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Fore- and Back-Arc Structures Along the Hikurangi-Kermadec Subduction Zone

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The Hikurangi-Kermadec subduction zone northeast of New Zealand represents an ideal target to study lateral variations of subduction zone processes. The incoming Pacific plate changes from being a large igneous province, called the Hikurangi Plateau, in the south to normal oceanic plate north of the Rapuhia Scarp. The overriding Australian plate is continental in the south, forming the North Island of New Zealand, and changes to an island arc in the north. Further lateral variability exists in changes in volcanic and hydro-thermal activity, transitions from accretion to subduction erosion, backarc spreading and rifting, and is accompanied by northward increasing seismicity. As part of the MANGO project (Marine Geoscientific Investigations on the Input and Output of the Kermadec Subduction Zone), four marine geophysical transects of largely seismic reflection and refraction data provide constraints on the upper lithospheric structures across the Hikurangi-Kermadec Trench between 29-38 degrees South. On MANGO profile 1 in the south, the initially shallow subduction of the incoming plateau coincides with crustal underplating beneath the East Cape ridge. To the west lies the 100 km wide and over 10 km deep Raukumara Basin. Seismic velocities of the upper arc mantle are around 8 km/s and are considered normal. In contrast, on MANGO profile 4, about 1000 km to the north around the volcanically active Raoul Island, the incoming oceanic crust appears to bend considerably steeper and thus causes a 50 km narrower forearc with a smaller forearc basin. Furthermore, the upper mantle velocities in both plates are relatively low (7.4-7.7 km/s), likely indicating strong bending related deformation of the incoming plate and thermal activity within the arc possibly due to spreading. Here, arc volcanism is relatively active, with many large volcanoes directly on the ridge. The central two transects MANGO 2 and 3, though without data coverage of the structure of the incoming plate, are more similar to MANGO 4. The arc regions appear to be strongly affected by the activity of the arc. The arc crust of the northern MANGO 3 becomes significantly thinner in the backarc region due to extension, and much reduced volcanism behind the ridge. The structures on MANGO 2, on the other hand, cover strong and densely spaced thermal activity from the adjacent arc volcanism, possibly linked to a recent, fluid-rich passage of the Hikurangi Plateau.