EGU24-10345, updated on 25 Jan 2025
https://doi.org/10.5194/egusphere-egu24-10345
EGU General Assembly 2024

Subduction initiation, propagation and progression recorded along the Sulu and Celebes seas (SE Asia)

Patricia Cadenas Martínez[1,2] and César R. Ranero[3,4]
[1]Instituto Dom Luiz (IDL) and Geology Department, Faculty of Sciences, University of Lisbon, Lisbon, Portugal (pcmartinez@fciencias-id.pt)
[2]Memorial University of Newfoundland, St Jonh´s, Canada (pcadenasmart@mun.ca)
[3]Barcelona Center for Subsurface Imaging (Barcelona-CSI), Marine Sciences Institut (ICM), National Spanish Research Council (CSIC), Barcelona, Spain, (cranero@cmima.csic.es)
[4]ICREA, Barcelona, Spain

The inception of a subduction system delineates the birth of a destructive plate boundary that constrains the closure of Earth´s oceans. Material and structures of the transient stage between the reactivation of a passive margin and the establishment of a self-sustaining subduction zone are rarely-preserved in the geological record of fossil subduction zones, and natural examples of currently ongoing subduction initiation are scarce. Reported Cenozoic fossil examples have been interpreted to illustrate successive immature stages of plate rupture, underthrusting and the formation of a volcanic arc, all prior to the formation of a mature self-sustained subduction zone. However, many uncertainties about the processes and the kinematics of subduction initiation remain, due to the scarcity- and lack of recent studies- of examples recording the plate rupture and decoupling, the transition to underthrusting, and the formation of the mega-thrust fault.

We use seismic images to study active subduction initiation and plate-boundary propagation in the Sulu and Celebes seas located in SE Asia. The two basins formed in Paleogene to Lower Miocene time and since possibly late Miocene, a phase of contractional deformation has led to the creation of the subduction trenches. The Sulu Trench is growing and laterally propagating along the SE margin of the Sulu Sea basin, and the Cotobato and North Sulawesi trenches propagate along the northeastern and southern margins of the Celebes Sea basin.

We reprocessed and interpreted >4857 km of 2D seismic reflection profiles that image the structure across three active trenches and the regions where the trenches are laterally propagating and display likely related deformation. We identified and mapped subduction-related structural domains of the downing and overriding plates. The megathrust plate boundary reaching the surface separates a trench filled with turbidites from the thrusts sheets of accretionary prisms, overlain with a forearc basin. The images show pre-existing faults and first-order seismo-stratigraphic horizons along the continental margins away from the trench, and the deformation structures associated to their reactivation and possibly linked to either lateral propagation of the subduction trenches or perhaps the local formation of a new trench.

The images illustrate the transition from diffuse deformation to two decoupled plates and to along-strike structural variations of subduction-related structural domains. We show for the first time how the three trenches record the spatial variability of currently active deformation associated to stages of passive margin reactivation, subduction initiation, propagation and progression. These results provide novel insights to further investigate and constrain unsolved questions about the initiation and development of subduction zones.