their morphology. The larger age-offset causes greater extension at OTFs and hence wider and deeper valleys as evidenced by our statistics on transform morphology.

References

Wilson, J. T. (1965), A new class of faults and their bearing on continental drift. Nature, 207, 343–347. doi: 10.1038/207343a0

Grevemeyer, I., Rüpke, L. H., Morgan, J. P., Iyer, K., & Devey, C. W. (2021), Extensional tectonics and two-stage crustal accretion at oceanic transform faults. Nature, 591, 402–407. doi: 10.1038/s41586-021-03278-9