GRAVITY SLIDE DEPOSITS IN TIMOR AND ECUADOR

SIR,—Mr. S. Marchant (1965) has suggested that the differences he cites between the Clay Pebble-Beds of Ecuador and the Bobonaro Scaly Clay of Timor (Audley-Charles, 1965) are " no more than one would expect from differences in provenance ". This begs the question of both the cause and mode of origin of these deposits.

The following are in my opinion the main differences between the Clay Pebble-Beds of Ecuador and the Bobonaro Scaly Clay of Timor :—

(1) The Bobonaro Scaly Clay is essentially a synorogenic deposit, it is intimately associated with the huge overthrusts of Permian and Mesozoic strata in space, time, and composition (the exotic material of the Bobonaro Scaly Clay is predominantly derived from the overthrust formations). In contrast the Clay Pebble-Beds do not appear to have any association with major overthrusting (Marchant and Black, 1959).

(2) The Clay Pebble-Beds of Ecuador are interbedded with stratified deposits so that they can be said to contain stratified horizons (Marchant and Black, 1959). This is not true of the Bobonaro Scaly Clay.

(3) The base of the Bobonaro Scaly Clay is a major unconformity ; it has been noted that in Timor every outcropping formation older than the Bobonaro Scaly Clay is somewhere overlain by the Bobonaro Scaly Clay (Audley-Charles, 1965). A similar unconformity does not appear to be present in Ecuador.

(4) The Viqueque Formation, which overlies the Bobonaro Scaly Clay unconformably, is a marine facies and exemplifies many of the features regarded as characteristic of molasse (Kuenen and Carozzi, 1953). It was deposited after the orogenic climax which saw the emplacement of the Bobonaro Scaly Clay. These immediately post-orogenic sediments exhibit a repeated regressive pattern marking the phases of uplift of the island. The principal lithologies are conglomerates, sandstones, siltstones, claystones, marls, calcilutites, and calcarenites.

In contrast the Clay Pebble-Beds are overlain with normal sedimentary contact by the Socorro Beds that are described as typical flysch (Marchant and Black, 1959 ; and Marchant, 1965). Limestones are reported to be absent from the Socorro Beds.

Despite these differences between the Socorro Beds and the Viqueque Formation there appear to be important similarities. Both contain graded, poorly sorted sandstones which are coarse and argillaceous. In both formations beds containing Foraminifera usually regarded as shallow water forms are interbedded with beds containing Foraminifera usually regarded as deeper water species. More important, the Viqueque Formation contains pebbly mudstones whose pebbles are of the same age and composition as some marls and claystones of the Viqueque Formation. These pebbly mudstones are in some respects similar to the Clay Pebble-Beds of Ecuador. There are other boulder and pebbly mudstones which make a sudden appearance in the marls of the Viqueque Formation, whose clasts are derived from older formations; these pebbly mudstones also resemble the Clay Pebble-Beds of Ecuador. The principal difference between the pebbly mudstones of the Viqueque Formation and those of the Clay Pebble-Beds seems to be one of scale ; the Ecuador beds achieving a much greater thickness.

Fortunately in Timor the Viqueque Formation is well exposed. It is palpably evident that it is a regressive facies. The old shore line is clearly marked in places by sands and conglomerates resting on what was a very steep rocky shore. The mixing of the shallow and deeper water Foraminifera may be attributed to the exceedingly steep shore and the rapidly deepening nature of the sea floor.

Without wishing to deny that the Clay Pebble-Beds are probably a submarine gravity slide deposit, it must be emphasized that there are very important differences between that formation and the Bobonaro Scaly Clay. The Bobonaro Scaly Clay is so closely associated with major overthrusting that its genesis cannot be considered without reference to the accompanying

tectonic events. From the published accounts of the Clay Pebble-Beds and Socorror Beds of Ecuador it appears that the characters of these two formations resemble more closely those of the Viqueque Formation rather than the Bobonaro Scaly Clay.

The other point raised by Mr. Marchant's letter involves much wider issues : it concerns the expanding of the Indian Ocean floor northwards under the Indonesian arcs. Notwithstanding the vogue for drifting continents there is no evidence from Timor that indicates the spatial relationship between Australia and Timor has radically altered since at least the beginning of Permian times.

Articles dealing with this last problem and with the nature of the Viqueque Formation are in preparation.

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