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Tectonic Control on Deposition and Evolution of the Baranof Fan, Gulf of Alaska

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The Baranof Fan, one of three large deep-sea fans in the Gulf of Alaska, is located in the southeast Gulf near the U.S.-Canada border. Previous research has been limited to discussion of Fan size and depositional history. We provide new constraints on the Baranof Fan's shape, volume, and channel development using 2D seismic reflection data collected by USGS in the late 1980s and aboard the R/V Marcus G. Langseth in 2011. The northern extent of the Baranof Fan is visible in seismic data at its intersection with the adjacent Surveyor Fan, and the southern extent is constrained by existing bathymetry. All Baranof Fan sediment sits atop a prominent high-amplitude downlap surface which we have mapped regionally throughout the Fan, and which we interpret to represent the onset of Fan deposition. We estimate the Fan's area and volume to be around 323,000 km^2 and 230,000 km^3, respectively, larger than previous volume estimates of 200,000 cubic km and placing it among the largest deep-sea fans in the world.

The Fan appears to consist of the levees from three distinct, aggradational channel systems: the active Horizon and Mukluk Channels, as well as the previously unstudied, inactive system we call the Baranof Channel. Offshore channel formation and avulsion is strongly influenced by the translation of the Pacific Plate to the northwest along the Queen Charlotte strike-slip fault, causing southeastward lobe switching within the Fan as the Pacific Plate's position changes relative to sediment sources present on the North American Plate. We mapped five buried, extinct channels in seismic data within the Baranof Fan. Relative ages of the channels and associated levee deposits correspond with their northwest-to-southeast migration. The southeasternmost extinct channel is a clear predecessor to the modern Horizon Channel.

Based on our observations and knowledge of regional tectonics and geology, we suggest that Baranof Fan sediment is glacial in origin and sourced from the Coast Mountains in southeastern Alaska, transported offshore via fjord to glacial sea valley and canyon conduits such as the Dixon Entrance and Lynn Canal. We also suggest that channel formation is linked to the position of the Pacific Plate relative to these sediment point sources, and that a new channel is poised to form at the Dixon Entrance. Assuming Baranof Fan deposition began when the northernmost channel (the Baranof Channel) was located at the southernmost point source (the Dixon Entrance), and that Pacific Plate motion to the northwest has been constant at 4.5 cm/year, we estimate that deposition initiated at ~7 Ma.

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