Rocks on Acid: Soil pH Levels Associated with Bedrock Type in Eastern California

THE UNIVERSITY *of* NORTH CAROLINA *at* CHAPEL HILL

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I. Motivation

Scientific literature has established that multiple factors affect soil pH including topography, parent material, and elevation.[1,2]

However, soil pH has largely been studied in relation to agriculture and the effect of powered rock on soil pH.[3] This study seeks to determine whether minerals present in four bedrock types from the White Mountains in eastern California will affect soil pH.

Hypotheses

1) pH is going to be controlled by $CaMg(CO_3)_2$ and SiO_2. Dolomite is $CaMg(CO_3)_2$ which acts as a base.[4] Basalt, granite, and sandstone have decreasing concentrations of SiO_2.[5,6,7] **It is hypothesized that pH will be highest in dolomite then decrease in basalt, granite, and sandstone.**

2) Organic material contributes to soil pH in the topsoil and varies in concentration. **It is hypothesized that pH values taken at a depth of 5cm will produce higher statistical variation than those taken at a depth of 15cm across all bedrock types.**

II. The White Mountain Range

The White Mountain Range is an up-faulted range east of Owens Valley composed of sedimentary rocks intruded by granites, as well as basalts.[8]

The geology of the White Mountain range makes it an ideal place to compare rock type and soil pH because the four bedrock types are in close geographical proximity to each other. The soil across all rock types has a similar moisture content and typically changes from gravelly loam to very gravelly loam at a depth of 10 cm.[9]

