Geophysical Research Abstracts
Vol. 17, EGU2015-13096, 2015
EGU General Assembly 2015

Sedimentary structures formed by upper-regime flows on a Pleistocene carbonate ramp (Favignana Calcarenite, Sicily, Italy)

Arnoud Slootman (1), Andrea Moscariello (1), Matthieu Cartigny (2), and Poppe de Boer (3)

(1) University of Geneva, Earth and Environmental Sciences, Geneva, Switzerland (arnoudslootman@gmail.com), (2) National Oceanography Centre, Southampton, United Kingdom, (3) Utrecht University, Utrecht, The Netherlands

Antidune, chute-and-pool and cyclic step deposits are found in the outcrops of the Pleistocene calcarenite wedge of Favignana Island. These deposits were formed on a prograding carbonate ramp. Three zones are identified: inner-mid ramp (shoreface), ramp slope, and outer ramp (offshore). The ramp slope dips 3° to 10° and drops 30-40 m over 400-600 m. The ramp slope and outer ramp show a succession of bioturbated dune cross beds with up to 10 m-thick, intercalated event beds containing supercritical-flow structures. Grain sizes range from coarse sand to granules, with large rhodoliths (algal balls) and shells as gravel-sized clasts. It is our aim to provide insight into the processes that create upper-regime flow structures and the hydraulic parameters of their generating flows.

During normal storms, wind-driven currents generated submarine dunes that migrated across the sea floor. During exceptional high-energy events (megastorms, tsunamis), large amounts of skeletal debris from the carbonate factory were transported towards the top of the ramp slope, where under the effect of gravity sustained supercritical sediment gravity flows were generated.

In a case study of bedform evolution, we present the formation of a large downstream-asymmetric bedform with two antidunes superimposed on its upstream flank. A stepwise flow reconstruction reveals the progressive steepening of the antidunes until critical steepness is reached, and the first and, shortly after, the second antidune wave breaks. The two hydraulic jumps thus formed, developed a temporary cyclic step morphology (i.e. hydraulic jump, accelerating subcritical flow, supercritical chute, hydraulic jump etc.).

The bedform geometries are used to reconstruct the nature of the catastrophic events that were active on the ramp slope. The wave length of the antidunes is measured from outcrop, which, through hydraulic equations, allows for estimation of mean flow velocity as a function of sediment concentration in the flow. Using published experimental Froude numbers for breaking antidune waves, average flow thickness and sediment flux is computed. The ratio of bed volume and sediment flux provides an estimate for the duration of the sediment gravity flows.

We show that applying hydraulic equations to upper-regime sedimentary structures in coarse-grained carbonate sandstones reveal that about half of the ramp deposits, that formed over ca. 350 thousand years, were deposited in not more than tens of hours. Our results provide renewed insight into the evolution of the Favignana Calcarenite and other carbonate ramp deposits.