Imperial College London

UKRI Natural Environment Research Council

2022_46_ESE_Whittaker: Submarine channels, structural deformation and delivery of sediment and plastics to the deep ocean

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Submarine channels are the main conduit by which sediment eroded from the continents is transported to the deep sea. Volumetrically, they are the most important sediment transport process on our planet, and they give rise to the largest sediment accumulations on Earth - submarine fans. Predicting the pathways and behaviour of these channels is therefore critical for constraining sediment budgets in the geologic past and for understanding the transfer of sediment and environmental pollutants such as micro- and macro-plastics to the sea floor. On passive margins, where thick wedges of siliciclastic sediments are additionally deposited on muddy substrates as gravitationally-unstable deltaic deposits, a key complexity is the tendency for these sediments to deform under their own weight, giving rise to a dynamically-deforming seabed. Submarine channels will interact with this structurally-controlled bathymetry, giving rise to an intricate pattern of sediment dispersal to the ocean floor. However the interactions and feedbacks between structural deformation, erosion and sedimentation in the marine realm have until recently been poorly understood. This project will use recent insights derived from the deep-water Niger Delta combined with a new seismic data set for the JDZ region of Nigeria & São Tomé e Príncipe to quantify sediment dispersal pathways and sediment distributions across a deforming passive margin.

In the JDZ zone, the 3D seismic data provided for this study from PGS shows there are several thrust structures active at the seabed, a number of seabed channel systems and a chrono-stratigraphic framework from well data. The student will (i) calculate structural growth rates for all faults in the area; (ii) forensically document the response of the submarine channels systems to time-integrated structural growth; (iii) quantify morphological evolution

of modern and shallowly buried in the JDZ area; (iv) evaluate the impact of growing structure on sediment transport, sediment routing and sedimentary architecture; and (v) develop a generalised, predictive model of submarine channel behaviour in response to growing structure. The student will also have the opportunity to compare their results to geological field analogues in the Ainsa and Jaca basins in Spain where they will quantify preserved channel dimensions and architectures.

The results will provide new constraints on how and where sediment and plastic is delivered from continental shelves to the deep sea, will help constrain the complex pathways by which sediment and plastics are today transported from the Niger River to the ocean floor with important implications for marine ecosystems. The student will join a strong research group in Imperial College with strengths in structural analysis, 3D seismic interpretation, sedimentology and tectonic geomorphology. Training will be given in software techniques for 3D seismic interpretation, and ARC-GIS.

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