A SEDIMENT ANALYSIS OF THE THREE DOG SITE (SS21), SAN SALVADOR ISLAND, COMMONWEALTH OF THE BAHAMAS

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Background

- Earliest known archaeological site within the Bahamian Archipelago.
- Dated between 660-865 AD
- Once inhabited by the Lucayans, or Lukki-Ciari
- Excavated 1984 - 1994
The Excavation Revealed the Following Site Structure:
Methods

- From 104 1x1m² excavation unit a sediment sample was taken from the overburden, cultural level, and “sterile” dune

- Samples taken from the wall
Sediment Samples were Bagged and Stored at the Gerace Research Center
Hypothesis

1. Can chemical anomalies within the cultural unit of the Three Dog Site be traced to anthropogenic activities?

2. Can these chemical anomalies be used to better characterize usage patterns within ancient Lucayan settlements?
Advantages of Using the Three Dog Site for this Study

• The site was excavated at an extremely high resolution
• The relatively pure calcium carbonate nature of Bahamian sediments reduces the number of ambient contaminants within them
Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)

Trace elemental concentrations examined:

-Mg, Al, P, Ti, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, As, Rb, Sr, Zr, Cd, Sn, Ta, and Pb.

- Elements with the highest concentrations included:

  P, Sr, Fe, Al, and Ni
Data Were Discriminated Using ANOVA Tests
Phosphorous Concentrations were Highest in the Midden

P Concentrations of SS21

P value = 0.355
P Concentrations displayed Stratigraphically
P Concentrations of SS21

P value = 0.355

Activity 2
Low Density
Midden

Phosphorus (ppb)
P Concentrations of SS21

Spherical
range = 5.59

Gaussian
range = 2.95

Legend
Elemental Phosphorous Value
High: 266171
Low: 178460

Spherical
Low Density Area
Activity Area 1
Activity Area 2
Midden
Increased Quantities of Phosphorous Have Been Associated Human Activities

- Activities including food consumption, food preparation, and fecal material

- Phosphorous occurred at the highest levels in the midden area and activity (food preparation) area

- Waste was being deposited in the Midden area
Strontium Concentrations were Highest in the Midden and Activity Area

Sr88 Concentrations of SS21

P Value = 0.000
Sr concentrations displayed stratigraphically.
Sr88 Concentrations of SS21

Area

P Value = 0.000

Spherical range = 12.88
Gaussian range = 6.16

Elemental Sr
Value
High: 7.04322e+006
Low: 5.138e+006
The Sr enrichment of midden sediments may have been due to the presence of shell material.

- Upon excavation the Midden contained the highest density of shell material.
- Little to no shell material was found in the house structure.
Iron Concentrations were Highest in the Midden Area

Fe57 Concentrations of SS21

P Value = 0.012
Fe Concentrations Displayed Stratigraphically

Stratigraphic Concentrations of Fe57 in Midden Area

Stratigraphic Concentrations of Fe57 in Activity 1

Stratigraphic Concentrations of Fe57 in Low Density Area

Stratigraphic Concentrations of Fe57 in Activity 2
Fe57 Concentrations of SS21

P Value = 0.012

Spherical
range = 8.23

Gaussian
range = 3.95

Elemental Fe
High : 053280
Low : 714937

0 1.25 2.5 6 7.5 10 Meters
Aluminum Concentrations were Highest in the House Structure

P Value = 0.051
Al Concentrations displayed Stratigraphically

Stratigraphic Concentrations of Al27 in Midden Area

Stratigraphic Concentrations of Al27 in Activity 1

Stratigraphic Concentrations of Al27 in Low Density Area

Stratigraphic Concentrations of Al27 in Activity 2
Spherical Gaussian

P Value = 0.051

range = 10.95

range = 18.35
Ni Concentrations were Highest in the House Structure

P Value = 0.038
Ni Concentrations Displayed Stratigraphically

Stratigraphic Concentrations of Ni60 in Midden Area

Stratigraphic Concentrations of Ni60 in Activity 1

Stratigraphic Concentrations of Ni60 in Low Density Area

Stratigraphic Concentrations of Ni60 in Activity 2
Ni60 Concentrations of SS21

Activity 2 Low Density Activity 1 Midden

P Value = 0.038

Spherical
A = 8.35

Gaussian
A = 4.32

Elemental Ni
Value
High : 12218.1
Low : 7706.9

Semivariance

Separation Distance (h)

Area

0 5 10 Meters
Al, Fe, and Ni Concentrations Could be Related to Lucayan Pottery

- Clays found in the Bahamas, tend to contain an average of 31.2 Wt% Al$_2$O$_3$, and 13.0 Wt% Fe$_2$O$_3$
- The highest levels of Al were located within the house structure
- Fe concentrations did not parallel Al
- The highest mean elemental concentration of Fe was in the midden
- Bahamian pottery contained less Ni than pottery from the Dominican Republic, Haiti, and Cuba
  - 30% of all found pottery traceable to east central Cuba, which may account for the presence of Ni at SS21
Major Conclusions

- Phosphorous concentrations were highest in the midden and food preparation areas; such trends are most likely indicative of usage patterns within the site.
- Phosphorous concentrations were stratigraphically highest in the cultural unit.
- The midden area was enriched in Strontium, possibly from the presence of shell material.
- Nickel concentrations were highest within the cultural unit; this signature may be related to Lucayan Pottery.
- Nickel concentrations were relatively constant across SS21.
- Aluminum concentrations were lowest in Activity Area 2.
- Iron concentrations were highest within the house structure.
Significance

• This study further proves that chemical anomalies can be tied to anthropogenic signals within an archeological site.
• Given this site was excavated at such a high resolution, these data may serve as a control for future chemical analysis.
• To survey archeological sites prior to excavation.
• To better understand settlement patterns.
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Questions
Works Cited


• Wells, C. E., Terry, R.E., Parnell, J.J., Hardin, P.J., Jackson, M.W., Houston, S.D., Chemical Analyses of Ancient Anthrosols in Residential Areas at Piedras Negras, Guatemala, Journal of Archeological Science; 27, p449-462

• Winters, John., Mark Gilstrap, "Preliminary Results of Ceramic Analysis and the Movements of Populations into the Bahamas." Proceedings of the 12th Congress of International association For
**SPHERICAL**

\[ \gamma(h) = c_0 + c \left( \frac{3h}{2\alpha} - \frac{1}{2} \left( \frac{h}{\alpha} \right)^3 \right) \quad 0 < h \leq \alpha \]

\[ \gamma(h) = c_0 + c \quad h > \alpha \]

\[ \gamma(0) = 0 \]

**GAUSSIAN**

\[ \gamma(h) = c_0 + c \left( 1 - \exp \left( -\frac{h^2}{r^2} \right) \right) \quad h > 0 \]

\[ \gamma(0) = 0 \]