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Sediment sourcing and depositional timing of submarine density-flows: insights from the sediment cores of Exuma Valley, The Bahamas

Johan Le Goff (1), Thierry Mulder (2), John J.G. Reijmer (1), Emmanuelle Ducassou (2), Audrey Recouvreur (2), Thibault Cavailhes (2), Vincent Hanquiez (2), and Hervé Gillet (2)

(1) King Fahd University of Petroleum and Minerals, College of Petroleum Engineering and Geosciences, Dhahran, Saudi Arabia (johan.legoff@kfupm.edu.sa), (2) Bordeaux University, UMR 5805 EPOC, 33615 Talence cedex, France

Exuma Valley (EV) is a giant, 130 km-long, submarine depression laying between between 2,200 and 3,000 m deep and connecting the southern part of Exuma Sound (ES) to a deep Exuma Canyon and the the Samana Channel in the San Salvador abyssal plain in the southeastern Bahamas. Shallow-water carbonate environments surrounding ES episodically provide sediments that are funneled in EV, which shows several sharp knickpoints, and a low sinuosity profile. High-resolution multibeam imaging, very high resolution (VHR) seismic as well as sediment cores were collected during the CARAMBAR 2 cruise (2016-2017) and allow for a detailed analysis of the depositional environments, their lateral extent as well as the nature of deposits that accumulated in the axis of EV.

Two of these cores (CAR2KS26 and CAR2KS24, 349 and 587 cm in length, resp.) were retrieved from the upper part of EV. The cores showed an alternation of coarse-grained deposits, interpreted as density flows, and periplatform ooze, interpreted as background sedimentation. Detailed sedimentary observations and analyses including, grain size, micro-paleontology, and point counting were performed to analyse the sediment.

The basal part of CAR2KS26 shows a debrite with fining-upward mudclasts that is overlain by a meter-thick turbidite with fluctuating grainsizes, so-called grain size pulses. The diffuse contact between the debrite and the turbidite as well as the homogeneity of the grain types, i.e. mainly mudclasts, aggregates, planktonic foraminifera and pteropods, suggest that aforementioned deposits are linked and is interpreted as the differentiation of the same density-flow event occurring during MIS2. The basal part of the debrite could not be reached by the coring device but VHR seismic data suggest that it might exceed 10 m. Regular sampling along the debrite-turbidite bed revealed that grain-type proportions are strongly dependent on the flow type. While mudclasts are dominant in the debrite, their proportion strongly decreases in the turbidite whereas the proportion of aggregates and planktonic grains (foraminifera and pteropods) strongly increases. The upper part of this core consists of carbonate ooze, and no turbidite could be evidenced in MIS1.

Thirty-two individual density-flow beds were identified in core CAR2KS24 embedded in carbonate ooze. Thinning and fining upward trends within the turbidites occur throughout the core suggesting pervasive tendencies in sediment shedding upslope. Twenty thin (thickness < 30cm) turbidites characterize the sedimentary record during MIS1, while turbidites deposited during glacial periods MIS2-3 are significantly thicker (up to 55 cm). The sediment composition of the turbidite beds shows significant proportions of Halimeda flakes, benthic foraminifera and bryozoans for those deposited during glacial periods, while the interglacial ones (MIS1) are dominated by ooids and pelagic organisms, i.e. foraminifera and pteropods.

The two sediment cores show a unique record of sediment shedding within Exuma Sound and reveal variations in sediment transport through time across the flanks bounding Exuma Valley. The data provide a better understanding of sedimentary transport processes toward the basin, and sediment deposition in deep-sea carbonate settings.