The Scotia Sea Crustal Mosaic: Current Understanding, Outstanding Questions, and Opportunities for Submersible Exploration

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The Scotia Sea records the progressive fragmentation of the former South America–Antarctica connection, the opening of Drake Passage, and the development of the South Sandwich subduction–back-arc system. Understanding its tectonic evolution is critical for reconstructing Cenozoic ocean gateways and evaluating how changes in gateway geometry influenced ocean circulation and water exchange between the Atlantic and Southern oceans. Its crustal architecture is highly heterogeneous, comprising continental fragments, inherited Mesozoic crust, extinct spreading centers, active back-arc crust, and arc-related terranes, yet the age, composition, and tectonic affinity of several submerged crustal blocks remain controversial. Recent studies increasingly indicate that parts of the Scotia Sea preserve crust substantially older than the main phase of Cenozoic seafloor spreading. A recent reconstruction proposed that fragments of Cretaceous oceanic or highly extended continental crust originated within a former Paleo-Pacific–Weddell Sea gateway and were subsequently fragmented and overprinted by Cenozoic South Sandwich back-arc tectonics (Oldenhage et al., 2024). Early–mid Cretaceous arc-like basalts from the northern Scotia region likewise challenge the interpretation of the W7 as a simple Cenozoic West Scotia Ridge spreading segment (*Riley et al., 2019*), while the composition and Antarctic affinity of continental blocks along the South Scotia Ridge remain incompletely constrained.

Future human-occupied submersible investigations could directly target exposed basement, fault scarps, and geological contacts in the Central Scotia Sea, Scotia ridges, and selected continental banks. Unlike conventional dredging, which may recover loose material or glacial dropstones and provides limited control on exact geological context, submersible sampling can document in situ relationships before collection. Integrated geochronology, petrology, and isotope geochemistry would distinguish inherited Cretaceous crust from younger Cenozoic products, providing critical information for reconstructing how heterogeneous crustal fragments were assembled into the Scotia Plate and refining the tectonic evolution of Drake Passage and the South Sandwich subduction system. (294 words)

Oldenhage, J.H., Schellart, W.P. and Beniest, A., 2024. Cretaceous crust in the Scotia Sea: Missing pieces in a geological puzzle?. Tectonics, 43(6), p.e2023TC008079.

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