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Modern carbonate submarine canyons on the Northern Slope of Little Bahama Bank (Bahamas): morphologies and associated sedimentary processes.

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The Northern slope of Little Bahama Bank (LBB, Bahamas) has been prograding northward since the early Miocene and has been thus defined as an accretionnary slope. Nevertheless, several by-pass morphologies are visible on the seafloor, such as the gullies that incise the slope over 150 m and identified by previous studies. The CARAMBAR cruise (Nov. 2010) on the Northern slope of LBB provided new seafloor and subsurface data, including high-resolution multibeam bathymetry (Kongsberg EM302 echosounder) and very high resolution (3.5 kHz/Chirp subbottom profiler) seismic data. This dataset brings new detailed information on these by-pass architectures and allows a precise characterization of 18 canyons. Both their morphology and geometry are more complex than the previously described gullies. These canyons evolve sharply into short and straight furrows that finally open to depositional fan-shaped lobes. These architectural elements form a narrow carbonate gravity system extending over 40 km along the LBB slope.

The average morphological features of the LBB canyons are: minimum and maximum water depths of 460 and 970 m resp., mean length = 16.3 km and sinuosity = 1.14. Canyons are floored with flat elongated morphologies interpreted as terraces. Some of these terraces are located at the toe of slide scars on canyon heads and canyon sides which suggest that they result from sediment failures. On the Chirp seismic data, wedge-shape aggrading terraces interpreted as “internal levees” can be observed. These terraces would then be formed by overbanking of the upper part of turbidity currents.

Some canyons show an amphitheater-shaped head with a wall edge consisting in coalescing arcuate slump scars, which suggests that the canyons are formed by retrogressive erosion. Other canyons show an amphitheater-shaped head that evolves upslope into linear valleys incising the upper slope. The onset and the spatial distribution of these linear valleys seem to be influenced by sediments transported from oolitic shoals of Walker Cay, located 5 km upstream toward the upper slope. Indeed, upslope the canyon heads, the reflectivity map shows low backscatters, characteristic of fine-grained sediments within small, elongated depressions (3-5 km long, 1-5 m deep). These elongated depressions are probably formed by the flow of sediments coming from the platform. Differential diagenesis of sediments also seems to play a role in the along morphology of canyons, particularly by forming topographic steps.

These initial results allow to suggest a model for canyon evolution. It includes three main stages: (1) a first stage controlled by retrogressive erosion, generating several slides and collapses and finally forming the amphitheater-shaped canyon heads, (2) a second stage where the retrogressive erosion propagates along elongated depressions on the upper slope, (3) a third stage of canyons filling by the gravity flow deposits originating from collapses of the canyon sides and/or from downslope sediment transport from the carbonate bank.

This study provides new insights on carbonate submarine canyon architectures and proposes a model of evolution that is primarily controlled by destabilization processes along the carbonate slope and secondarily by the transfer of sediments from the platform to the slope. Moreover, these short systems could have a larger scale implication on the sediment fluxes from shallow to the deep water as they seem to act as small tributary feeding systems to the large Abaco Canyon, located at the Northeast of LBB and incising the Blake Bahama Escarpment.