Role of Internal Waves Within Ponded Turbidity Currents: Experimental Data and Deposit Implications

Patacci, Marco [1]; McCaffrey, William D.[2]; Haughton, Peter D.[1] (1) School of Geological Sciences, University College Dublin, Dublin, Ireland. (2) TRG, University of Leeds, Leeds, United Kingdom.

Turbidity currents in confined basins can form distinctive ponded turbidites. A range of bed types and facies transitions are recognised but presently there is only a superficial understanding of the links between process and product. A series of experiments carried out at the Sorby Environmental Fluid Dynamics Laboratory (University of Leeds) gives new insight into flow behaviour during the ponding process. One of the key findings is that sustained turbidity flows form an internal concentration interface within the ponded sediment-bearing cloud. Where sharp density interfaces form, internal waves are prominent within the suspension cloud. Image analysis of video recordings was used to characterise the internal waves (amplitude, frequency, velocity) for a range of input conditions and basin geometries.

In all cases the internal waves generated travel from the flow inlet toward the confining slope along the internal density interface with a phase velocity much higher than that of the ponded flow. They are therefore not solitary waves propagating off the confining slope. Their characteristics are tied to the value of the concentration gradient at the interface and to the velocity of the ponded flow. Thin and concentrated flows result in sharp internal density interfaces associated with large amplitude, high frequency and high phase velocities. In contrast, weak density gradient interfaces result in small amplitude, low frequency and low velocity waves. The speed of the internal waves is also related to the input flow velocity. The velocity structure imparted by the internal waves is characterised by vertical and horizontal components, defining an orbital movement superimposed on the confined flow structure. Where partly contained, the waves induce pulsing in the downstream overspill.

The presence of internal waves influences the velocity field at the base of the suspension cloud and therefore it can affect the aggrading deposit. The amplitude of the velocity fluctuations is strongest where the internal concentration interface impinges against the confining slope where the internal waves have maximum amplitude. Internal waves can provide an alternative model to interpret the distinctive structure of onlapping turbidite beds showing repetitions of a set of sedimentary structures (e.g. repetitions of highly structured and massive sandstone within a single event bed).