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Tectono-stratigraphic development of the Coastal Group of south-eastern Jamaica

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ABSTRACT

The sedimentary succession of southeastern Jamaica preserves a depositional record of accommodation changes and tectonic events for the last 14 Ma. The depositional systems which occur in the area have been classified according to distinct tectono-stratigraphic packages based on the depositional environments, rapid facies changes, and or significant erosion surfaces. This paper places the sedimentology and geochemistry within a tectonic evolutionary framework for the northern margin of the Caribbean Plate over the last 14 Ma. This involves considering issues of changing accommodation; deformation episodes including folding and faulting and the subsequent cutting of unconformities. A model for the tectono-stratigraphic development of southeastern Jamaica is also proposed. The model incorporates critical surfaces, major faults, subsidence and uplift which later influence the depositional environments.

1. Introduction

Jamaica is located at the eastern end of the Nicaraguan Rise (Fig. 1) in what was originally described as a 200 km wide seismically active zone of deformation between the North American and Caribbean plates (Burke et al., 1980; Robinson, 1994; Mann et al., 1995, 2007). The Nicaraguan Rise is a topographic extension of northern Central America, bordered to the north by the Cayman Trough and to the south by the Colombian Basin (Robinson, 1994), and is represented by an extensive area of shallow-water blocks (carbonate platforms) and deeper-water troughs (Hallock et al., 1988). The 200 km wide boundary between the North American and Caribbean plates was designated the Gonâve Microplate by Mann et al. (1995), the southern boundary of which passes through eastern then northern Jamaica (Fig. 1). The Gonâve Microplate developed in response to the collision of the Caribbean Plate with the Bahamas Platform 1000 km to the east (Mann et al., 1995; Calais, 1999; McCann, 1999). Movement along the plate boundary is one of left-lateral strike-slip, across a right-lateral restraining bend (Molnar and Sykes, 1969; Burke et al., 1980; Mann, 1999; DeMets et al., 2000; DeMets and Wiggins-Grandison, 2007). Estimates suggest that the relative motion between the Caribbean and North American plates is between 18 and 25 mm per year (Dolan et al., 1998; DeMets et al., 2000). In Jamaica, the microplate boundary passes through the Plantain Garden Fault system, the Wagwater Fault Zone and the Duanvale Fault system (Horsfield, 1974; Horsfield and Roobol, 1974; Mann, 1999).

Draper (1987) divided the geological history of Jamaica into four phases: (1) a Cretaceous to early Eocene island arc; (2) extensional rifting (Paleocene to early Eocene); (3) a quiescence phase (middle Eocene to mid Miocene) during which the rocks of the Yellow Limestone and White Limestone groups were deposited; and (4) left-lateral transpression (mid Miocene to Recent) which led to the emergence of Jamaica out of the Caribbean sea. It is stage 4 which we are concerned with in this paper.

The mid Miocene to Recent stratigraphy of eastern Jamaica consists of the rocks of the Coastal Group (Fig. 2) which are generally exposed around the periphery of the island. This study concentrated on understanding the stratigraphy of the south-eastern portion of the St. Thomas Shelf (Fig. 3) in eastern Jamaica. Here the Coastal Group consists of a Miocene to early Pleistocene mixed clastic-carbonate succession, overlain unconformably by a late Pleistocene mixed clastic-carbonate succession. We present a new geological map (using the 1:12,500 series topographic maps from the Survey Department of Jamaica (Sheets 126D, 127A and 127B) as base) for the central-southern St. Thomas, where the Coastal Group is well exposed (Fig. 3); determine relationships between sedimentological packages (i.e., conformable or unconformable); and determine the facies relationships (Tucker, 1982; Reading, 1986; Miall, 1990) within formations and/or members.

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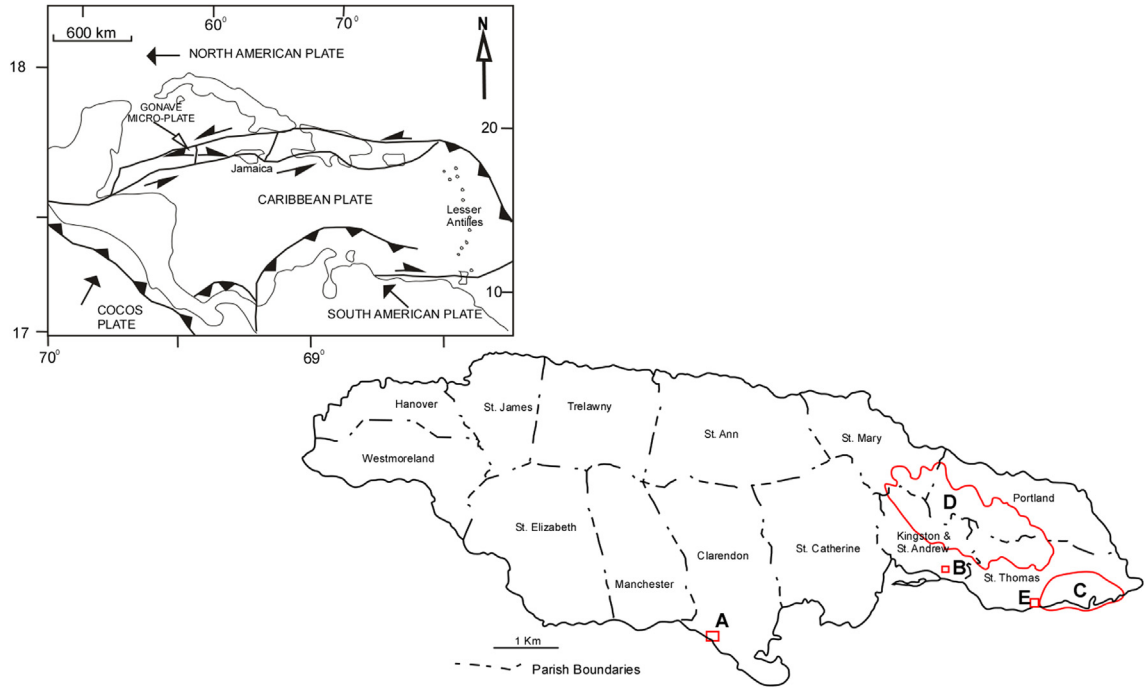