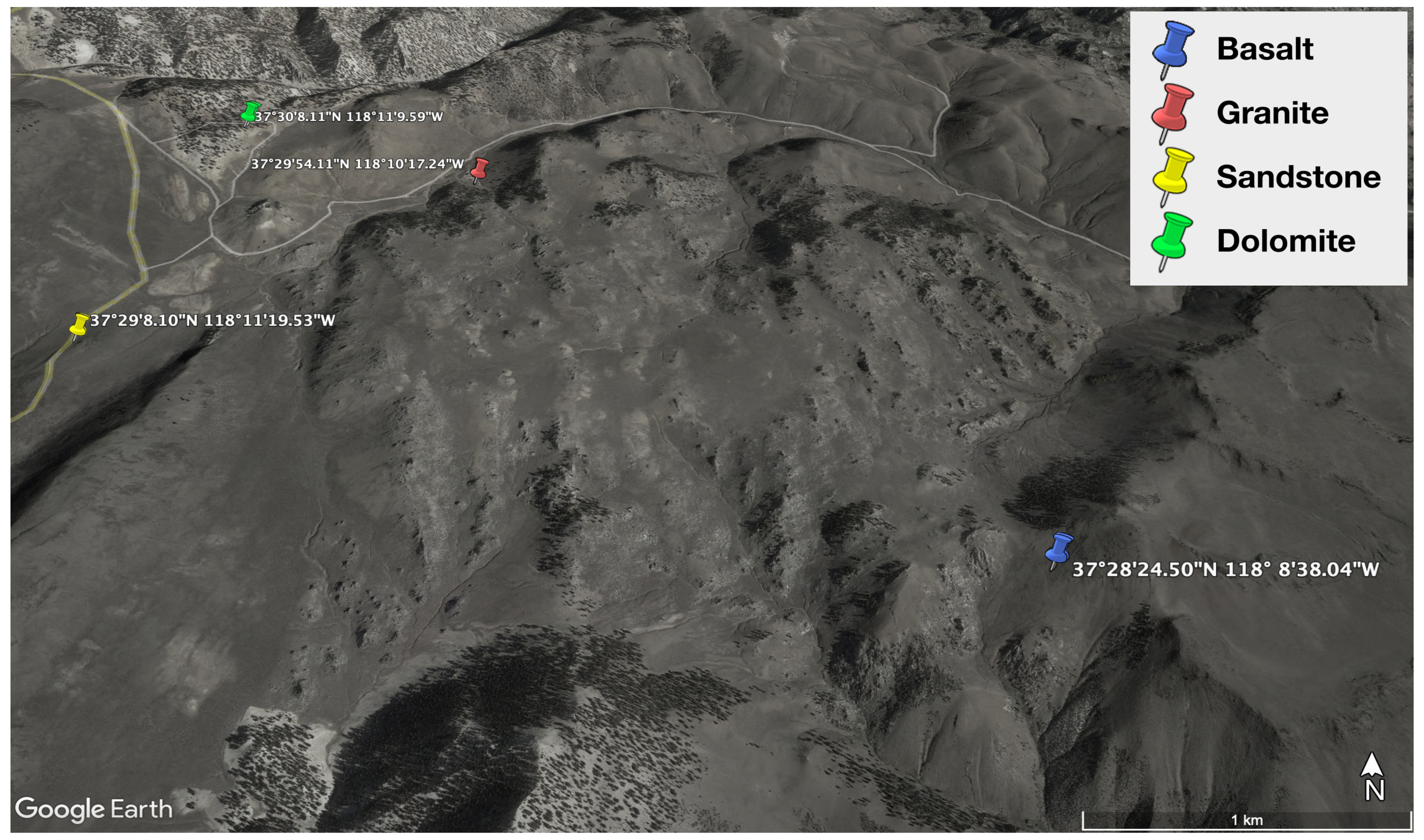

Figure 1: Map of test pits for each bedrock type. Samples were taken from the Campito Sandstone, Reed Dolomite, Buck's Peak Basalt, and Sage Hen Flat Pluton. Test pits were spaced 2-3 m apart at each site. The location of the pits was determined by quantity of soil present to achieve a pit depth of 15 cm. Soil samples were taken at a depth of 5 cm and 15 cm from each pit.

III. Methods

Site Selection & Soil Collection

Sample locations were selected based on bedrock type, proximity to each other, and ease of access. Three test pits were dug at each site 2-3 m apart in areas where the soil was accessible.

Figure 2: Test pits for granite bedrock marked by flags. Soil samples were taken at a depth of 5 cm and 15 cm from each pit. Samples were triple-bagged and labeled with location, sample number, and soil depth.

Sample Preparation & Testing

At Chapel Hill, samples were spread to dry and large stones and roots were removed.

Each sample was tested using semi-quantitative pH soil tests and a pH meter. The mean and standard deviation of the pH meter readings were analyzed.

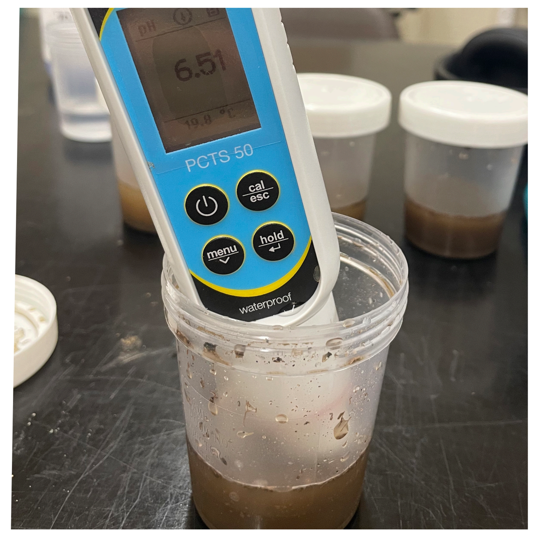

Figure 3: pH meter test conducted on soil sample. pH meter testing was performed on each of the 24 samples, with a ratio of 7 mL soil to 36.5 mL distilled water. The pH meter was calibrated using 4.01, 7.00, and 10.01 solutions, and rinsed with distilled water between each test.

