



NPK of Rock Types in the White Mountains of Eastern California

Robert Berger, Chandler Deese, Jackson Miller, and Kailey Powell
Department of Earth, Marine and Environmental Sciences

Introduction and Background

We hypothesized that soil developed from the Buck's Peak Basalt (BPB) would have higher phosphorous (P) values, while the Sage Hen Flat Pluton (SHFP) and Campito Sandstone (CS) soil would have higher potassium (K) values. We expected nitrogen (N) to be independent of rock type.

Proper nitrogen, phosphorus, and potassium (NPK) levels in the soil are crucial for plant growth. We based our hypothesis on a general understanding of bulk rock composition. In prior research, we found that igneous rocks have higher K_2O and P_2O_5 concentrations (Singh et al., 2014). We also found that the Campito Sandstone formation contains K-feldspar (Douglas et al., 2018).

Methods

California

North Carolina

- Collected 24 samples: 4 rock types with 2 locations each; 3 samples from each location. Samples came from approximately 15 cm below the topsoil. Recorded observations, latitude, and longitude.

- Spread each soil sample onto separate pieces of paper. Left to dry for over 24 hours.
- Placed 8 mL of soil with 40 mL of distilled water in a 50 mL tube. Shook thoroughly then centrifuged at 60,000 rpm for 15 minutes.
- Poured off centrifuged solution into labeled cups using a strainer. Performed for each sample twice.
- Poured 20 mL solution into *Luster Leaf 1601 Rapitest Test Kit*. Added corresponding powder to the test kit and shook until the powder was thoroughly mixed. Allowed to sit for 10 minutes before evaluating NPK level.

