GEOLOGICAL RECONNAISSANCE OF THE MIDDLE-LATE MIOCENE ALHAJUELA FORMATION (PANAMA): IMPLICATIONS FOR SHOALING OF THE CENTRAL AMERICAN SEAWAY

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Introduction:

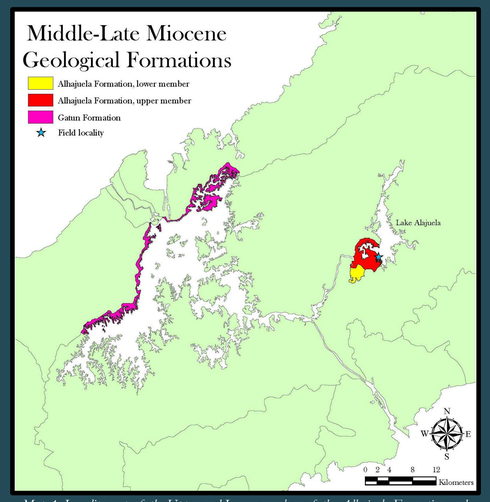
The shoaling and closure of the Central American Seaway (CAS) during the late Neogene had a major impact on local ecosystems, oceanographic currents, and global climate. Constraining the spatial and temporal context of CAS shoaling, however, is hindered by ambiguity in the stratigraphic relationships and depositional environments of marine sedimentary exposures in the Panama and adjacent regions. Here, we present new information from the Alhajuela Formation (Lake Alajuela, central Panama) with implications for the presence of the CAS in the Panama Canal and Lago Alajuela Basins.

The age and stratigraphic relationships of the Alhajuela Formation are problematic due to its geographically-restricted exposures and lack of contacts with other age-constrained formations in the Panama Canal Basin. Recent discoveries of a vertebrate assemblage from basal strata of the Alhajuela Formation suggest a Middle-Late Miocene age contemporary with the proposed onset of shoaling.

Figure 1: Modern surface currents shown in solid black line – dashed black line shows the Late Miocene main Caribbean surface currents. The Eastern Panama Isthmus (outlined in the dotted black line) is the depositional region of the Alhajuela Formation (Collins, 1996)

Location:

The Upper Member of the Alhajuela Formation is located in the Lago Alajuela Basin on the southwestern edge of Lake Alajuela near Chilibre, Panama.



Map 1: Locality map of the Upper and Lower members of the Alhajuela Formation and the Gatun Formation

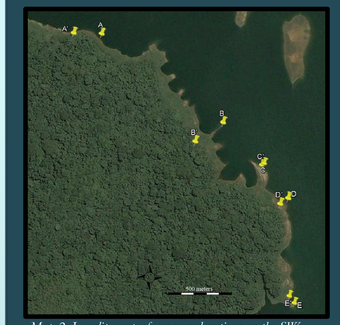
Methods:

Structural and lithologic data was collected with a Brunton compass using standard strike and dip collection techniques. Thicknesses of beds were measured using a 1.6 meter Jacob's Staff.

Field geologists measured and described 39 meters of bedding in five sections along the SW shores of Lake Alajuela beginning from the southern portion of the mapping area at E to E' working north towards A to A'. Geologists collected fossil flora and fauna which are now included in the Smithsonian Tropical Research Institute collections and database.

Image 1: J. Moreno-Bernal and M. Barboza record lithologic data at B to B'

Image 2: E. Whiting collecting a turtle carapace



Map 2: Locality map of measured sections on the SW shore of Lake Alajuela

Image 3: GABI-RET participants discuss geology on the shores of Lake Alajuela

Results:

Structure: Average dip and dip direction: 7°, 310° with local long-wavelength folding

Lithofacies 1: matrix-supported pebble conglomerates containing fossil wood, and marine vertebrates (sting-ray, turtle) and invertebrates (bivalves)

Lithofacies 2: cross-bedded sandstones with terrestrial fauna (crocodile), marine fauna (crab, turtle, shark, bivalves) and conglomeratic lenses

Lithofacies 3: carbonate cemented fossiliferous (bivalves, gastropods, turtle, sting-ray) sandstones and conglomerates/limestones with exclusively marine fauna (oysters, gastropods)

Lithofacies 4: massive sandstones with marine fauna (shark)

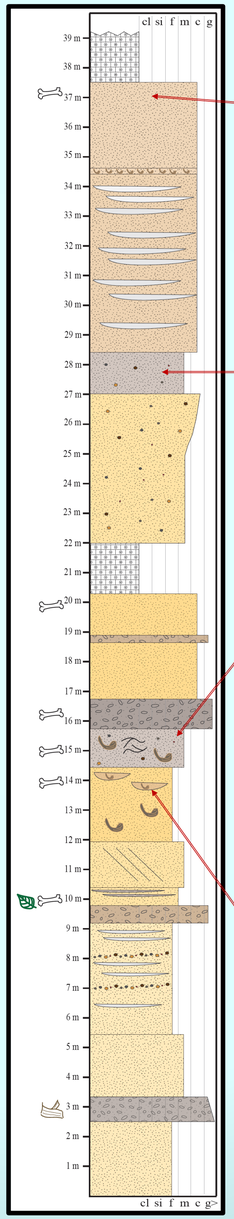


Image 4: C. megalodon tooth found in massive coarse-grained sandstone (Lithofacies 4)

Image 5: Fossiliferous conglomeratic sandstone with a carbonate cement and unarticulated bivalves (Lithofacies 3)

Image 6: Fossiliferous sandstone with a carbonate cement, pebble inclusions and horizontal burrow holes (Lithofacies 3)

Image 7: Crocodile maxilla found in siltstone (Lithofacies 2)

Stratigraphic Interpretations:

This section represents a transgressive sequence from nearshore facies to a shallow shelf environment at about 14.5 meters up on the composite stratigraphic column.

- Nearshore Environment
  - shallow marine subaqueous deposition (Lithofacies 2)
  - mass debris flow and re-working processes (Lithofacies 1)
- Shallow Shelf Environment
  - shallow shelf deposition of sandstone (Lithofacies 4) and calcareous fossiliferous sandstones with exclusively marine fauna (Lithofacies 3)

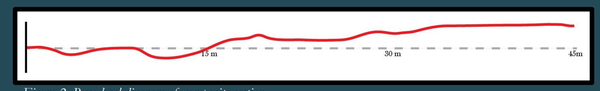


Figure 2: Base-level diagram of composite section

Implications:

This transgressive sequence from nearshore facies to a shallow shelf environment is consistent with the paleobathymetry reported in the roughly contemporaneous Late Miocene Gatun Formation to the NW – see Map 1 (Collins, 1996). In addition, the CAS (Central American Seaway) was present during the Middle-Late Miocene in the Lago Alajuela and Panama Canal Basins as the Alhajuela Formation was deposited near a terrestrial body based on its stratigraphy and the presence of terrestrial flora and fauna.

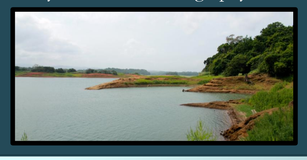


Image 4: Lake Alajuela shoreline showing view towards sections measured from C to C'

Conclusions:

This preliminary paleoenvironmental reconstruction is the first of its kind for the Alhajuela Formation. Further investigation into the stratigraphic relationship with underlying and above formations will help to better constrain the age of the Alhajuela Formation. The transgressive sequence observed in the Upper Member of the Alhajuela Formation is consistent with the roughly contemporaneous Gatun Formation, prior to the onset of shoaling in the Late Miocene.

Acknowledgements:

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Works Cited:

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