IV.I Results

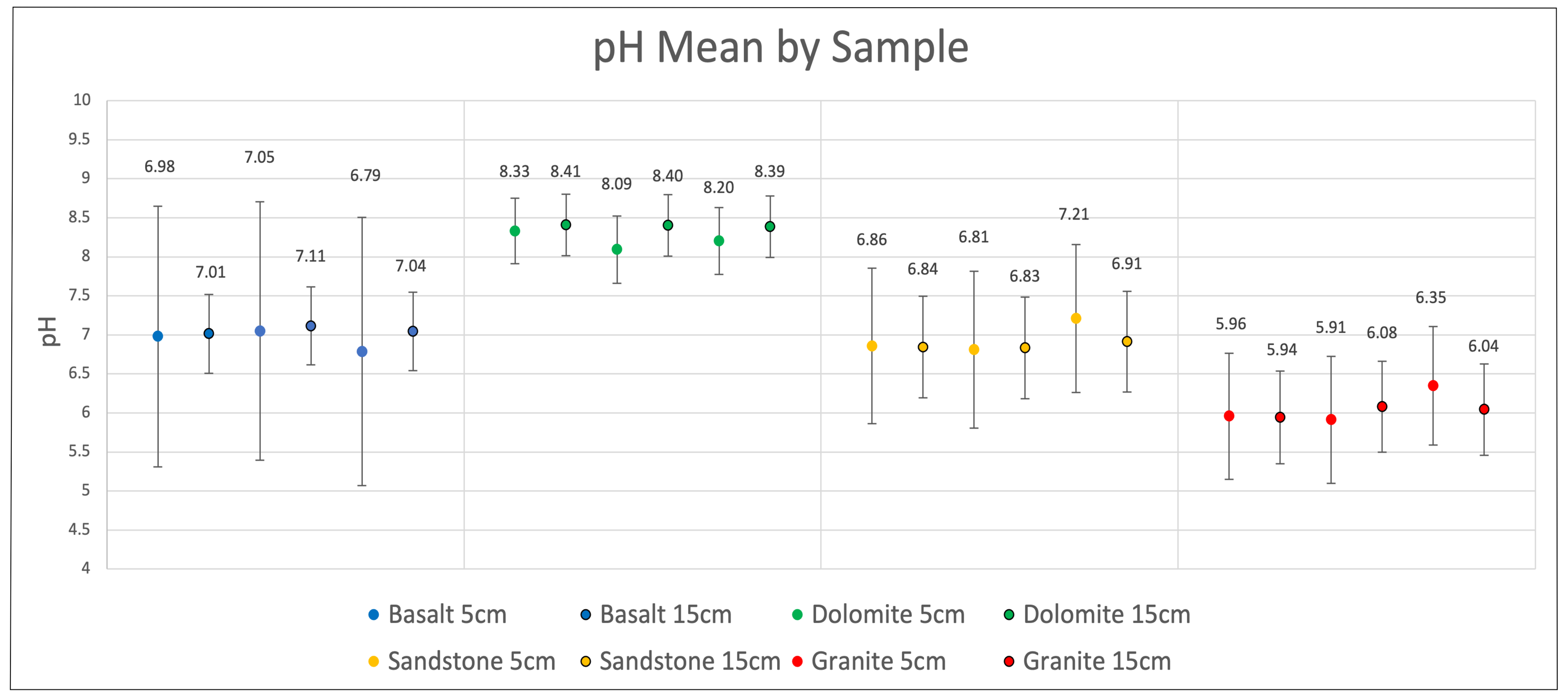

Figure 4: pH-meter data showing the average pH of each test pit. Three pH tests were run per sample, and ten pH tests were run for one 5 cm pit and one 15 cm pit randomly selected from each rock type. The standard deviation of the ten-test sample was used to calculate the coefficient of variation for each sample, which was used as the positive and negative error.

