Exploration for Critical Mineral Resources in the Zuni Mountains, NM

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Abstract

Exploration geochemistry is important for locating critical minerals resources that are crucial to meeting the demand placed by a variety of industries, and stream sediment sampling is often the first step towards achieving this goal. This exploration technique has been shown to be a reliable way of locating deposits in the early stages of exploration over large areas. In the past, the Zuni Mountains have been mined for their deposits of copper, fluorite, and barite, though obsidian, turquoise, azurite, malachite, and copper have been (and continue to be) mined by the Zuni people and later prospectors. The Zuni Mountains are a small mountain range located in Northwest New Mexico, near Grants. These mountains were formed during the Laramide orogeny and lie along the Jemez Lineament. While much of the lithology of the Zuni Mountains is sedimentary, there are units of Precambrian basement rock, some of which have been metamorphosed. With the demand for critical minerals increasing, the NMBGMR has been contracted by the USGS to evaluate the critical minerals potential of the Zuni Mountains through stream sediment sampling and chip sampling. From the data that were received from USGS (all stream sediment and chip sample data from the August 2023 field trips), there are some key differences between the initial NURE (National Uranium Resource Evaluation) data and the Zuni Mountains project data.

Though the Zuni Mountains project is mainly focused on sampling new locations and evaluating the critical minerals potential of the district, there are some key details that are different between the original NURE data taken in 1970s and the newly generated data. The first key difference between the two projects is the mesh size of stream sediment samples. The original NURE sampling project used a 150-micron mesh, while this project used a 2 mm mesh to sample stream sediments. This creates differences in the data due to the properties of different critical minerals. For example, the original NURE data had higher concentrations of vanadium when compared to Fe_2O_3 than the new data collected in late 2023. This is due to vanadium having the tendency to be absorbed into clay structures or iron oxide coatings, and the original NURE sampling procedures collected clay-sized stream sediments. Another key difference is what elements the two projects analyzed. The original NURE program did not analyze for elements such as Cd, Cs, Rb, Sb, and Y, all current critical minerals. This is possibly due to what the laboratory could analyze for at that time. Given the two key differences, the current data can now be evaluated based on what wasn't evaluated in the previous NURE data. New geochemical data may help gain a better understanding of critical minerals behavior in coarser size fractions. When looking at the current data from the Zuni Mountains district on a chondrite normalized graph (McDonough and Sun, 1995), both show an enrichment in REEs, and the datasets correlate similarly even though some REEs weren't analyzed for in the NURE data. Anomalies of TREEs are above 150 ppm and are found within the granitic gneisses, the Paleoproterozoic rhyolite and felsic volcanic units, along faults in the southeast portion of the district, and few along the shear zone. Anomalies of Cu (>22 ppm) were found along the shear zone and in the granitic gneisses and red sandstones. Sb anomalies (>3.8 ppm) were found mainly along a fault in the northwest part of the district and only two were located in the granitic gneiss unit. Ba (>850 ppm) anomalies were found along faults, the shear zone, granitic gneisses, and the Paleoproterozoic rhyolite and felsic volcanic units. Zn anomalies (>16 ppm) were found in the Paleoproterozoic rhyolite and felsic volcanic units, granitic gneisses, along the shear zone, with some found along the faults in the southeast area of the district.

