Late Quaternary Deepwater Fan Depositional Cycles in the Gulf of Papua: Linking Sources, Dynamic Sedimentation Processes, and Depositional Architecture

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We have studied a Late Quaternary deepwater channel-fan system in the Gulf of Papua for relationships among sediment supply, transport processes, and depositional architecture over centennial to millennial timescales. Our study focuses on two contrasting depocenters, Pandora and Moresby Troughs in the Gulf of Papua, and incorporates observations from 3.5 KHz seismic profiles, groundtruthed by jumbo piston core analyses.

The age model of Pandora Trough core MV-23 (2068 m depth) shows a period of rapid sedimentation (41.3 cm/ka) from 44-19 Ka Bp, slowing to 20 cm/ka afterward, through the end of Marine Isotope Stage (MIS)-2. The turbidite succession observed in core, tied with the seismic profiles, suggests multiple point sources for the fan system, which appears to have shifted oceanward during periods of falling sea level. Sand provenance in this core ranges from dissected arc to recycled orogen, with quartz and litho-volcanic proportion increasing upward, and suggests the increased supply through time from extrusive volcanic terranes in the southern Fly Highlands. A contrasting story is told in the Moresby Trough, through cores MV-22 (2058 m depth) and 27 (2071 m depth). The age model for core MV-27 shows a lower average depositional rate of 17cm/Ka. The core is composed primarily of thin sheet sands, with provenance varying widely from undissected arc to transitional arc (resembling sources from the Papuan Peninsula) to recycled orogen, with upward increasing textural maturity, suggesting additional allochthonous input from drainage systems to the northwest (e.g. Fly-Strickland and Kumalo, Kikori, and Purari Rivers).

We propose two elements in the source-to-sink narrative for our study area during this period. (1) In the Pandora Trough, turbidite sedimentation dominated from late MIS-3 to MIS-2 (>40 Ka - 12.5 Ka), and ceased by early Holocene due to rising sea level and associated shelf trapping of sediment. (2) Turbidite sedimentation continued in the Moresby Trough, although at a slower rate, into the Holocene transgression. Sediment sources to deep water included reworked shelf edge deposits, and more direct river-mouth supply entrained by coastal currents on the flooding continental shelf (<~15 Ka Bp). This flooding and current system enabled coalescence of multiple river sources to supply fan aggradation in the Moresby Trough.