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We appreciate the commentary by Stephen K. Donovan regarding our assembly and use of a data base on Pleistocene rocky shores dating from 120ka to 135ka (Substage 5e). No fate worse than total silence can befall a journal article that attempts to organize information in a new way and, thereby, stimulate additional interest in an undervalued topic. The primary goal of our review was to demonstrate that a surprising number of research articles exists (60) describing unconformities characteristic of Late Pleistocene rocky shores from a narrow window in geologic time. We anticipate future field research in this area will result in the discovery and description of additional Upper Pleistocene rocky shores. Our real motivation, however, was to use the recent geological record as an attractive foil for comparable processes that must have occurred during the preservation of older rocky shores through deep geologic time. We want to stimulate geologists, geomorphologists, and paleontologists to pay more attention to rocky shores dating back in time as far as the Cambrian or the late Precambrian.

Our secondary goal was to focus the Substage-5e data set on three general topics illustrating that rocky shores: (1) span a wide range of geographic latitudes with appropriate biodiversity, (2) occupy unconformities with many different substrate lithologies, and (3) underwent different degrees of post-depositional uplift consistent with tectonic segregation. Clearly, these factors apply also to rocky shores predating the Pleistocene. It is the last of these focal points that Donovan finds problematic from a nomenclatural point of view. We assigned Upper Pleistocene rocky shores described in 19 research papers to tectonic settings characteristic of island arcs (JOHNSON and LIBBEY, 1997, Table 1). Included, therein, are four examples from the Caribbean islands of Barbados, Grand Cayman, Hispaniola (Haiti), and Jamaica. Donovan asserts that the example from Barbados (MESOLELLA et al., 1969) is the only one from among this Caribbean subset that qualifies as a rocky shore in an island-arc setting. According to the definition cited from PARKER (1997), however, there exists a certain amount of generalization. The island group behind an arc is usually manifested in a curved pattern. Outboard from the island group is a deep trench or a trough. Furthermore, the definition does not state whether any of the islands must be actively volcanic in order to retain their qualification as part of an island arc.

In addition to the Puerto Rico Trench off the Lesser Antilles (which does form a curved pattern), the northern Caribbean also features the Cayman and Muertos troughs (CASE et al., 1990). These features are in geographic proximity to Grand Cayman, Hispaniola, and Jamaica. Key questions are whether or not the Substage-5e rocky shores on these or other Caribbean islands were affected by postformational uplift and whether such uplift is related to tectonic bulges that continue to pervade the Caribbean plate. Elevations in excess of approximately 6 m above present sea level, as on Bermuda (HARMON et al., 1983), are taken by us to signify tectonic uplift divorced from normal sea-level rise on passive continental margins. In our list (JOHNSON and LIBBEY, 1997, Table 1), we included elevation data from as many of 60 references as possible. The Barbadian and Haitian rocky shores cited by us demonstrate considerable elevation in the range of 30–60 m above present sea level. No elevation data were recorded by EMERY (1981) for Grand Cayman Island or by DONOVAN and MILLER (1995) for Jamaica. We hope authors will make a point of incorporating this important information in future studies of unconformities interpreted as ancient rocky shores. It is clear that the Barbadian and Haitian examples involve considerable post-formational uplift.

Donovan argues that ongoing tectonic activity on Jamaica and Haitian Hispaniola is disassociated with an earlier episode of arc development dating from Cretaceous time. Thus, Pleistocene and later tectonics are attributed to impingement along the North Caribbean Plate Boundary by the North American Plate, rather than ongoing island-arc development. Generally, the North Caribbean Plate Boundary is depicted
as one involving transcurrent motion between the Caribbean Plate moving east and the North American Plate moving west. Indeed, no arc volcanism occurs today on this plate boundary. Donovan also points out that Grand Cayman sits on the summit of the Cayman Ridge, which has been the site of limestone deposition since Oligocene time. Although neighboring islands are volcanically quiescent, it is curious that the linear Cayman and the Muertos troughs associated with the North Caribbean Plate Boundary have remained physiographically intact. Likewise, most of the Puerto Rico Trench has remained intact along the West Caribbean Plate Boundary without associated island volcanism in evidence (Montserrat being one exception).

In addition to transcurrent movement, some authors (for example Ladd et al., 1990, Figure 4) show that transpressional movement is linked with the North Caribbean Plate Boundary. Such a compressional component is likely to be responsible for maintaining the physiography of the Cayman Trough, Muertos Trough and the Puerto Rico Trench, as well as any associated bulges like the Cayman Ridge. Trough or trench-bounded, volcanism or quiescence, we remain comfortable with the classification of many Caribbean islands as island-arc related. We do not consider our usage an egregious violation of the definition given by Parker (1997). Donovan prefers the designation “active plate margin” in place of island arc. Our usage of established nomenclature was meant to distinguish between plate boundaries at the junction of oceanic plates (island arcs) and those adjoining continents (active continental margins). If we have hammered square pegs into round holes through narrow conformity to this nomenclature, we hope the advantages outweigh the distractions. Meanwhile, the greater challenge ahead remains to find and explore the biodiversity, lithologies, and tectonic relationships of ancient rocky shorelines that date from a broad range of geologic ages.

**LITERATURE CITED**