IV.II Results

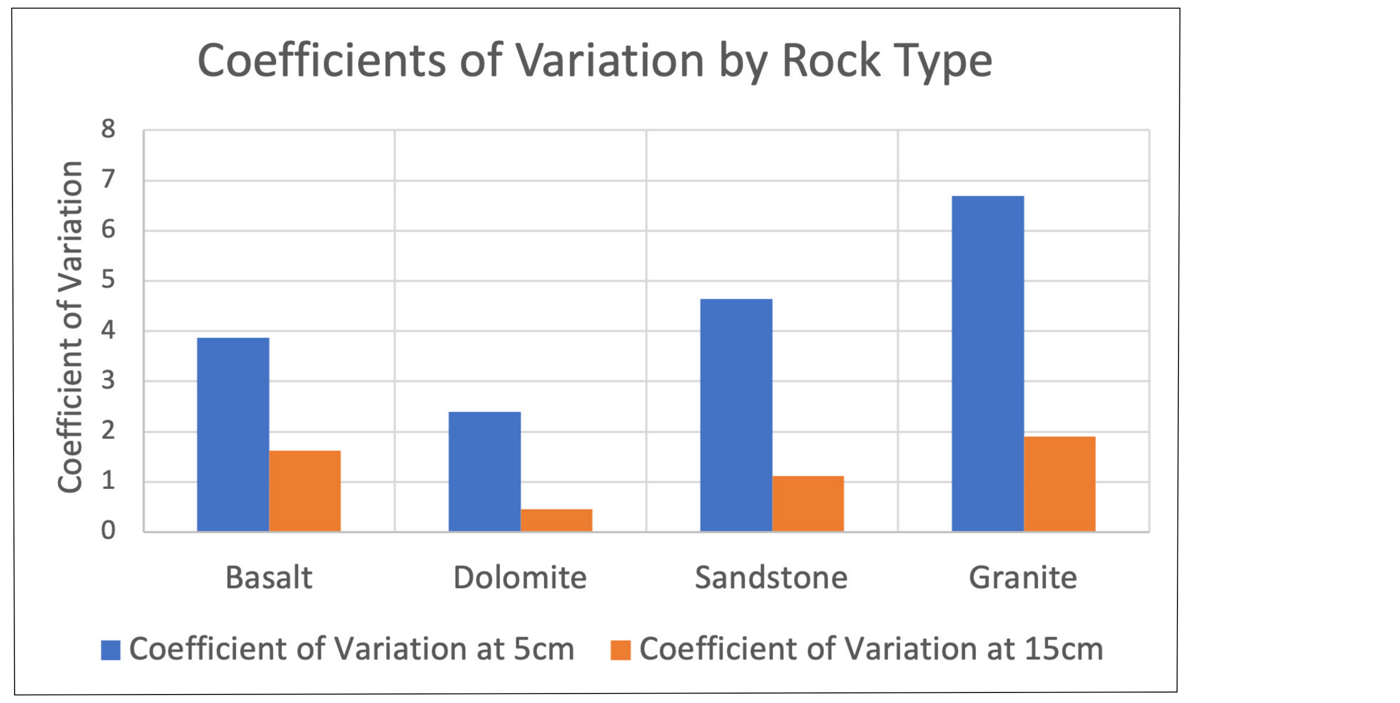

Figure 5: Coefficients of variation broken down by rock type and depth. The average of all pH readings at each depth per rock type was used to calculate the standard deviation and coefficient of variation.

V. Discussion and Conclusions

Results indicate the first hypothesis was partially correct. **Dolomite had the most statistically significant effect on soil pH and made the soil more basic**. All granitic soil samples were statistically more acidic than all dolomite soil samples. The effects of sandstone and basalt on soil pH compared to these other bedrock types are statistically indeterminate.

The second hypothesis was correct. **Samples taken at 15 cm showed less statistical variation across all bedrock types compared to samples taken at 5 cm**. This result is likely caused by the presence of organic material, dust, and ash at the 5 cm layer.

Limitations include a low number of test pits, possible contamination from the trowel and topsoil sliding into the pit, and human error in pH meter measurements. To minimize the errors caused by these limitations, future studies should include more test pits, clean the trowel before collecting each sample, and conduct more pH meter tests per soil sample.

Future Studies

Chemical analysis of samples taken at similar locations and depths to confirm the types of materials present in the 5 cm layer such as ash, dust, or organic material.

Work to explore whether SiO_2 in rocks affects soil pH by analysis of concentrations of SiO_2 in the soil.

Analysis of minerals present in other bedrock types and their effect on soil pH in other geographical locations.

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