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Geophysical investigation of the western end of the Carlsberg Ridge: preliminary results of the CARLMAG cruise

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A sizeable portion of oceanic lithosphere has been produced at the Carlsberg Ridge, one of the three major ridge branches that shaped the Indian Ocean. Accretion started in the Paleocene with the ultra-fast widening of the Arabian Sea to the North and the Eastern Somali Basin to the South (full spreading rate of ~130 mm/yr between 61 Ma and 49 Ma), both basins opening in the wake of the rapid migration of India towards Eurasia. Spreading rate abruptly dropped to ultra-slow after 47 Ma and a long period of accretion stagnation prevailed (full rate <12 mm/yr) until the establishment of the slow present-day regime at ~20 Ma (mean 24 mm/yr rate since Chron 6 at the western end of the Carlsberg Ridge). Mode and rate of production of ocean floor at the Carlsberg Ridge seem to have interacted with a number of regional tectonic events since the beginning of the Himalayan orogeny, including the early Indian continent collision, the westward propagation of the Sheba Ridge into the Africa/Arabia continent and the coeval initiation of the Owen transform and opening of the Gulf of Aden. Here we report the results of the recent CARLMAG survey (Spring 2019) conducted at the westernmost edge of the Carlsberg Ridge close to its intersection with the active Owen transform fault. The cruise was conducted aboard BHO Beautemps-Beaupré operated by the French Naval Hydrographic and Oceanographic Service. We explored the post-50 Ma ocean floor along a set of long profiles crossing both sides of the ridge using multibeam bathymetry, bottom reflectivity, mud penetrator, magnetic and gravimetric measurements. For the first time, semi-complete multibeam coverage allows detailed mapping of the seafloor until it gets buried below the sediments of the Indus fan, at least over the northern limb. The southern limb, devoid of sediments, shows clear rotation of the main fault trends towards older ages, which we attribute to changes in India-Somalia kinematics. The region close to the ridge axis and close to the Owen transform is rich in oceanic core complexes, some of them known from patchy previous acquisitions, and others discovered in the course of our survey. Their highly corrugated surfaces show a wide variety of shapes at various distances from the ridge axis that may be seen as snapshots through time, bearing important information regarding their formation and progressive erosion as they move away. A clear pattern of Miocene oceanic magnetic lineations is recognized, as well as a few older anomalies at the extreme Northern and Southern limits of the survey. This dataset allows us to build a new structural and kinematic

scenario for the evolution of this segment of the Carlsberg Ridge and frame it into a more regional geodynamic framework.