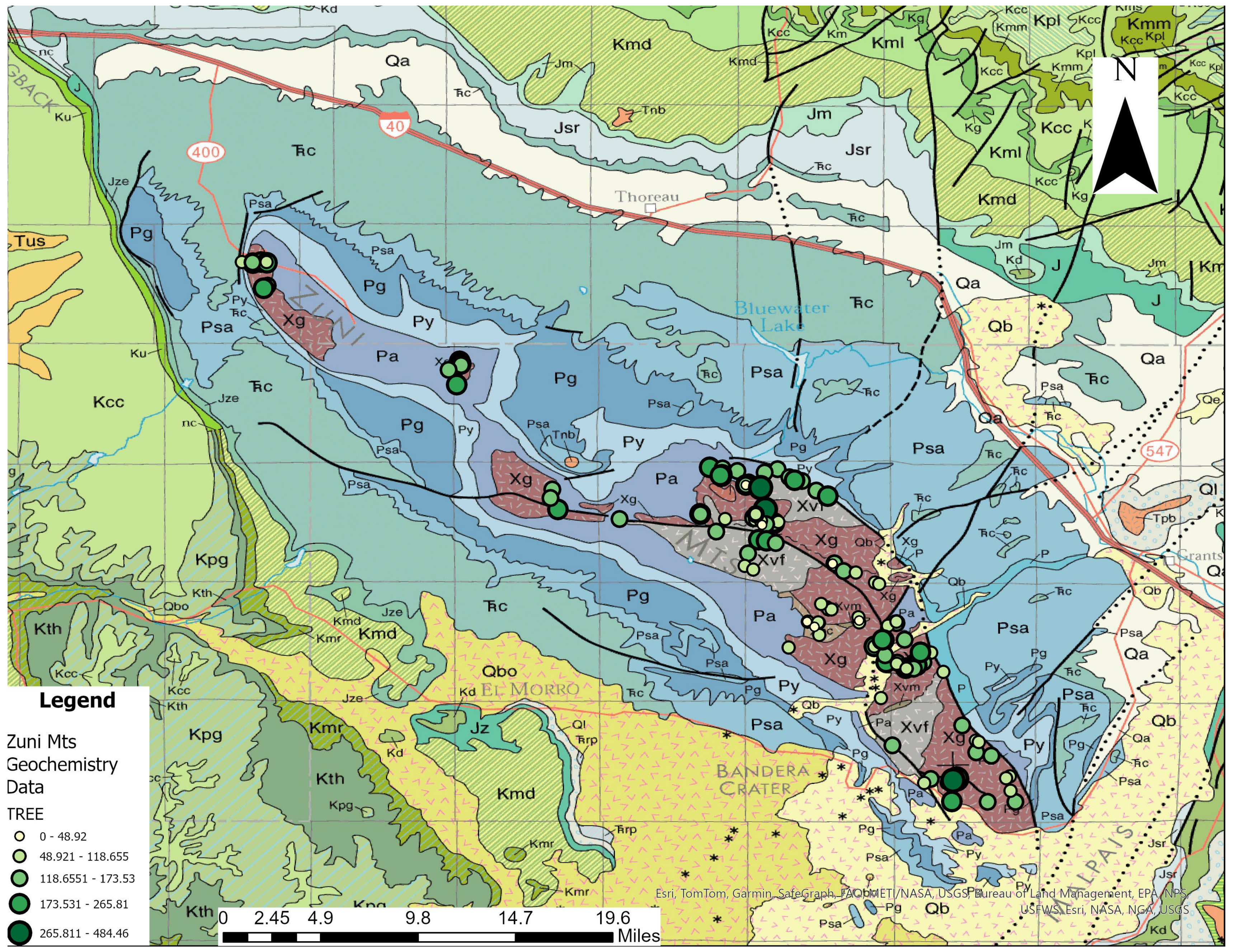

Fig. 1: A map of some of Total REEs in the Zuni Mountains. 2003 Geologic map of New Mexico from NMBGMR.

