THE IMPACT OF DENSE SHELF WATER CASCADES ON THE SEAFLOOR OF THE SW ADRIATIC SLOPE

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Abstract

Cascading North Adriatic Dense Water (NAdDW) impact energetically the seafloor of the SW Adriatic margin, eroding and depositing large amounts of fine-grained sediment below a markedly erosional upper slope. This cascading NAdDW is generated in the broad and shallow North Adriatic shelf through intense winter cooling and evaporation. The NAdDW flows, southward along the Italian coast, reaches the shelf break, typically over a prolonged interval (several weeks) at the end of the winter season, and sinks across the slope By cascading across the slope, the dense NAdDW impinges the seafloor and interacts with the complex margin morphology, generating: 1) patchy fields of large-scale mud waves, 2) a variety of erosional bed forms, such as moats, furrows and comet marks, 3) an area of widwspread sea floor erosion.

Keywords: Currents, Deep Sea Sediments, Adriatic Sea, Swath Mapping

The North Adriatic Dense Water (NAdDW), represents the densest water of the whole Mediterranean and generates in the broad and shallow North Adriatic shelf through intense cooling and evaporation. The NAdDW forms during the winter months, flows southward along the Italian coast and cascades off the shelf break, over a prolonged interval (typically several weeks) at the end of the winter season. The South Adriatic basin is also intruded by the LIW (Levantine Intermediate Water), a salty water mass that enters the south Adriatic through the Otranto Strait and flows southward along the western Adriatic, along the upper slope ([2]). The NAdDW is active every year for a short interval can exceed speeds of 60cm/s ([4]), depending on the meteorological conditions for each year, and may or may not reach a density capable to allow sinking all the way to the basin floor (in 1200m); the LIW, less energetic, impacts the sea floor only at depths less than 600m. By cascading across the slope, the dense water impinges the seafloor and interacts with the complex margin morphology, caused by the presence of active faults and exposed slide scars and a variety of mass-transport deposits, generating patchy fields of large upslope-migrating mud waves that are spatially associated with moats, furrows and comet marks ([3], [4]) (Fig. 1)

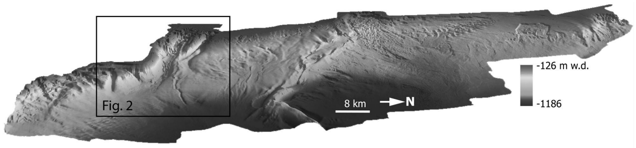

Fig. 1. 3D image of the Multi Beam Bathymetry of the SW Adriatic Margin

Sediment cores and seismic correlations suggest that all these bed forms, both erosional and depositional, are primarily active during the modern interglacial as well as during the last interglacial, when climatic forcing also allowed the formation of the NAdDW on the shallow north Adriatic shelf ([5]). The spatial distribution and inferred genetic association of erosional and depositional bedforms on the SW Adriatic slope define two preferred paths along which the NAdDW cascade into deeper waters before exiting the Adriatic through the Otranto Strait. Both pathways: 1) represent the time-averaged response of repeated dense-water cascading; 2) extend to the bottom of the basin (1200 m); 3) define a few-km-wide "core" and a "fringe" area where mudwaves develop and show increasing continuity away from the "core" (Fig. 2).

More in general, the sedimentological study of the modern sea floor in relation to near-seafloor oceanographic processes, inevitably relies on implicit assumptions on the equilibrium between the sea floor (and its erosional and/or depositional bedforms) and processes that can only be observed (and measured) over a time span of few months to few decades, at the most ([1]). A major theoretical and practical question is therefore establishing whether the modern sea floor "landscape" is the product of 1) extreme events, 2) rather uniform events that repeat themselves with some sort of regularity or 3) a combination of both.

By reviewing the main morphological and stratigraphic products of the dense-water cascading process in this area, this contribution aims at addressing the following, more general questions: 1. Do oceanographic processes on the shelf lead to focussing of cascading processes along preferred slope pathways 2. How does the interannual variability in production of dense water, affect the location where cascading is initiated, the duration of the process (few days to several weeks) and its capability to reach the bottom of the basin (1200m) 3. During its downslope flow, does the NAdDW spread laterally, entraining ambient water, or remains focussed along a narrow belt In this context, what dynamic interaction occurs between the NAdDW and the slope parallel (salty) LIW 4.The upslope-migrating mud waves have furrowed seaward limbs indicating that they undergo erosion. Is this an indicator of an ongoing intensification of the bottom current regime or, rather, of a reduction of sediment supply.

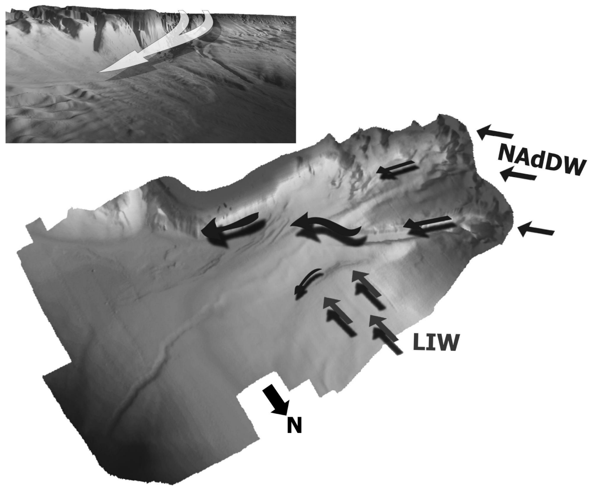

Fig. 2. 3D image of theBari Canyon System (BCS) representing the major sediment conduit on the SW Adriatic margin. The figure shows two preferred paths along which the NAdDW cascade into deeper waters before exiting the Adriatic through the Otranto Strait.

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