Plate-Boundary Tectonism and Magmatism Meets Prolific Sediment Supplies in the Young Oceanic Basins of the Southern Gulf of California

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During the Late Miocene an obliquely extensional part of the Pacific-North American plate boundary shifted 200 km inland to create the Gulf of California trough within a pre-existing volcanic arc terrain. By ~8-6 Ma, tectonic breaching of the Mesozoic batholith that separated this trough from the Pacific allowed a marine incursion. Thereafter, biogenic sediment from the Gulf's surface waters supplemented the volcaniclastic and detrital sediment input from submarine density flows to depocenters at the deepest parts of the Gulf. During the Pliocene the axes of 6 of these basins developed into short oceanic spreading centers linked by long transform faults. We use multibeam bathymetry and multichannel seismic reflection profiles to define the pathways by which debris flows and turbidity currents have delivered sediment from coastal and continental-margin sources to spreading axes. These pathways have changed through time because of relief-creating tectonic events such as changes in the relative plate motion, and steady, systematic changes like the migration of spreading-center/transform intersections along shearing continental margins. Rapid accumulation of low-density turbidites in the young, isolated basins of the Gulf greatly affects the structure of the bisecting spreading axes, and the stratigraphy of their accreted crust. Drilling and profiling show that sediment deposition is a major component of the initial accretion process, creating thick sediment-sill complexes rather than the thin pillow-lava upper layer typical of open-ocean crust. At axes with the greatest terrigenous sediment input eruptive volcanism is completely suppressed, though at more protected axes we have found and sampled small pillow basalt cones. The characteristic shallow structure of the Gulf spreading centers is an axial graben, 200-1000m deep and 5-10 km wide, bounded by rift walls of semi-lithified sediment, a topography that further focuses density-flow deposition at the spreading axis. Seismic reflection profiles show that during glacial periods with large terrigenous input, some of these axial grabens were completely filled with sediment, which would have further suppressed volcanism. Additionally, the southernmost Gulf axis changed at 2 Ma from accreting a sediment-sill complex at an axial graben to erupting fissure basalts at an axial ridge. This change coincided with the tectonic opening of a pathway to the south, allowing turbidity currents to pass through the basin.