Results

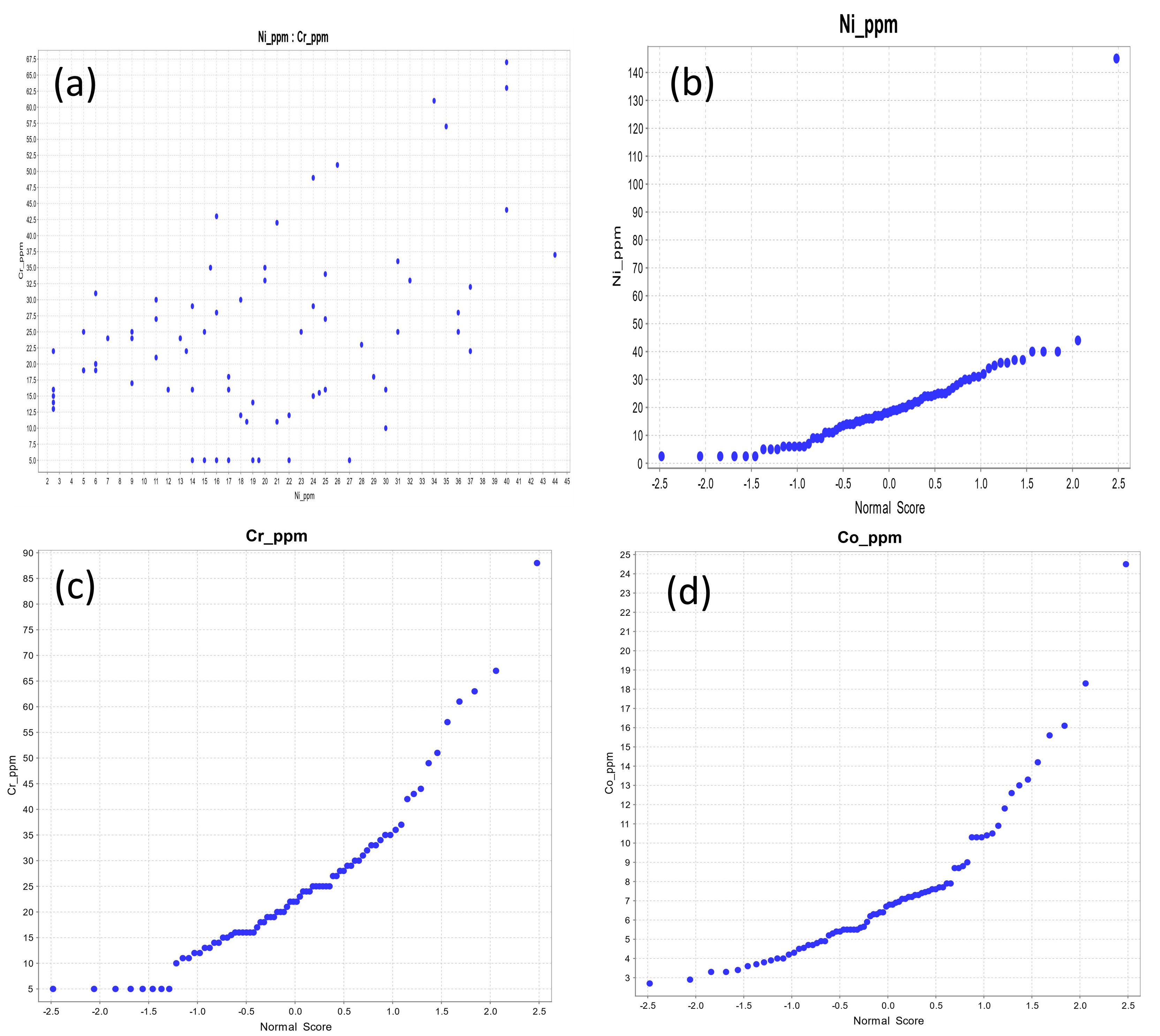

Fig. 2: Figure 2a is a comparison plot of Ni vs. Cr, figure 2b is a probability plot for Ni, figure 2c is a probability plot for Cr, and figure 2d is a probability plot for Co.