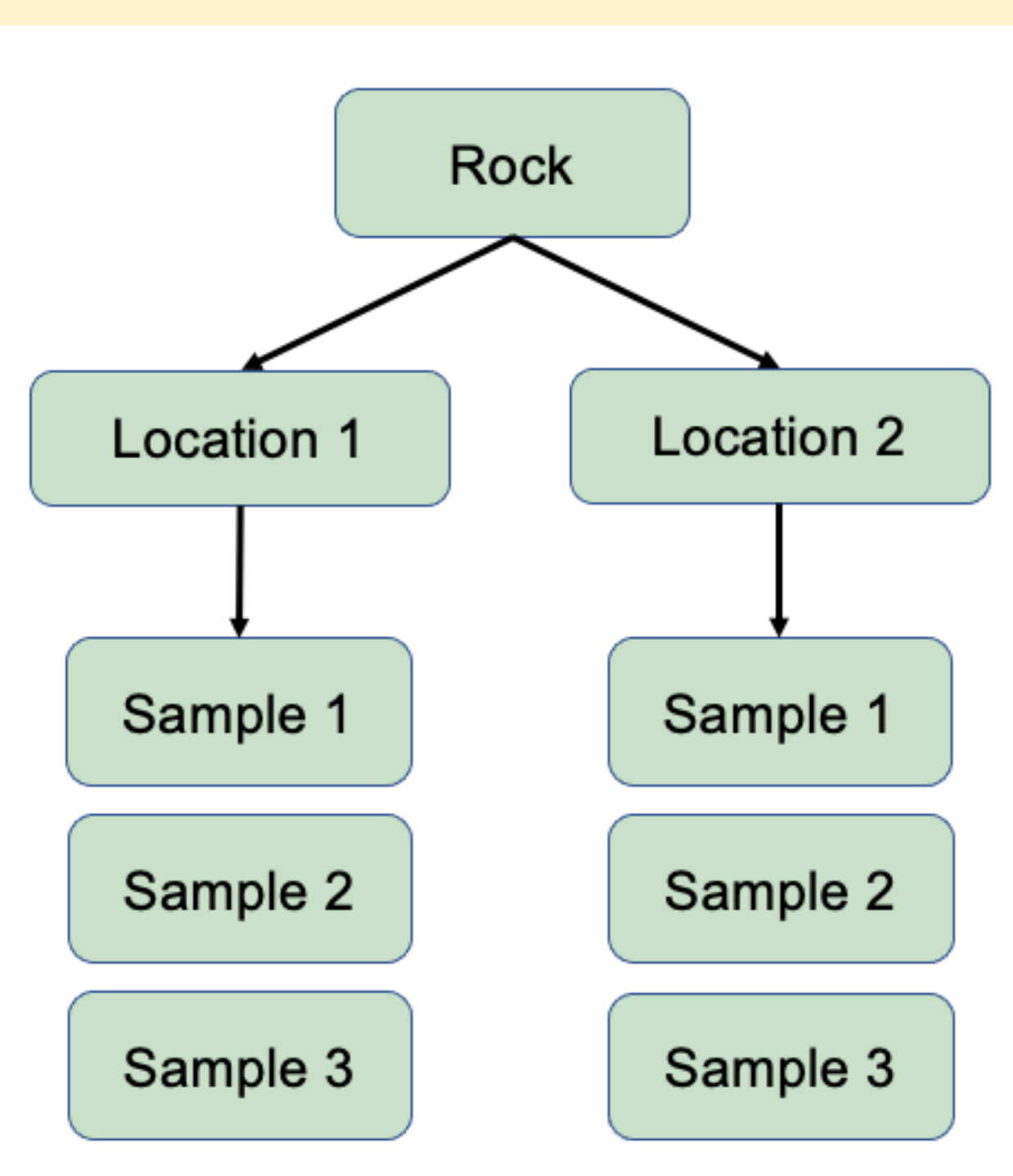


Figure 1: Taking soil samples from Eastern California



Figure 2: Kailey and Robert digging 15 cm hole in SHFP

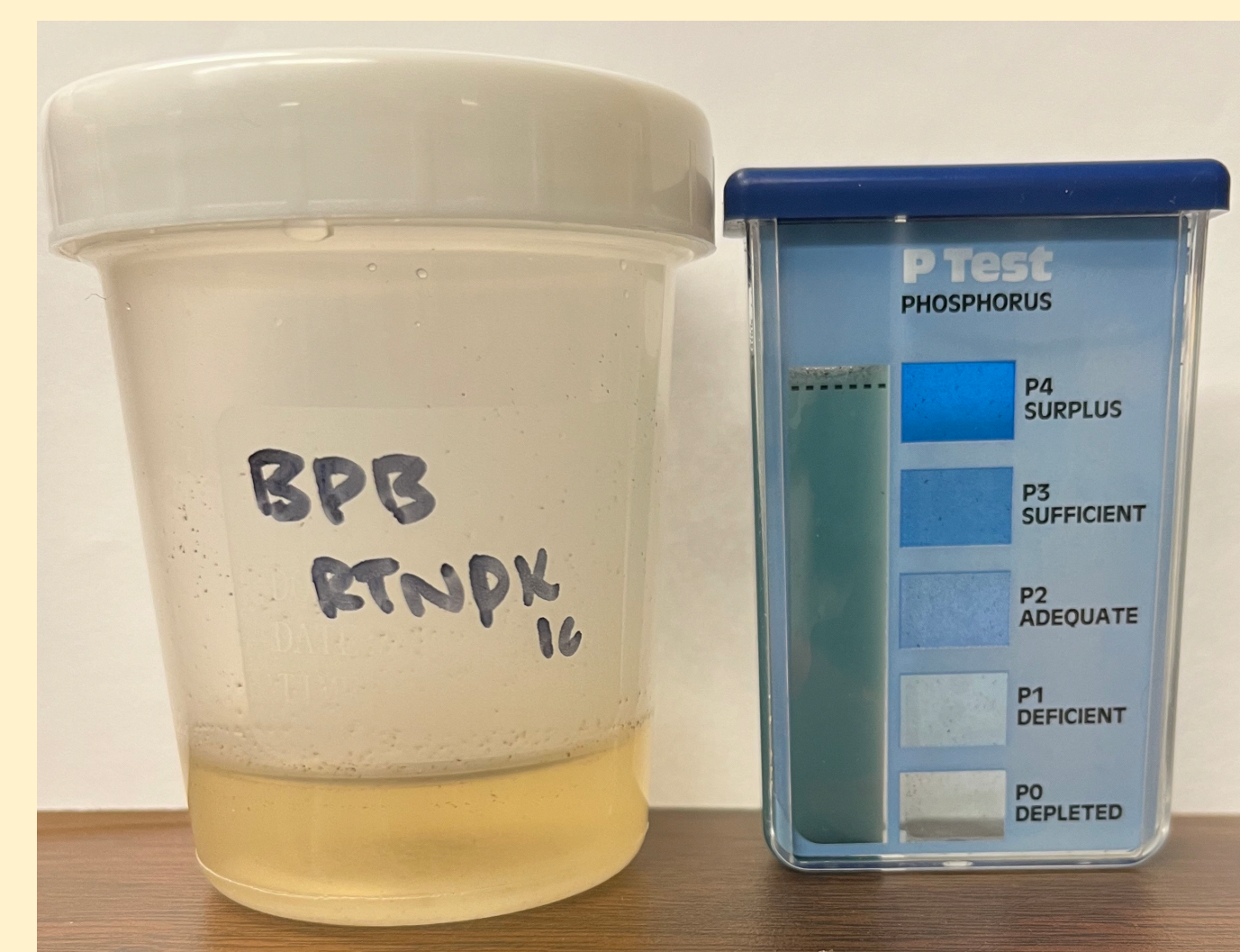


Figure 3: P Test and sample water for BPB-1c

