The Southern Mariana Forearc: An active Subduction Initiation (SI) analogue

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It is important to understand how new subduction zones form. Some subduction zones begin spontaneously, with sinking of dense oceanic lithosphere adjacent to a lithospheric weakness. The Eocene evolution of the Izu-Bonin-Mariana convergent margin is the type example of this process, with an increasingly well-documented evolution including results from IODP 352 drilling. A lack of any active examples of spontaneous SI hinders our understanding, but our studies of the evolution of the southernmost Mariana convergent margin provides important insights. Here the Mariana Trough backarc basin terminates against the Challenger Deep trench segment, where it has opened ~250 km in the past ~4 Ma. This corresponds to GPS opening rate of ~4.5cm/y at the latitude of Guam (Kato et al., 2003). This newly formed and rapidy widening margin faces the NW-converging Pacific plate and causes it to contort and tear. Pacific plate continues to move NW but the upper plate response is illustrative of a newly formed subduction zone. Slab-related earthquakes can be identified to ~200 km deep beneath this margin; with convergence rate of 3cm/yr, this may reflect no more than 7 Ma of subduction. The usual well-defined magmatic arc is missing; its position ~100 km above the subducted slab is occupied by the magma-rich (inflated) Malaguana-Gadao Ridge

(MGR); instead hydrous MORB-like basalts with ~2 wt. % H_2O have erupted unusually close to the trench where they overly mantle peridotites ~6 km water depth. HMR-1 sonar backscatter mapping reveals a chaotic fabric that is at a high angle to the trend of the MGR to the east but is concordant to the west. This unusual spreading fabric may have formed by chaotic upper plate extension in response to rapid rollback of the short, narrow Pacific slab in a manner similar to that thought to occur during SI. Further interdisciplinary studies are needed to understand this rapidly-evolving tectono-magmatic province and what it can teach us about SI.