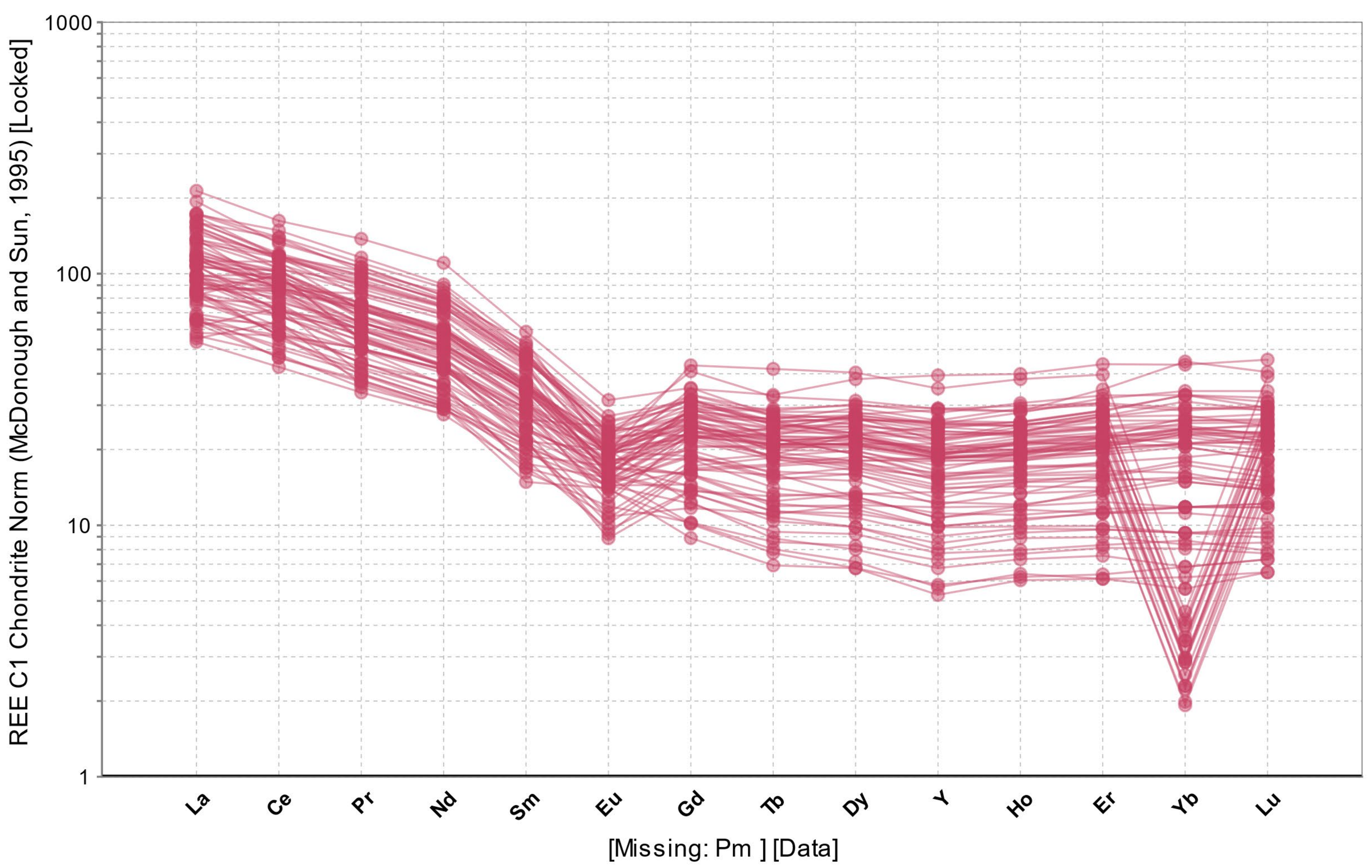

Fig. 3: A REE Chondrite Normalized Graph (McDonough and Sun, 1995)

Samples and Methods

- ~71 stream sediment samples were collected.
- 2mm or less particulates were put in a bucket and divvied up into three bags for each sampling location; one bag for analysis by the USGS, and two bags were collected for archive.
- ioGAS was used to evaluate the data for anomalies.
- ArcGIS pro was used to see where these anomalies lie.

Discussion

- Anomalies of Ba, Cu, Zn, Sb, and REEs are present in the district.
- Significant anomalies of Ni, Cr, and Co have been found in the district, indicating deposits of Platinum Group Metals.