Results

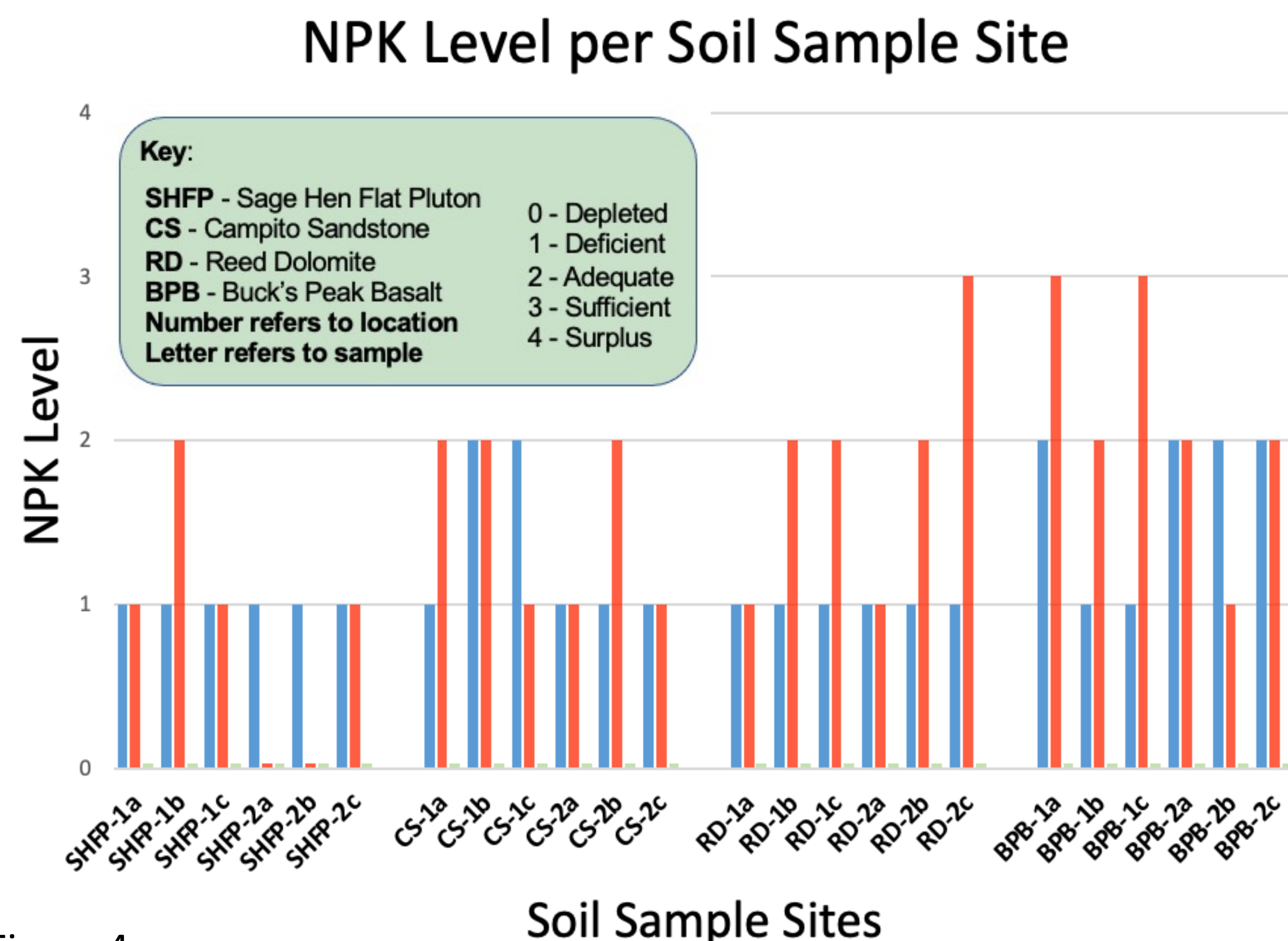


Figure 4

Only three of the twenty-four soil samples resulted in a value deemed "sufficient" for plant growth. The potassium and phosphorus values for the majority of the samples fell in the "deficient" category. Regardless, the soil samples from the BPB yielded the most promising results with five of the six samples having phosphorous levels of "adequate" or "sufficient," and four of the six having potassium levels of "adequate."

