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The Moroccan Turbidite System: a modern example of a multi-basin mixed siliciclastic-volcaniclastic deep-water sedimentary system

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The Moroccan Turbidite System encompasses three interconnected depocentres: Agadir Basin, Seine Abyssal Plain and Madeira Abyssal Plain (Wynn et al. 2002). Both siliciclastic and volcaniclastic turbidites are discovered within these basins using piston coring, but have been found to behave differently according to their source and site of entry. The Agadir Basin is fed directly by the Agadir Canyon, which is the primary source for siliciclastic shelf-edged derived turbidity currents. The Agadir Basin also represents a proximal site of deposition for volcaniclastic turbidites derived directly from Madeira, Tenerife, Las Palma and El Hierro. Though these mixed deposits are also found in the Seine and Madeira Abyssal Plains, the focus of this presentation will be the Agadir Basin. Focusing this study is primarily because it removes the added complexity of these flows passing through the regions interconnecting the basins, but also because of the higher quality of coring completed in the Agadir Basin.

Siliciclastic turbidty currents here are affected by both grain-size bypass and flow transformations owing to sensitive interactions with topography (Talling et al. 2007). These deposits form tabular sheets through the centre of the basin, with bypass within the Madeira Channel System and recommencing deposition in the distal Madeira Abyssal Plain. Volcaniclastic deposits vary in their behaviour since they travel up-gradient through the Agadir Basin, with the deposit architectures not only affected by topographic interactions but with the characteristics of the landslide failures that generated them.

Large scale volcaniclastic turbidites, such as those from Tenerife and El Hierro, exhibit a vertically stacked sand facies relating to the failure mechanism at source. This facies architecture is maintained >400km away from source in the Agadir Basin. In comparison smaller flank failures generate localised turbidite lobes feeding off small aprons, which have been found to be restricted by basin topography. There are also a number of small volcaniclastic turbidites relating to barranco canyon outwash events, which though not regionally extensive, could still yield important information regarding climate controls on weathering rates. Adding to these siliciclastic and volcaniclastic deposits are a number of carbonate-rich turbidites originating from volcaniclastic draped seamounts such as the Selvage Islands.

Understanding the provenance area of each turbidite, its composition and pathway are pivotal in understanding the mechanics of the gravity flows that deposited them. Understanding how turbidity currents, debris flows and debris avalanches react to the basin settings is in turn important, since this records how the basin is evolving through time both distally here in the deep sea and within the hinterland.

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