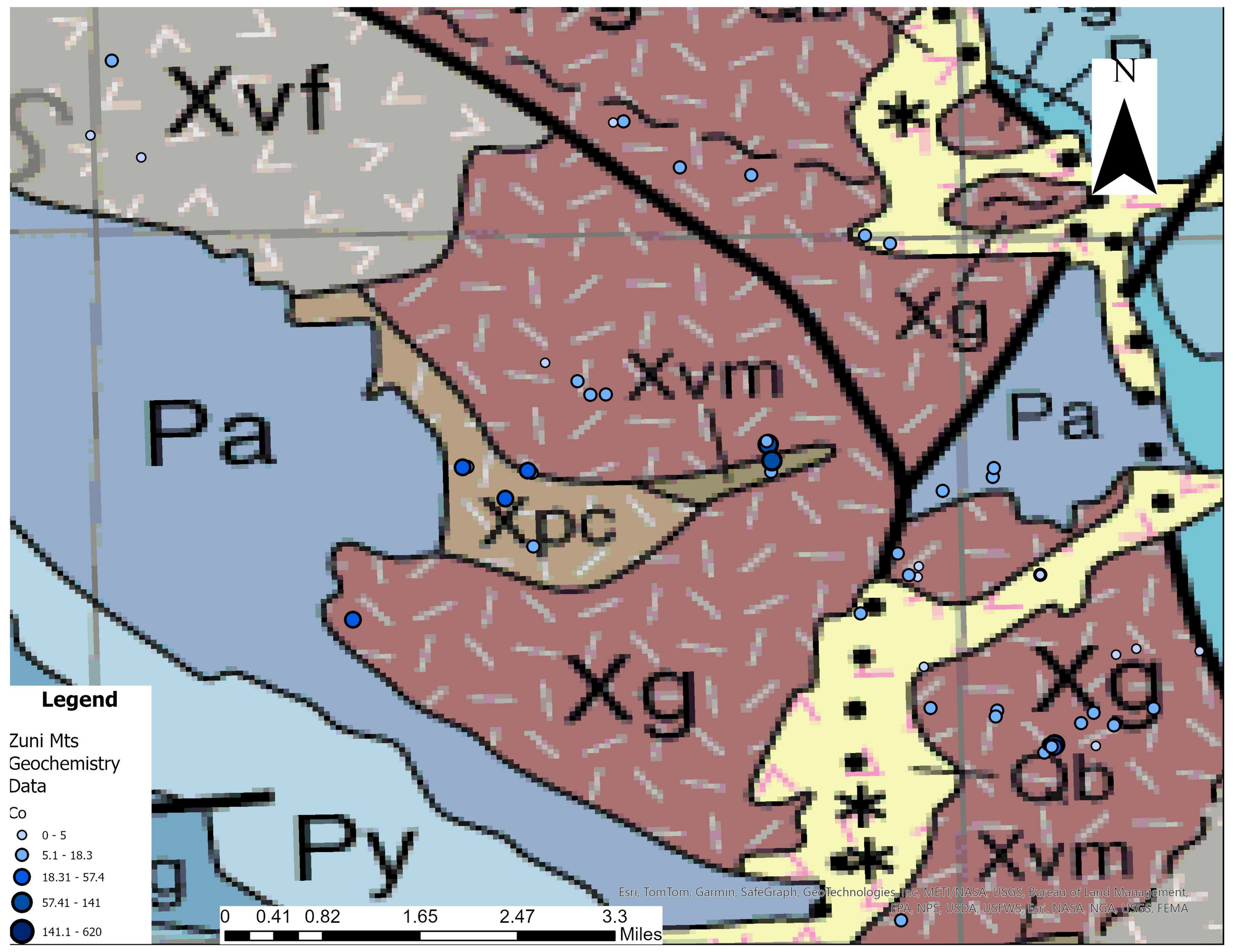

Fig. 4: A map showing Co anomalies around ultramafic lenses. 2003 Geologic map of New Mexico from NMBGMR.

Preliminary Conclusions

- Slight LREE enrichment in the district.
- Eu shows a negative anomaly, and there appears to be low Yb values potentially due to the concentrations being close to the detection limit.
- The cutoff for Ni is 36.5 ppm.
- The cutoff for Co is 10 ppm.
- The cutoff for Cr is 40 ppm.
- The Ni and Cr comparison plot could show two distinct trends.
- Ni, Cr, and Co anomalies being prevalent in the district could indicate potential PGE anomalies.

Acknowledgements

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