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Morphology and evolution of a channel system created by salinity underflow into the Black Sea

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Observations of the morphology and structure of turbidity current channels and deposits have guided our understanding of the mechanisms and effects of subaqueous gravity flows. The excess density in turbidity currents is due to the presence of suspended sediment, and both fluid and sediment dynamics play roles in the creation and evolution of sedimentary deposits. However, the relative importance of sporadic vs. continuous density current flows in creating and modifying submarine morphology remains a topic of study. The density difference that drives a subaqueous gravity flow can be created by temperature or salinity as well as by suspended sediment, and the morphological features created by such gravity flows will depend on the nature and amount of sediment present as well as the speed, continuity and structure of the current. Comparative studies of depositional systems created or modified by a range of subaqueous gravity flows contribute to our understanding of these important processes. The Black Sea shelf channel complex and related density currents provide an important natural laboratory for studying continuously flowing density currents and their sedimentary effects. Such an environment may be important for testing models derived for sediment-laden flows.

In 2005 we conducted a seismic, multibeam bathymetry and coring study of the channel complex on the outer shelf of the Black Sea off the Bosporus (water depths of about 80 to 120 m), a channel complex that is apparently formed by a high-salinity density current that enters the Black Sea through the Bosporus. In water depths of about 90 to 120 m (a distance of 20 km), the flow pathway consists of a network of anastomosed channels separated by streamlined bars. The widths and depths of the individual channel segments are 0.2–1.8 km and 5–7 m, and the bars have widths and lengths up to 2.5 and 5 km. The channel banks and intrachannel bars consist of silty muds, and channel floors are generally coarser and locally molded into low-relief bedforms with relatively straight crests orthogonal to channel trend, heights of <1 m and wavelengths of 85–155 m. Some of the bar tops are ornamented with mudwaves having heights of 1–2 m and wavelengths of 130–160 m. Toward the shelf edge, the degree of channel bifurcation increases dramatically to over 10 separate courses, and bar tops are locally dissected by secondary channels suggesting that characteristics of the density flow have changed with time. The bedded muds which form the bars and channel banks thin toward the east and locally show a pattern of east-trending lineations. The sources of the sediments in this channel system are not clear as the high-salinity water from the Bosporus appears to carry little sediment. Some of the finer-grained sediment may be brought to the area by the shelf-parallel Rim Current while some of the coarser sediment in the channel is shell and pebbles that may have a local source.