4-5-2019

GEOMORPHOLOGY OF MATTHIESSEN AND STARVED ROCK STATE PARKS

Kristen Ohls
Illinois State University, krohls@ilstu.edu

Geomorphology of Matthiessen and Starved Rock State Parks

Kristen Ohls, Dr. Lisa Tranel, Department of Geology

Abstract

Starved Rock and Matthiessen State Parks in La Salle County, Illinois contain interesting canyons. They were created when glaciers retreated after the last glaciation period, causing stream channels that eventually eroded away most of the sandstone to create the canyons we know and see today. The sandstone member that makes up most of the state parks is known as the St. Peter sandstone, which is weakly cemented and friable. Landslides happen periodically, sometimes after freeze-thaw events. The stability and steepness of the canyon walls may be created by case-hardening of the rock surfaces due to filling bedrock pore spaces with iron or calcite. The strengthened rock surfaces could also be due to lichen and algae growth, known as lithobionts, on the surface. Overall this sandstone is weakly cemented with a silica cement, so it typically does not react with HCl, but reactions observed in isolated locations in a few canyons indicate some calcite accumulation in the rock or on the surface. I hypothesize that this may be due to case hardening or lithobiont occurrences.

My research study will investigate surface features on the bedrock and their influence on the geomorphology of the watersheds in Matthiessen and Starved Rock State Parks. My goal is to study why there is variability of bedrock surface characteristics across the canyons within the same sandstone formation. I hypothesize that the reactions to HCl on the rock surface are caused either due to surface runoff or case hardening. I will test my hypothesis by testing areas every 5-10 feet at eye level, roughly 5 feet above the ground surface, and mapping which areas reacted to HCl and what biologic or water flow processes could cause the reaction. I will note proximities to streams and the top of the rim of the canyon to see if water containing calcite or iron drained down the canyon walls. Observations are likely to indicate different levels of erosion and stability along the canyon walls.

Introduction

Frederick William Matthiessen first owned the land that is now Matthiessen State Park. The estate was his home and private property used to host friends and family. After his death, the family donated the land to the state, after which, it became a state park. On the main trail, there are several key places to stop and explore the history of the geology. In the 1890's, the land that became Starved Rock State Park was purchased by a man named Dan Hitt who later developed the land for vacationers. In 1911, the state of Illinois purchased the land back from Mr. Hitt and made it the state's first recreational park.

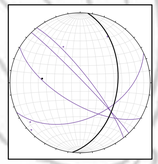
Starved Rock and Matthiessen State Parks were both made by glaciers retreating. These glaciers left behind canyons, carved mostly out of the St. Peter Sandstone formation, some of the Platteville-Galena Group, and part of the Pennsylvanian aged Carbondale formation. These canyons contain some glacial erratics and the gentle topography upstream and away from the Illinois River is covered with glacial till These canyons have been used by students and professors alike to do research on the erosion of material over time, how lichen grows on canyon walls, and what kind of till glaciers carry, and how far the sediment is carried. One example is "The analysis of short term erosion of the St. Peter sandstone" (Rutte, M. 2018) which looked at how fast the walls of the canyons were being eroded away by looking at carvings that have been done by guests in the park. Another study investigated how quickly the streams erode rock and transport sediments through the canyons (Tranel et. Al, 2018).

Objective

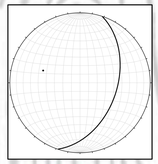
The objective of this independent study was to explore possible hypotheses as to why there were reactions in certain areas of Starved Rock and Matthiessen State Parks but not in others in the same sandstone formation. My hypotheses were that the reactions in certain areas of the canyons could be caused by mineral accumulation, surface runoff, or case hardening, or biologic agents. If reactions only occurred in parts of the canyon, I hypothesized that water flowing through bedrock or glacial till allowed precipitation of minerals on the bedrock surfaces below.

Methods

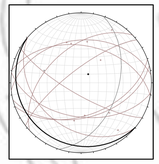
To test different areas of the state parks, 5 canyons were chosen that were accessible by trail to hikers: Illinois, Kaskaskia, Ottawa, Matthiessen, and St. Louis. HCl was used on the surface of the canyons in intervals, and on surfaces with varying dips and orientations We created 7 classifications to describe the surface, including: lichen coverage, moss, mineral accumulation, erosion, human intervention, biofilms, and fresh surfaces. The strike and dip were taken at each stop, to see if the aspect of the wall affected growth or accumulation on the surface. To collect all the data points, an app called "Clino FieldMove" was used. In the app, we made each surface type a "layer", and recorded the strike, dip, and surface type in the comments. The app collected location information and allowed us to export data as a GoogleEarth (.kmz) map or as a table. The direction the canyon wall was facing was also recorded and visualized in stereonets to see if there were any similarities in where there were reactions.



