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The hydrological system of erosional convergent margins and its influence on long-term tectonics and interplate seismogenesis

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Tectonic erosion is the process that removes material of the overriding plate at convergent margins and transfers it to the underthrusting plate, that eventually recycles it in the mantle. Even though tectonic erosion occurs at about half of all convergent margins, the mechanisms that operate along this type of plate boundaries are not well understood because their structure and, particularly, their hydrological systems are not adequately known. Observations along the Middle America Trench reveal that erosional margins contain a distinct hydrological system that fundamentally influences long-term tectonics and the location of the seismogenic zone. Fluid budget calculations across the forearc indicate that 80-90% of the fluid migrates from the plate boundary to the ocean by focused flow through fracture-controlled permeability of the overriding plate, contrasting the dominantly disperse flow of accretionary prisms. The plate boundary region with abundant - possibly overpressured - fluid determines the width of the area where tectonic erosion causes subsidence, governing the formation of the continental slope. The observations indicate that the only first-order change shared by erosional and accretionary plate boundaries in the zone of transition from stable slip to the seismogenic zone is an abrupt decrease in fluid abundance, indicating that pore pressure decline may dominantly control the nucleation of earthquakes at all types of subduction zones.