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High-resolution bathymetry and shallow acoustic images of current-controlled sedimentary processes in the Southern Mozambique Channel

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The Mozambique Basin and Mozambique Channel are one of the key areas in the Southwest Indian Ocean, where ocean currents are considered to generate a highly variable microtopography on the sea floor. The Antarctic Bottom Water (AABW) and the North Atlantic Deep Water (NADW) flowing northward along the southeast African margin and returning southward along the west Madagascan margin are the dominant bottom currents. The Mozambique Current (MC) flowing southward along the southeast African margin, the East Madagascar Current (EMC) surrounding the southern tip of Madagascar and the southward flowing Agulhas Current (AC) formed by the confluence of the former two currents off southeast Africa are the dominant surface currents. Pronounced eddies traveling southward through the Mozambique Channel additionally contribute to the surface circulation.

During the R/V Sonne cruise SO-183 a rectangular grid (500 km x 700 km) of high-resolution multibeam sonar and parametric subbottom profiler data was collected in the Southern Mozambique Channel, which allows to study both the orientation and lateral extension of the current-controlled submarine bedforms and the shallow acoustic subsurface structures. Generally, this data set illustrates, that factors such as the large-scale morphology, the sediment supply from southeast Africa and Madagascar, the sediment transport and sorting via the Zambesi Channel and external forces like the Coriolis force play an important role in the generation, distribution, shape and size of the submarine bedforms. Based on the multibeam bathymetry several microtopographic zones ranging from a flat sea floor over large- and small-scale sinusoidal bedforms to rough, irregular, erosional features are defined to classify the study area. An additional inspection of the subbottom profiler data allows a further detailed description and subdivision of the microtopographic zones. For instance, both the northwestern and the southeastern part of the study area are characterized by a flat sea floor. But in the northwestern part a fine-scale parallel subsurface layering was observed indicating hemipelagic sediments on the southeast African continental slope. In contrast, in the southeastern part, where the Zambesi Channel branches into several distributary channels, a zone with prolonged parallel subbottom reflectors and high reflection amplitudes occurs indicating a coarse-grained sandy lobe. Towards the south, where the sea floor is still flat, the subbottom profiler data show more and more indications of erosion typical for an increasing influence of a strong bottom current. The southwestern and central parts of the study area are characterized by different types of sinusoidal bedforms. That is, sediment waves of some kilometres length, tens of metres height and with a fine-scale parallel subsurface layering dominate in the southwestern part and wavy bedforms of about 1 km length, several metres height and with almost no acoustic penetration prevail in the central part. The orientation of their wave crests varies and even shows two perpendicular directions in a small area between 23° and 24°S west of the Zambesi Channel. The Zambesi Channel itself as well as the Tsiribihina Valley, descending from the Madagascan margin, reveal a slightly meandering course with small terraces in the meander bends and asymmetric levees, which are higher on the eastern than on the western side due to the Coriolis force. Strong erosional scours are mapped close to the volcanic Bassas da India islands and Europe, Jaguar and Hall seamounts.

The occurence and distribution of these submarine bedforms will be discusssed with respect to the regional ocean circulation, and a modelling approach will be tried to explain the shape and size of the different sediment waves and to derive constraints for the current speeds.