Geophysical Research Abstracts
Vol. 15, EGU2013-1531, 2013
EGU General Assembly 2013

New insights into the character and triggers of submarine sediment flows, and how do we produce a future step change in understanding?

Peter Talling
United Kingdom (Peter.Talling@noc.ac.uk)

Submarine sediment density flows are arguably the volumetrically most important flow process for moving sediment across our planet. A single submarine flow can transport over 100 cubic km of sediment, ten times the annual sediment flux from all of the World's rivers. These flows are the longest sediment density flows recognised on Earth, and can achieve prodigious run out distances in excess of 1,500 km. The largest flows travel across remarkably low gradients of just 0.01 to 0.1 degrees, and can be extremely fast. Sea floor cable breaks have recorded average frontal flow speeds of up to 19 m/s, and flow speeds of 3 to 6 m/s can be sustained for 100s of kilometres. Submarine flows create channel systems that extend far out into the deep ocean, but flows also sometimes achieve remarkable run out distances despite being more than 180 km wide. For comparison, the Amazon River is $\sim$10 km wide at its mouth. Submarine sediment density flows have created some of the largest and thickest sediment accumulations on Earth, both on the modern sea floor and in the ancient rock record, which host some of our largest oil and gas reserves.

It is important to appreciate the strong contrast between the amount and level of information from direct monitoring of submarine flows and other major sediment transport processes. Sediment concentration is a key parameter. It has never been measured directly in a long run out flow on a submarine fan, not even as a spot measurement. This is a stark contrast to the other major sediment transport process (river systems) on Earth, where there are at least several hundred thousand direct measurements of sediment concentration. To produce a step change in understanding of submarine flows we will eventually need to monitor submarine sediment flows in action in more detail, as they evolve along their flow path, and in locations worldwide. This is feasible with concentrated efforts, as suitable locations and technology exist.

This contribution also summarises key results from a series of recently collected large-scale field datasets (Talling et al., 2012), including those from the Miocene Marnoso-arenacea Formation in the Italian Apennines, coring of the modern sea floor offshore NW Africa, and monitoring of active flows within Monterey Canyon. Mapping of individual flow deposits (beds) over very long distances emphasises how a single event can contain several flow types, with transformations between flow types. Flow transformation may be from dilute to dense flow, as well as dense to dilute flow. Laboratory experiments show how flow-state, deposit type, and flow transformation are strongly dependent on the volume fraction of cohesive fine mud within a flow. In some locations, field observations suggest that debris flows may spread layers of relatively clean sand across large areas of sea floor, a hypothesis that has previously been highly controversial. These field observations challenge many widely used models that capture what these submarine flows are, how they evolve, and how they deposit sediment. There is much still to understand about the first-order character of these remarkable submarine flows.

Reference: Talling, Sumner, Masson, and Malgesini, (2012) Subaqueous sediment density flows: depositional processes and deposit types. Sedimentology,doi: 10.1111/ j.1365-3091.2012.01358.x.