Sample Sites

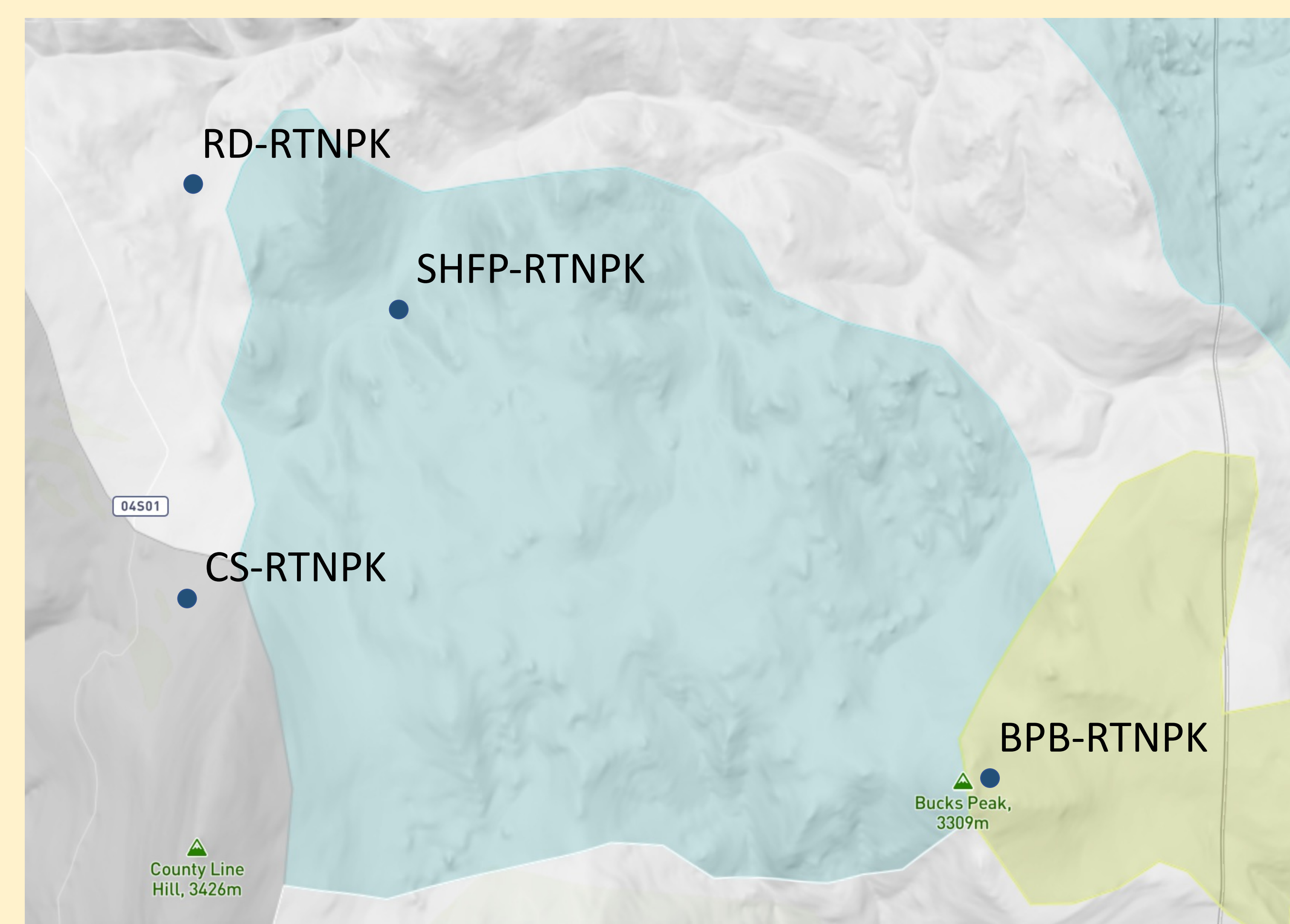


Figure 5:

This is a map of the four locations of different rocks that samples were taken from. Color Key: white is RD (Precambrian sedimentary), blue is SHFP (Mesozoic granite), gray is CS (Cambrian marine), and green is BPB (tertiary volcanic).

Discussion

The higher P and K levels in the basalt are best explained by bulk rock composition, but the higher P and K levels of the RD are surprising. The RD results are surprising as dolomites are calcium magnesium carbonate. The CS contains moderate levels of potassium-feldspar, thus the results of "adequate" K are reasonable. The presence of P and K in the CS and RD may be ash from the Bishop Tuff eruption (Drew Coleman, personal communication, November 30, 2022). It must also be noted that the samples from the SHFP location were close to the Crooked Creek Research Station and the other three locations were not surrounded by settlements.

The plant life surrounding the soil samples at three of the sites was similar with minimal large plant growth and many shrubs. RD sample sites were an outlier. The samples were taken surrounded by dense Western White Pines. Although it would seem that P and K levels would be most suitable for plant growth in the RD soil, our results indicate that basalt soils contain the highest P and K values and are the most suited for plant growth.

Conclusion

BPB soil had the highest P and K values

SHFP soil had the lowest P and K values

There are trace amounts of N in all soil samples

NPK levels in our soil samples are not ideal for plant growth

Future Directions

- Use quantitative analysis on existing and future samples
- Compare NPK levels at different soil depths
- Sample multiple locations across a single rock formation
- Test NPK of soil at different elevations of a single rock formation
- Compare NPK levels of our samples with Bishop Tuff ash

Acknowledgements and References

The First Year Seminar Program, The James M. Johnston Center for Undergraduate Excellence and the Honors Program, The Office of Undergraduate Research Graduate Research Consultant Program, and the Department of Earth, Marine, and Environmental Sciences, Dr. Michael Sandstrom, Ami Ward, and Dylan Morrison.

Singh, B., Cattle, S. R., & Field, D. J. (2014). Edaphic soil science, introduction to. *Encyclopedia of Agriculture and Food Systems*, 35–58. <https://doi.org/10.1016/b978-0-444-52512-3.00092-9>
Douglas, Q. S., Kent, C. R., Lien, M. C., Rivers, S. R., Robinson, E. A., & Su, C. X. (2018). An Illmenite, Biotite, and Magnetite Study of the Anomalous Dark Coloration of the Andrews Mountain Sandstone. *Geology* 072H, 4, 12–15.