Sedimentology, stratigraphic occurrence and origin of linked debrites in the West Crocker Formation (Oligo-Miocene), Sabah, NW Borneo

Abstract

The West Crocker Formation (Oligocene-Early Miocene), NW Borneo, consists of a large (>20 000 km2) submarine fan deposited as part of an accretionary complex. A range of gravity-flow deposits are observed, the most significant of which are mud-poor, massive sandstones interpreted as turbidites and clast-rich, muddy sandstones and sandy mudstones interpreted as debrites. An upward transition from turbidite to debrite is commonly observed, with the contact being either gradational and planar, or sharp and highly erosive. Based on their repeated vertical relationship and the nature of the contact between them, these intervals are interpreted as being deposited from one flow event which consisted of two distinct flow phases: fully turbulent turbidity current and weakly turbulent to laminar debris flow. The associated bed is called a co-genetic turbidite-debrite, with the upper debrite interval termed a linked debrite. Linked debrites are best developed in the non-channellised parts of the fan system, and are absent to poorly-developed in the proximal channel-levee and distal basin floor environments. Due to outcrop limitations, the genesis of linked debrites within the West Crocker Formation is unclear. Based on clast size and type, it seems likely that a weakly turbulent to laminar debris-flow flow phase was present when the flow event entered the basin. A change in flow behaviour may have led to deposition of a sand-rich unit with 'turbidite' characteristics, which was subsequently overlain by a mud-rich unit with 'debrite' characteristics. Flow transformation may have been enhanced by the disintegration and incorporation into the flow of muddy clasts derived from the upstream channel floor, channel mouth or from channel-levee collapse. Lack of preservation of this debrite in proximal areas may indicate either bypass of this flow phase or that the available outcrops fail to capture the debris flow entry point. Establishing robust sedimentological criteria from a variety of datasets may lead to the increasing recognition of co-genetic turbidite-debrite beds, and an increased appreciation of the importance of bipartite flows in the transport and deposition of sediments in deepwater environments.