Experiments in rheoplasis during sediment intrusion

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Injection of semi-fluid silt/water suspensions into semi-fluid sand/cement slurries resulted in the formation of a variety of structures at the interface between the two materials. These structures resemble flute, load, groove and ridge-casts and form as a result of flow-moulding ('rheoplasis'). These experimental results complement earlier work on certain natural occurrences of these structures and substantiate the hypothesis that they form as a result of post-depositional sediment movement and not through primary sedimentary processes.

INTRODUCTION

In a recent paper, Poll & Patel (1981) described a variety of sedimentary structures, resembling load, flute and groove casts. These structures, morphologically indistinguishable from sole markings of primary origin, differ from the latter in that they occur at the interface between sandstone and discrete masses of siltstone. The sole-mark-like structures comprise inward-protruding bulges of sandstone into siltstone and occur on all sides of the siltstone masses (including 'bottom' surfaces) and are at all orientations to bedding. Field evidence shows clearly that both the sandstone and siltstone have suffered substantial post-depositional remobilization which probably reflects an initial inverse density stratification. Under these conditions there exists considerable potential energy (Anketell 1968; Anketell et al. 1970). As a result of induced shear, perhaps due to earthquakes, major remobilization of the sediment may occur. Ascending, relatively less dense mud bodies may remain attached to the parent bed forming diapirs, or may become completely detached 'intrusions'. The field evidence suggests that the flutes, grooves, etc. formed through a process of flow-moulding ('rheoplasis') at the sand-silt interface during periods of sub-surface remobilization when siltstone masses were intruded into adjacent liquefied sandstone (Poll & Patel, 1981). In order to test this hypothesis, a series of experiments were conducted in an attempt to replicate natural rheoplastic structures. The experimental results showed that, in almost all instances, inward-protruding bulges of cement into mud formed at the mud-cement interface. We believe this fact to be important substantive evidence in favour of the process of rheoplasis.

This paper describes the experimental technique and includes a preliminary account of the results of the first series of experiments.

METHODS

General

The experiments in rheoplasis involved injecting mud of varying consistency, into a box containing a sand/cement slurry, again of varying consistency. Following mud injection, the cement was allowed to set, removed from the box and sectioned. The mud could then be washed out and the mud-cement interface examined.