Sediment transfer from shelf to abyss through giant ganyons and valleys system in deep-sea carbonate slopes (Bahamas)

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Bahamas are one of the rare present-day study areas in the world that allows to understand carbonate particle transfer from platform to deep-sea. A lot of ancient (DSDP/ODP, Bacar cruises) and recent (Carambar Cruises) dataset have been collected from 30 m to 5,000 m water depth. It includes high-resolution multibeam mapping, backscatter imaging, very-high resolution seismics and gravity cores. These new high-resolution data expose in great details the deep-water sedimentary system in the southern part of Exuma Sound (ES) and the northern part of Little Bahama Bank (LBB, Bahamas). The data reveal the detailed and complex morphology of giant valleys like the Great and Little Abaco canyons (GAC and LAC) along the LBB slope, the Great Bahama Canyon between LBB and Eleuthera Island, being the deepest canyon in the world, and the Exuma Valley/Canyon in the ES area. In all cases, present-day off-bank transport is initiated by two ways: (1) When a cold atmospheric front occurs, high-density, cold surface water sinks and entrains fine-grained particles through density cascading. This process is at the origin of the deposition of the Holocene Prograding Wedge that began to form 13.6 ka ago with a maximum growing at 4 ka when the platform was flooded. (2) During hurricanes when the fine-grained particles deposited on the shelf are resuspended and pushed off the platform through tidal passes. There, acceleration of tidal currents generates tidal flushing. On the LBB smooth slopes, coarse-grained particles (ooids and bioclasts) are trapped in tidal deltas and only fine-grained carbonate particles reach the upper slope. In Exuma area, steeper slopes allow transfer of coarse-grained particles that reach the ES slope and finally supply coarse-grained (bioclasts-rich) turbidity currents and concentrated/hyperconcentrated flows that are channeled down to the Atlantic Abyssal Plain though giant valleys. Along the valley, they form classical spill-over levee deposits. Four of these large valleys extending parallel to the shelf are presented. They all probably extend along structural directions. In GAC, finely-grained sediments originate essentially from the canyon flanks, driven by sediment slides as well as many secondary slope gullies and smaller tributaries. In LAC, gullies directly drain the upper LBB slope providing coarser particles. In the Exuma Valley/Canyon, a part of the material comes from the slope of adjacent islands and cays through small-scale gravity processes and mass failures. A substantial part of the sediments also originate from along-slope sediment flow erosion. In all areas, the valleys abruptly turn into deep canyons incising the Bahama Escarpment (BE). The canyons link the LBB and ES sedimentary systems to the deep abyssal plain of the Western North Atlantic where water depth exceeds 5,000 m. The transition occurs through major knickpoints with outsized chutes exceeding several hundred of meters in height. The sudden transformation from a wide valley to a deep narrow canyon occurs as a result of flow erosion of the underlying lower Cretaceous carbonate platform stack. Huge hydraulic jumps as well as enormous and permanent plunge pools and related deposits were identified at the transition. Dissolution processes in the carbonate deposits may also play a part in the formation of theses outsized plunge pools. In ES, the high kinetic flow energy constrained by narrow and deeply incised canyon formed a wide fan-shaped channel-levee complex on the abyssal plain. The latter is made up of coarse-grained carbonate turbidites and concentrated density-flow deposits that are mixed with fine-grained siliciclastics transported along

the BE by the energetic Western Boundary Undercurrent. Conversely the canyon mouth of the LBB system only reveals a small channeled lobe. Seismic data on this system at water depth > 4500 show the distalmost deposits are younger than mid-Miocene, suggesting that the activity of the canyon is very recent.

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