Preliminary Evidence For Presence of Varnished Rocks on Eastern Long Island

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Background

- Rock varnish is characterised by thin (5–500 μm) and shiny coatings of iron and manganese oxides (Esposito, 2019).
- Long Island was formed by glaciers around 22,000 years ago (Long Island Sound Resource Center, 2011).
- Since varnish is sedimentary, it is possible for the varnish to contain a microstratigraphy that records climate change (Liu, 2013).
- What is believed to be rock varnish found in the Dead Sea basin has a high concentration of manganese towards the outer edge of the rock, and is suspected to be formed from the Younger Dryas cooling (Liu, 2013).
- Varnish can be created from a multitude of different substances but must contain Fe and Mn. These can be referred to as “skins” or “glazes.” (Watchman, 2000).
- Varnishes can be a combination of different environmental factors, mixing in with erosion and deposition (Watchman, 2000).
- Rock varnish can occur in all environments, but mostly common in arid and semi-arid climates (Nagy, 1991).
- Inside some rock varnishes, free and hydrolyzed peptide/protein-bound amino acids were found (Nagy, 1991).
- Research Question: Can we establish that there are varnished rocks on Eastern Long Island?
- Hypothesis: If the rock has an outer layer consisting of mostly manganese and iron, then it has a varnish layer.

Methods

Sample Collection

Sample Preparation

Beamline Specifications

Data Processing

Data Analysis

- The most significant peaks of the d-spacing vs intensity graphs were determined.
- A diffraction search to determine quantities of specific minerals took place using the American Mineralogist Database.
- If the minerals found are consistent with typical rock varnish, presence of rock varnish will be supported.

Figure 3: XFM Elemental map of Rock A: Green shows the Mn around outer edge of varnish, red shows Fe under the Mn, and blue shows Ca spread throughout the rock.

Discussion

- Minerals containing high levels of manganese and iron are present in all of our samples (Figures 4-7), as is expected of rock varnish. This data agrees with data generated by previous XFM (Figure 3) and SRX analysis of the rocks.
- Varnish most likely formed during the Younger Dryas Cooling event that occurred around the same time that the Harbor Hill moraine was being formed.
- This combined with microlaminations can help determine the duration and extent of Cooling Events on the island. These varnished rocks can serve as a marker bed for the event.
- Applying the new field of geochronology, the varnish can provide insight into interactions between early migrating Clovis populations and their environment.
- To complete this study, we have successfully submitted a proposal to use the HRTEM at the Center for Functional Nanomaterials (CFN) where varnish micromorphologies (VMM’s) might reveal features related to specific climatic changes such as the Younger Dryas cooling event. We will perform these experiments from May to June 2021.

XPD Data for all six sample rocks was analyzed using Dioptas with all samples having similar mineral profiles; four graphs are shown below.

Figure 1: Rocks were collected from eroding beach cliffs near Wildwood State Park, NY.

Figure 2: Samples before being placed in the XPD beamline.

Figure 4: Comparison of intensity and d-spacing for Rock D. Top match was Pseudolaurite (Very high in Fe and Mn).

Figure 5: Comparison of intensity and d-spacing of Rock F. Top match was Braunite (Very high in Fe and Mn).

Figure 6: Comparison of intensity and d-spacing values for Rock E. Top match was Brauniite (Very high in Fe and Mn).

Figure 7: Comparison of intensity and d-spacing values for Rock A. Top match was Lauleite (Very high in Fe and Mn).

References


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