Marine Geology 443 (2022) 106675

Contents lists available at ScienceDirect

Marine Geology

journal homepage: www.elsevier.com/locate/margo

Research Paper

Interplay of deep-marine sedimentary processes with seafloor morphology offshore Madeira Island (Central NE-Atlantic)

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ARTICLE INFO

Editor: Michele Rebesco

Keywords:
Central Atlantic
Madeira Island
Bottom currents
Contourite drift field
AABW
Turbidity currents

ABSTRACT

The deep-water sedimentary processes and morphological features offshore Madeira Island, located in the Central-NE Atlantic have been scantly studied. The analysis of new multibeam bathymetry, echo-sounder profiles and few multichannel seismic reflection profiles allowed us to identify the main geomorphologies, geomorphic processes and their interplay. Several types of features were identified below 3800 m water depth, shaped mainly by i) the interplay between northward-flowing Antarctic Bottom Water (AABW) and turbidity currents and ii) interaction of the AABW with oceanic reliefs and the Madeira lower slope. Subordinate and localized geomorphic processes consist of tectono-magmatic, slope instability, turbidity currents and fluid migration. The distribution of the morphological features defines three regional geomorphological sectors. *Sector 1* represents a deep-seafloor with its abyssal hills, basement highs and seamounts inherited from Early Cretaceous seafloor spreading. *Sector 2* is exclusively shaped by turbidity current flows that formed channels and associated levees. *Sector 3* presents a more complex morphology dominated by widespread depositional and erosional features formed by AABW circulation, and localized mixed contourite system developed by the interplay between the AABW circulation and WNW-ESE-flowing turbidite currents. The interaction of the AABW with abyssal hills, seamounts and basement ridges leads to the formation of several types of contourites: patch drifts, double-crest mounded bodies, and elongated, mounded and separated drifts. The patch drifts formed downstream of abyssal hills defining an previously unknown field of relatively small contourites. We suggest they may be a result of localized vortexes that formed when the AABW's flow impinges these oceanic reliefs producingthe erosional scours that bound these features. The bottom currents in the area are known to be too weak (1–2 cm s^{-1}) to produce the patch drifts and scours. Therefore, we suggest that these features could be relics at present, having developed when the AABW was stronger than today, as during glacial/end of glacial stages.

1. Introduction

Over the past decade, the use of high-resolution geophysical techniques allowed an unprecedented revolution for viewing seafloor morphology, changing our previous understanding of morphogenetic processes that shaped the deep ocean (e.g., Harris et al., 2014; Mayer and Mosher, 2018; Micallef et al., 2017; Lucieer et al., 2019). The modern seafloor morphology along continental margins and oceanic basins is the result of a complex interplay among tectonic, sedimentary, oceanographic and autogenic processes (e.g., Flint and Hodgson, 2005) directly linked with marine habitat distribution (e.g., Harris and Baker, 2019). Comparatively with continental margins, seafloor morphology and morphosedimentary processes around ocean islands have been less investigated (e.g., Mitchell et al., 2002; Quartau et al., 2018). The

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https://doi.org/10.1016/j.margeo.2021.106675
Received 16 June 2021; Received in revised form 8 October 2021; Accepted 14 October 2021
Available online 26 October 2021