# LATE MIOCENE CHONDRICHTHYANS FROM LAGO BAYANO, PANAMA WITH IMPLICATIONS FOR A MARINE CONNECTION BETWEEN THE CARIBBEAN AND PACIFIC

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Background: Evolution of the Isthmus of Panama

Materials & Methods: Chondrichthyans of Lago Bayano

**Results:** Paleoenvironment, Paleobathymetry, Paleobiogeography

Summary: Overview of Late Miocene Chondrichthyans of Panama

Future Work: Geochemical Characterization



### Two Models for the Evolution of the Isthmus of Panama



15 – 13 Mya



Lago Alajuela Lago Gatun

Panama

Panama

US Dept of State Geographer Image Landsat © 2015 Google Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Lago Bayano

Google earth



palynology samples, hundreds of sedimentary and igneous petrology thin sections as well as stratigraphic sections and structural traverses.

Image taken from <a href="http://www.stri.si.edu/sites/jaramillo/PDFs/Panama\_Geology\_Project.pdf">http://www.stri.si.edu/sites/jaramillo/PDFs/Panama\_Geology\_Project.pdf</a>



	Darien Gatun		un	Alajuela	
Formation	Chucunaque Formation (Coates et al., 2004)	Gatun Formation (Pimiento et al., 2013)	Chagres Formation (Carrillo-Briceno et al., 2015a)	Alajuela Formation (Unpublished)	
Age	5.7 – 9.4 mya	9 – 11.5 mya	8 – 6.5 mya	Miocene	
Paleogeography	Pacific	Caribbean	Caribbean	Caribbean	
Depth	200 – 500 m	< 100 m	100 m (Rio Indio) 200-300 m (Piña	< 200 m?	



# Reconstructing Environments from Sharks and Rays

Why Sharks?

- 1) Long-lived species
- 2) Mobile
- 3) High Preservation Potential

### Modern Analogs

- Depth Preferences
- Diet Habits
- Migratory Patterns
- Temperature Restrictions
- Biogeography

Late Miocene Urumaco Fm - Venezuela



#### Carrillo-Briceno et al. (2015b)

# Lago Bayano

- Western Margin of the Bayano-Chucunaque Basin
- Flooded river valley (artificial lake)
- Late Paleogene-Neogene succession
- Molluscan assemblage from shark tooth bearing strata correlate with that of the Chucunaque Formation (Hendy, in prep.)





Photo Credit: Catalina Pimiento



### **Taxonomic Diversity**

1432 specimens
5 orders
8 families
20 genera
38 taxa (21 extant)



Batoidii

## **Functional Diversity**



#### Cutting-Grasping (Carcharhinus)





#### Vestigial/Filter-Feeding (Mobula)



#### Crushing (*Rhinoptera*)

- Cutting
- Crushing
- Clutching
- Cutting-Grasping
- Grasping-Cutting
- Vestigial

Littoral



#### Dentition Types (as defined by Kent, 1994)

1 47

40.88

3.65

- 0.84 0.49 0.07 0.07 Littoral: Cancritrophic Littoral: Eurytrophic Littoral: Teuthitrophic Littoral: Sphyrnid 4.21
- Littoral: Archipelagic
- Aquilopelagic
- Macroceanic
- Macroceanic: Tachypelagic
- Microceanic
- Rhyncobathic
- Rajobenthic

Ecomorphotypes (as defined by Compagno, 1990)

19.57

5.61

# **Paleobathymetry – Ancient Depth**







	Bayano	Darien	Ga	tun	Alajuela
Formation	Chucunaque Formation	Chucunaque Formation	Gatun Formation	Chagres Formation	Alajuela Formation
	(Perez et al., In Review)	(Coates et al., 2004)	(Pimiento et al., 2013)	(Carrillo et al., 2015)	(MacFadden et al., In Prep)
Age	9.4 – 9.8 mya	5.6 – 9.4 mya	9 – 11.5 mya	8 – 6.5 mya	9 – 10 mya (9.7)
Paleogeography	Pacific	Pacific	Caribbean	Caribbean	Caribbean
Abundance	1432	N/A	800	500	42
Diversity	38 taxa (21 extant)	N/A	26 taxa (18 extant)	30 taxa (14 extant)	8 taxa (2 extant)
Depth (m)	Neritic	Bathyal	Neritic	100 (Rio Indio)	Marginal Marine – Neritic
	< 195 (avg. 100)	200 – 500	< 110 (avg. 55)	< 650 (avg. 370) (Piña Sandstone)	< 200 ?

## Chondrichthyan Paleobiogeography

	Caribbean	Pacific	Both
Chucunaque Fm (N=21)	3 (19%)	2 (10%)	16 (76%)
Gatun Fm (N=18)	4 (22%)	3 (17%)	11 (61%)





# How can we improve our understanding?

- Describe new late Miocene marine localities from the Neotropics
   Alajuela, Bayano, Darien, ...
- Characterize the late Miocene marine environments
  - Salinity, Temperature, Nutrients, Dissolved Oxygen, Isotopes
  - Improve ocean circulation models
- Continue to explore paleobiogeography (more fossils!)
  - Vertebrates, Invertebrates, and Plants
  - Macro, Micro, and Nano fossils







Amanda Waite

Photo Credit:

Jon Hendricks

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