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Geochemical evidence of multistage retrogressive failure during the 160,000ka Icod landslide from turbidite facies analysis: multidisciplinary investigative approaches using destructive and non-destructive methodologies

James Hunt, Russell Wynn, Doug Masson, and Ian Croudace

National Oceanographic Centre, Southampton, University of Southampton Waterfront Campus, European Way, Southamton SO14 3ZH

The study of modern deep-sea systems through targeted piston coring has enabled detailed investigations into the process mechanics of turbidity currents. In complex systems such as the Moroccan Turbidite System the derivation of provenance is of vital importance, since flows from different sources in this system have been found to behave differently. Early provenance studies in the Madeira Abyssal Plain found that bulk sand-fraction geochemical analysis through ICP-AES could enable successful attribution of provenance to specific turbidites alongside electron microprobe analysis (de Lange, Jarvis & Kuijpers, 1987; Pearce & Jarvis, 1992). These sources including the Moroccan siliclastic shelf, Tenerife, Las Palma, El Hierro and Madeira. ICP-AES, MC-ICP-MS and XRF have been utilised here, however these present destructive methodologies, using 0.1-5g of material >63μm. Deep-sea piston cores are also expensive to collect, and often there is not enough material to remove for analysis without compromising the core. Furthermore, routine sampling, preparation and analysis using the destructive methods stated above are undertaken at considerable cost and analytical time. The successful use of non-destructive instruments to yield quantitative geochemical has become paramount at the NOC.

This presentation serves to show the successful application of the TM-1000 tabletop SEM EDS analyser, ITRAX micro-XRF analyser and the GEOTEK XYZ logger, in coincidence with traditional destructive methods. These instruments can only supply semi-quantitative data, unless correct calibration can be achieved, and will be shown here.

The 160,000ka Icod landslide from Tenerife generated a 150km3 debris avalanche with a runout of 105km and a >180km3 turbidity, which will form the case study for application of these instruments. The vertically stacked subunit facies of the Icod turbidite has been attributed to generation from a multistage retrogressive failure (Wynn & Masson, 2003). Here there have been five regular subunit packages identified and correlated. This failure mechanism would have significant consequences of decreasing ensuing tsunamigenic potential. Variations in subunit mineralogy, bulk geochemistry, and volcanic glass geochemistry could yield results to support this hypothesis, and rule out other generation mechanisms such as flow reflection.

ITRAX micro-XRFmeasurements taken every 100μm show variations in bulk geochemistry. Major element (K, Ca, Ti, Fe) and trace element (Zr, Y an Sr) demonstrate this when plotted in Harker variation diagrams against silica. However these variations, along with those from ICP-AES, ICP-MS and XRF, could be accounted for by density fractionation of basaltic mafic clasts and volcanic glass constituents within the turbidity current. In regards to the mineral composition, the basal subunit contains altered volcanic glass with authigenic Ti-Fe oxide growths, seen using the TM-1000 SEM, compared to unaltered glasses found in the later four intervals. Furthermore, focussed studies of the volcanic glasses using the TM-1000 SEM EDS showed that the basal subunit had volcanic glasses of different major element compositions compared to the later four subunit intervals. This study, demonstrates the application of non-destructive geochemical analytical tools in not only discriminating provenance, but being able to aid deciphering of flow mechanical problems. Also, using non-destructive geochemical instruments will help discern provenance of further deposits around the Canary Islands.

De Lange, G.J., Jarvis, I., & Kuijpers, A. 1987. Geochemical characteristics and provenance of late Quaternary sediments from the Madeira Abyssal Plain, N Atlantic. In: Weaver, P.P., & Thomson, J. (eds). Geology and Geochemistry of Abyssal Plains. Geological Special Publications, no.31, pp.147-165.

Pearce, T.J., & Jarvis I. 1992. Composition and provenance of turbidite sands: Late Quaternary, Madeira Abyssal Plain. Marine Geology, 109, p.21-51.

Wynn, R. B. & Masson, D. G. 2003 Canary island landslides and tsunami generation: can we use turbidite depositis to interpret landslide processes. In Submarine mass movements and their consequences (ed. J. Locat & J. Mienert), pp. 325–332. Dordrecht, Netherlands: Kluwer Academic Publishers.