Delineation of the Brac Unconformity on Grand Cayman, B.W.I.: implications for late Oligocene – early Miocene paleoclimate and glaciation

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Due to their isolated position in the Caribbean Sea, the carbonate sedimentary succession on the Cayman Islands is ideally suited for assessing eustatic changes in sea level. The Bluff Group, which forms the core of each island, consists of the unconformity-bound Brac Formation (Lower Oligocene), Cayman Formation (Middle Miocene), and Pedro Castle Formation (Pliocene). The unconformities developed as karstic surfaces when the islands were emergent during periods of sea-level lowstand. The Brac Unconformity, which defines the upper boundary of the Brac Formation, developed over a 6 – 11 million-year period during the late Oligocene and early Miocene. In the subsurface of Grand Cayman, the Brac Unconformity is a paraconformity that denotes the boundary between the fabric retentive, finely crystalline dolostones of the Brac Formation and the fabric retentive, microcrystalline dolostones of the overlying Cayman Formation. Although the Brac Unconformity is readily apparent in the cliff faces (up to 20 m above sea level) on the east end of Cayman Brac, it is difficult to recognize in the subsurface based on well cuttings and/or core. Accordingly, biostratigraphic information and the $^{87}Sr/^{86}Sr$ isotope ratios have been used to establish the location of this unconformity.

Variations in the position of the Brac Unconformity reflect the effects of eustacy and tectonism that contributed to karst development. Cayman Brac was uplifted and tilted westward during Pliocene-Pleistocene times, whereas there is no evidence that Grand Cayman experienced tectonic uplift or tilting. In well RTR-1 on Grand Cayman the Brac Unconformity is 129 m below sea level – 149 m below where it is found on the east end of Cayman Brac. This value represents the absolute maximum lowstand position, if it is assumed that Grand Cayman has experienced no tectonic uplift/subsidence. In contrast, the erosional relief on the Brac Unconformity reflects the absolute minimum lowstand position, if it is assumed that the present-day depth to the unconformity is entirely due to post-Oligocene subsidence. Available evidence indicates that the erosional topography on the Brac Unconformity developed as a karst surface rather than constructional processes. In well GET-1 on Grand Cayman the Brac Unconformity is at 73 m below sea level, 56 m above where it is found in well RTR-1. There is, therefore, at least 56 m of erosional relief on the Brac Unconformity.

Although the general framework of eustatic changes in sea level is well known, the absolute magnitudes of such fluctuations are open to debate. Estimates of the magnitude of eustatic fall during the late Oligocene-early Miocene transition, for example, range from ~160 m to ~60 m. Information from the Brac Unconformity on Grand Cayman indicates that the late Oligocene-early Miocene lowstand was between 56 m and 129 m below present-day sea level.

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