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Rapid Pliocene Rollback of the Tonga-Kermadec Trench caused by Differential Kinematic Plate Motion

S. Clark

Simula Research Laboratory, Fornebu, Norway (stuart@simula.no / +47 67 82 82 01)

Seafloor spreading across the earth occurs mostly at mid-ocean ridges, the system of underwater mountain ranges that span the largest ocean basins. However, back-arc spreading centres that form behind the arc of an active subduction zone remain poorly understood. Recent work to explain the extension of oceanfloor in what is otherwise a compressive subduction driven environment has focused on the subducting plate dynamics and its relation to trench rollback. Thus debate has centred on the role of mantle flow around the subducting slab's edges, its tip or the slab's interaction with the transition zone that is most strongly affecting the speed of trench rollback. In the Lau basin, the trench is retreating at nearly 16 cm/yr, the highest relative velocity of any plate boundary. Going south, trench retreat and subduction velocities slow until strike-slip motion begins under North Island, New Zealand. In this paper, we examine the asymmetric nature of trench retreat, its timing and relation to plate forces at the trench using both data and numerical modelling.