Using publicly available national geoscience and geochemical geographic data sets to predict the probable presence of the rare blue tourmaline Paraiba in the United States

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April 16, 2023

TABLE:

Table 1: Background, threshold, and anomalous values in parts per million (ppm).

	Boron	Lithium	Copper
Background	≤ 64.113	≤ 38.414	≤ 55.297
Threshold	64.114 to 85.782	38.415 to 52.592	55.297 to 85.782
Anomalous	≥ 85.783	≥ 52.593	≥ 85.783

This table represents the background, threshold, and anomalous values of boron, lithium, and copper. These numbers were retrieved from equations using integers from the average and standard deviation of the USSOILS data from USGS Mineral Resource Database. The background of a certain element is any parts per million (ppm) value that is considered normal, the threshold is any number that could be of interest but nothing remarkable, and anomalous values are out of the ordinary and of significant appeal.

GRAPHIC:

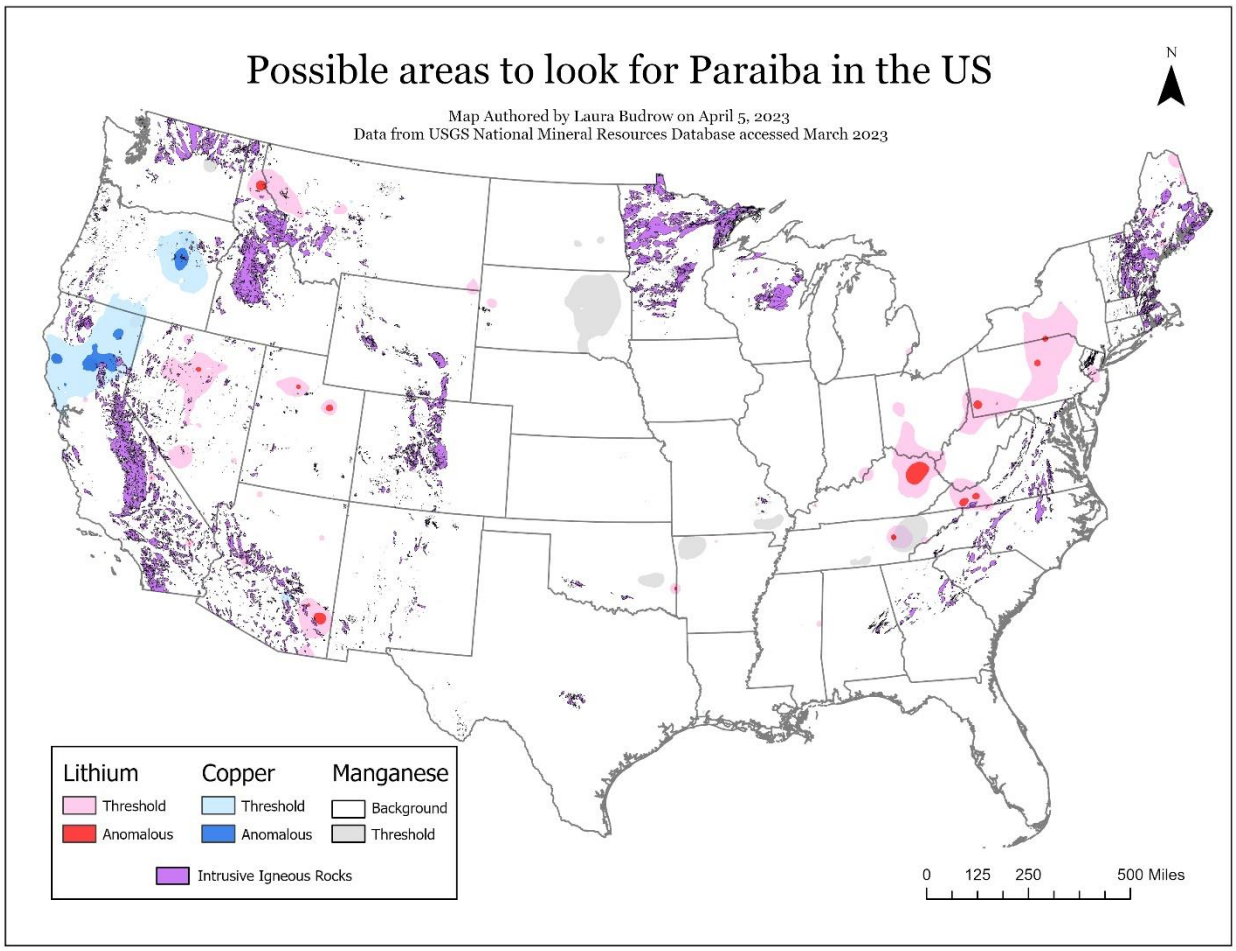

Figure 1: Map exhibiting anomalous values in parts per million (ppm) of elements in consideration in finding Paraíba in the United States as well as intrusive igneous rocks shown in purple. The threshold value of lithium is anything between 38.41 and 52.58 ppm and any value above 52.59 would be considered anomalous. The threshold for manganese is between 997.1 and 1504.0 ppm and the background value is anything less than 997.0 ppm. The threshold value for copper is 55.29 to 85.78 ppm and the anomalous value is anything greater than 85.79 ppm.

Using the values in figure 1, this map was created to demonstrate areas in the United States where there are significantly high parts per million values of elements of interest in the formation of Paraíba tourmaline. Three crucial chemical components in the genesis of Paraíba include boron, lithium, and copper. In this graphic, green represents background values, yellow depicts threshold values, and red exhibits anomalous values. This visual could help narrow down provinces in the continental United States that may be of significant interest in finding the host environment of Paraíba tourmaline.

MODIFIED GRAPHIC:

Figure 2: Various colors and cuts of Brazilian Paraíba tourmalines. Image modified after Robert Weldon taken on February 23, 2009. Photographed for the Gemological Institute of America for the Dr. Edward J. Gübelin Gem Collection.

This photo exhibits the numerous colors that may be considered Paraíba tourmaline. Most people anticipate the turquoise blue and electric blue type of Paraíba tourmalines, but there are many different varieties of this jewel. The diversity of hues, carats, and cuts makes this precious stone highly sought after in the gemological community, not only for scientists and researchers but also for purchasers.

EQUATIONS:

Background = ≤ AVG + 1STD

Threshold = between ≥ AVG + 1STD and ≤ AVG + 2STD

Anomalous = ≥ AVG + 2STD

These equations were used to retrieve the values for figure 1 and create the map in figure 2. The numbers utilized for these calculations were derived from the statistics of the element under consideration in the USSOILS dataset. The background equation represents parts per million values that are less than or equal to the average plus one standard deviation of the data, the threshold equation depicts integers that are between the background values and anomalous values, and the anomalous equation portrays values that are greater than or equal to the average plus two standard deviations.

Citations:

Boerngen, J.G., and Shacklette, H.T., 1981, U.S. Geological Survey Open-File Report, U.S. Geological Survey, Denver, CO.

ESRI, 2022, ArcGIS Pro.

Horton, J.D., 2017, U.S. Geological Survey data release, U.S. Geological Survey, Denver, CO.

Microsoft, 2022, Paint

Weldon, R., 2009, Brazilian Paraíba Tourmaline