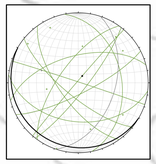
Fresh Surface- Three of the surfaces were oriented NW, but one was NE.



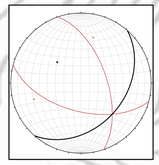
Erosion- The one surface recorded indicated that most erosional surfaces were covered by lichen or biofilms.



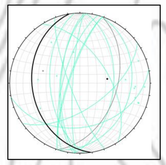
Biofilm- surfaces were oriented East-West where there was some sort of biofilm observable



Moss- Moss had no orientation preference, and grew over multiple surfaces, but needed some moisture

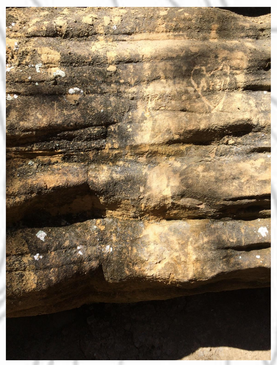


Human Intervention- Human intervention did not have a preferred orientation, as people carve all over every canyon.



Lichen- Surfaces covered by lichen were oriented North-South, which can be interpreted as lichen preferring to be where there is accessible sunlight.

Mineral Accumulation- There was no orientation preference, but Mineral Accumulation was one of the most prominent surfaces observed, and the most prominent surface that had reactions in Matthiessen Canyon



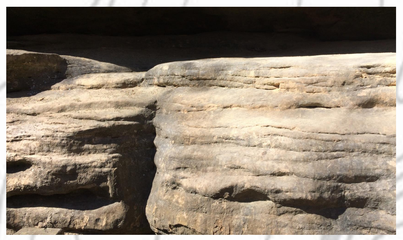


Figure 1- Iron Streaks

Results

Out of the five canyons that were tested, only two had reactions, and one of the two had reactions only in one area. When looking at the entire area, it may be unclear as to why only two canyons reacted when the other three did not. When looking more closely at the two canyons that did react, it was noticed that they had a grey tint to the surface, and most of the areas that were tested were under overhangs, indicating that the cement of the St. Peter Sandstone could be calcite. Unfortunately, the dips and strikes were not an indicator of where there should be reactions as they were all over the place. In Matthiessen canyon, under closer observations, iron streaks were noticed running down the walls within the first few stops (Figure 1)

Discussion

Five canyons in Starved Rock and Matthiessen State Parks were chosen to be studied in this project: Illinois, Kaskaskia, Ottawa, Matthiessen, and St. Louis. Out of these five canyons, the only one with reactions throughout the canyon was La Salle Canyon in Matthiessen. After doing a thorough study of the area and recording observations, our interpretation is that because the Matthiessen canyon is on the Split Rock Monocline, this could be causing fractures in the rock. As the rock formations folded to create the monocline, it is hypothesized that the formation in this area was fractured more than in other areas of the park. This would allow glacial outwash full of reactive minerals and sediment to fill these fractures, eventually leaving behind the minerals such as calcite and dolomite.

If these fractures filled with eroded materials from the Platteville- Galena group, the Equality formation, or the Carbondale formation, it would explain why we had reactions in certain areas but not others, as only the Matthiessen canyon is affected by the monocline and these formations were rich in calcite and dolomite. Because of the vigorous reactions, it was interpreted that the minerals were most likely calcite, as dolomite requires scratching to get a mild reaction with HCl.

Questions to Further Study:

- Why did we only get one reaction in Illinois Canyon?
- To what extent is the St. Peter Sandstone fractured?
- Will thin sections of the sandstone reveal what minerals are in the cement of the sandstone?

References

Conca, J., Rossman, G., 1982, Case hardening of sandstone, Geology, V10., p 5230-523, October

Kurtz, H. D., Netoff, D., 2001, Stabilization of friable sandstone surfaces in a desiccating, wind-abraded environment of south-central Utah by rock surface microorganisms, Journal of Arid Environments, V. 48, 89-100

Li, S., Huo, R., Wang, B., Ren, Z., Ding, Y., Qian, M., Qiu, T., 2018, Experimental Study on Physicomechanical Properties of Sandstone under Acidic Environment, Hindawi Advances in Civil Engineering Volume 2018, Article ID 5784831, 15 pages