Fig. 1. Map of Jamaica showing parish boundaries and selected localities (A-Round Hill, B-Hope Gorge, C-Study area, D-Blue Mountains area, E-Morant Bay). Map inset shows location of Jamaica with regard to the Gonâve microplate and the Caribbean/North American plate boundary (modified from Mann et al., 1995, p. 212 & Mann, 1999, p. 290).

2. Results

We compiled a revised tectonic map for eastern Jamaica, showing major fault relationships and large-scale lithostratigraphic units based on previous maps (e.g., McFarlane, 1977) and our recent geological mapping. The major structural features relate to the Jamaica restraining bend (Molnar and Sykes, 1969; Burke et al., 1980; Mann, 1999, Fig. 4) which has resulted in a flower structure (here called the eastern Jamaica flower structure) with reverse faults (some probably re-activated normal faults related to the formation of the Wagwater Graben in the Paleocene to early Eocene: Draper, 1987).

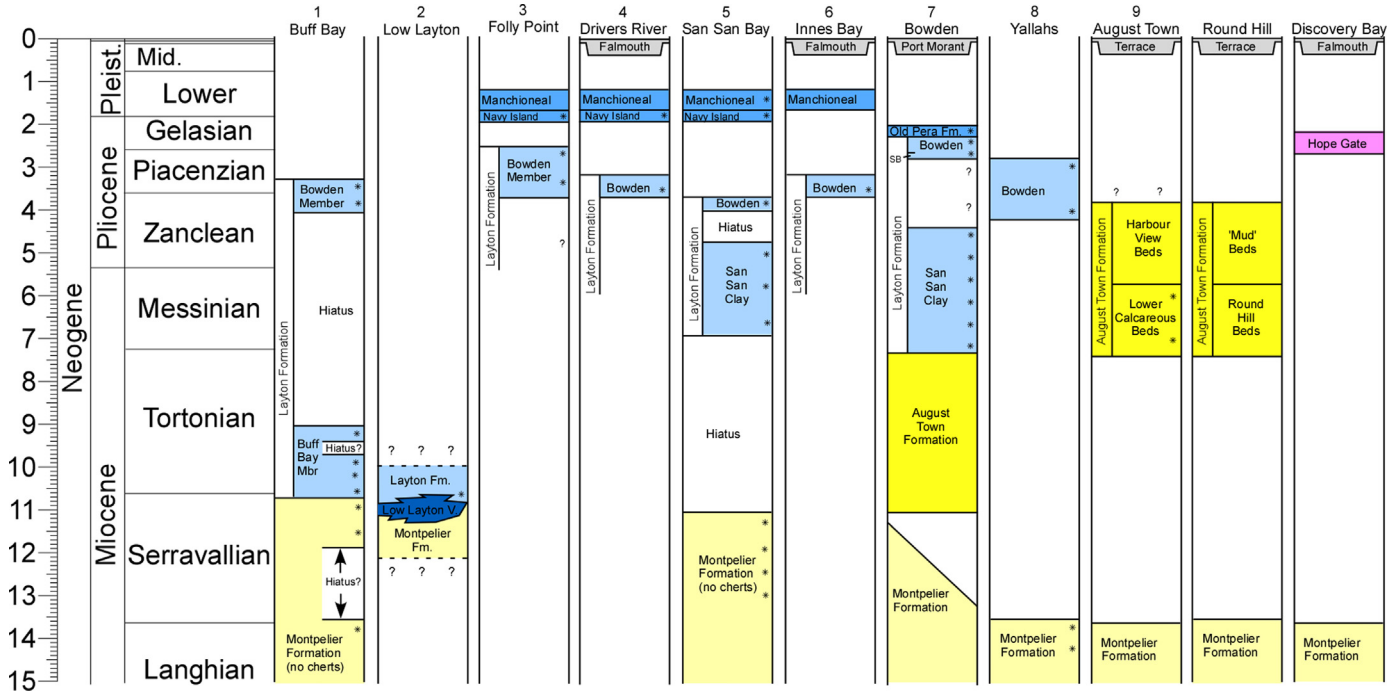

Fig. 2. Chronostratigraphy of the Coastal Group of Jamaica.