Geophysical Research Abstracts
Vol. 20, EGU2018-6746, 2018
EGU General Assembly 2018

Gravitational, erosional and depositional processes on volcanic ocean islands: Insights from the submarine morphology of Madeira archipelago

Rui Quartau (1,2), Ricardo Ramalho (2,3,4), José Madeira (2), Ruben Santos (1), Aurora Rodrigues (1), Cristina Roque (5), Gabriela Carrara (6), and António Brum da Silveira (2)

(1) Instituto Hidrográfico, Geologia Marinha, Lisboa, Portugal (rui.quartau@hidrografico.pt), (2) Instituto Dom Luiz, Faculdade de Ciências da Universidade de Lisboa, Lisboa, Portugal, (3) School of Earth Sciences, University of Bristol, Bristol, UK, (4) Lamont-Doherty Earth Observatory at Columbia University, New York, USA, (5) Estrutura de Missão para a Extensão da Plataforma Continental, Paço de Arcos, Portugal, (6) PROAMBIENTE Consortium, Emilia-Romagna High Technology Network, Bologna, Italy

The submarine flanks of volcanic ocean islands are shaped by a variety of physical processes. Whilst volcanic constructional processes are relatively well understood, the gravitational, erosional and depositional processes that lead to the establishment of large submarine tributary systems are still poorly comprehended. Until recently, few studies have offered a comprehensive source-to-sink approach, linking subaerial morphology with near-shore shelf, slope and far-field abyssal features. In particular, few studies have addressed how different aspects of the subaerial part of the system (island height, climate, volcanic activity, wave regime, etc.) may influence submarine flank morphologies. We use multibeam bathymetric and backscatter mosaics of an entire archipelago – Madeira – to investigate the development of their submarine flanks. Crucially, this dataset extends from the nearshore to the deep sea, allowing a solid correlation between submarine morphologies with the physical and geological setting of the islands. In this study we also established a comparison with other island settings, which allowed us to further explore the wider implications of the observations. The submarine flanks of the Madeira Archipelago are deeply dissected by large landslides, most of which also affected the subaerial edifices. Below the shelf break, landslide chutes extend downslope forming poorly defined depositional lobes. Around the islands, a large tributary system composed of gullies and channels has formed where no significant rocky/ridge outcrops are present. In Madeira Island these were likely generated by turbidity currents that originated as hyperpycnal flows, whilst on Porto Santo and Desertas their origin is attributed to storm-induced offshore sediment transport. At the lower part of the flanks (−3000 to −4300 m), where seafloor gradients decrease to 0.5[U+25E6]–3[U+25E6], several scour and sediment wave fields are present, with the former normally occurring upslope of the latter. Sediment waves are often associated with the depositional lobes of the landslides but also occur offshore poorly-developed tributary systems. Sediment wave fields and scours are mostly absent in areas where the tributary systems are well developed and/or are dominated by rocky outcrops. This suggests that scours and sediment wave fields are probably generated by turbidity currents, which experience hydraulic jumps where seafloor gradients are significantly reduced and where the currents become unconfined. The largest scours were found in areas without upslope channel systems and where wave fields are absent, and are also interpreted to have formed from unconfined turbidity currents. Our observations show that tributary systems are better developed in taller and rainy islands such as Madeira. On low-lying and dry islands such as Porto Santo and Desertas, tributary systems are poorly developed with unconfined turbidite currents favouring the development of scours and sediment wave fields. These observations provide a more comprehensive understanding of which factors control the gravitational, erosional, and depositional features shaping the submarine flanks of volcanic ocean islands.

Acknowledgments
This work is funded by FCT–Fundação para a Ciência e a Tecnologia through the PLATMAR project (PTDC/GEO-GEO/0051/2014).