

Examining Elemental Abundances of Chromophores in Red Beryl from the Known Localities

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DEPARTMENT OF GEOLOGY



Introduction

Beryl, $Be_3Al_2(SiO_3)_6$, is a ring silicate important to the aviation, electronics, and jewelry industries. It comes in a variety color. Most notably, its green variety is known as emerald. Beryl is a common mineral, forming in schists, hydrothermal veins, and granitic pegmatites. Its red form, however, is both exceptionally valuable and rare, among one of the rarest known minerals. Red beryl forms only in topaz rhyolite of the western United States. It has only been found at three locations: Wah Wah Mts. and Thomas Range in UT, and the Black Range in New Mexico. Minerals often get their color from chromophores, or certain elements substituted for cations within a crystal structure. Red beryl coloration is caused by Mn and Fe.



Figure 1: Photos of red beryl. Red beryl isn't always red—it can be tan, pink, magenta, purple, burgundy, brown, and taupe.

Hypotheses

H_0 : Red beryl from each locality are chemically indistinguishable among the chromophore elements

H_a : Red beryl from each locality differ chemically among the chromophore elements

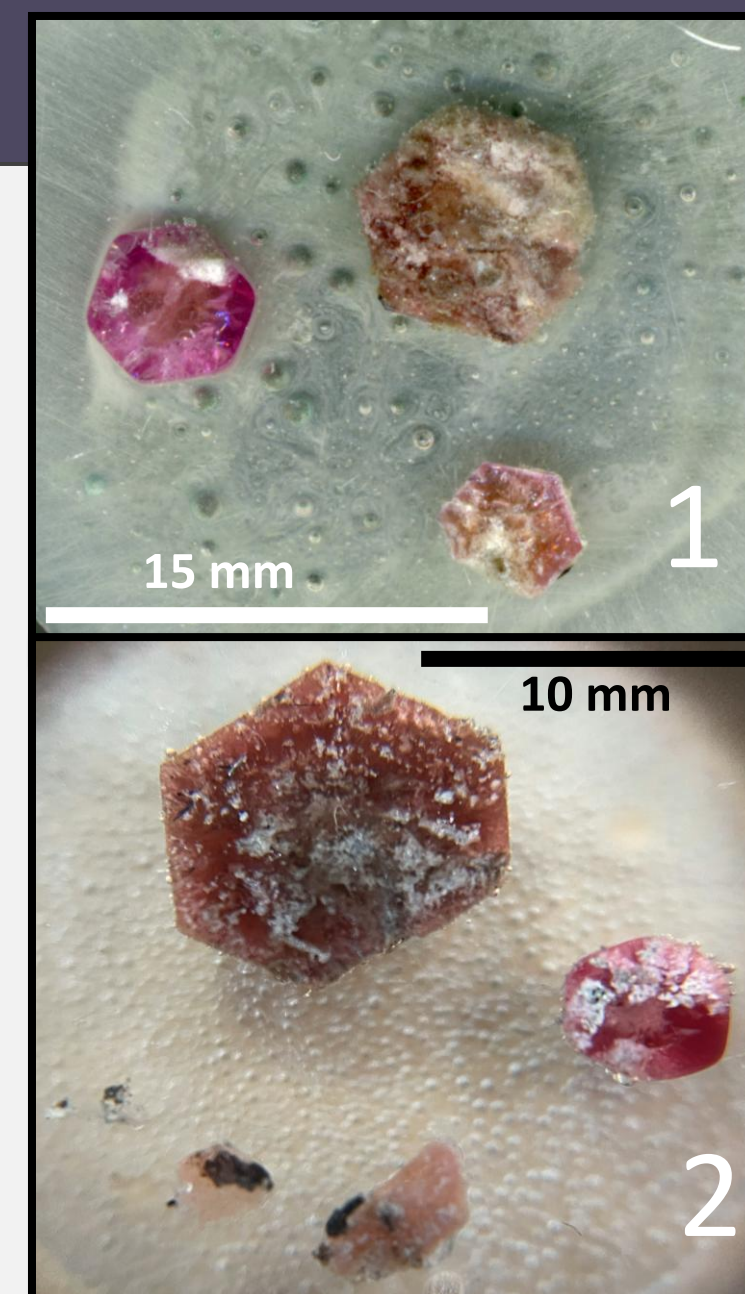
H_0 : Red beryl chromophore element concentrations are indistinguishable from other beryl varieties.

H_a : Red beryl chromophore element concentrations are distinct from other beryl varieties

Methods

Eight samples were collected from each red beryl locality and mounted and polished in two one-inch epoxy rounds. All samples were analyzed by LA-ICP-MS. Traverses were done on each specimen to measure zoning. Results were then normalized to Si (using the standard beryl formula) and converted from cps to ppm.

Figure 2: Close-ups of the analyzed epoxy rounds.



References

Gavrilchik, A. K.; Skublov, S. G.; Kotova, E. L.; Trace Element Composition of Beryl from the Sherlovaya Gora Deposit, Southeastern Transbaikai Region, Russia. *Geology of Ore Deposits*, Vol. 64, p. 442-451, 2023
Red beryl photos of Figure 1 are from images uploaded to Mindat.com from the collections of Dan and Diana Weinrich Minerals, Marin Mineral, Van King, Zaac Leite, Michael C. Michayluk, and Rolf Luetchke

Results

Figure 3: Elemental abundances of chromophores (as well as chromophore-behaving elements) measured in all red beryl samples analyzed within this study.

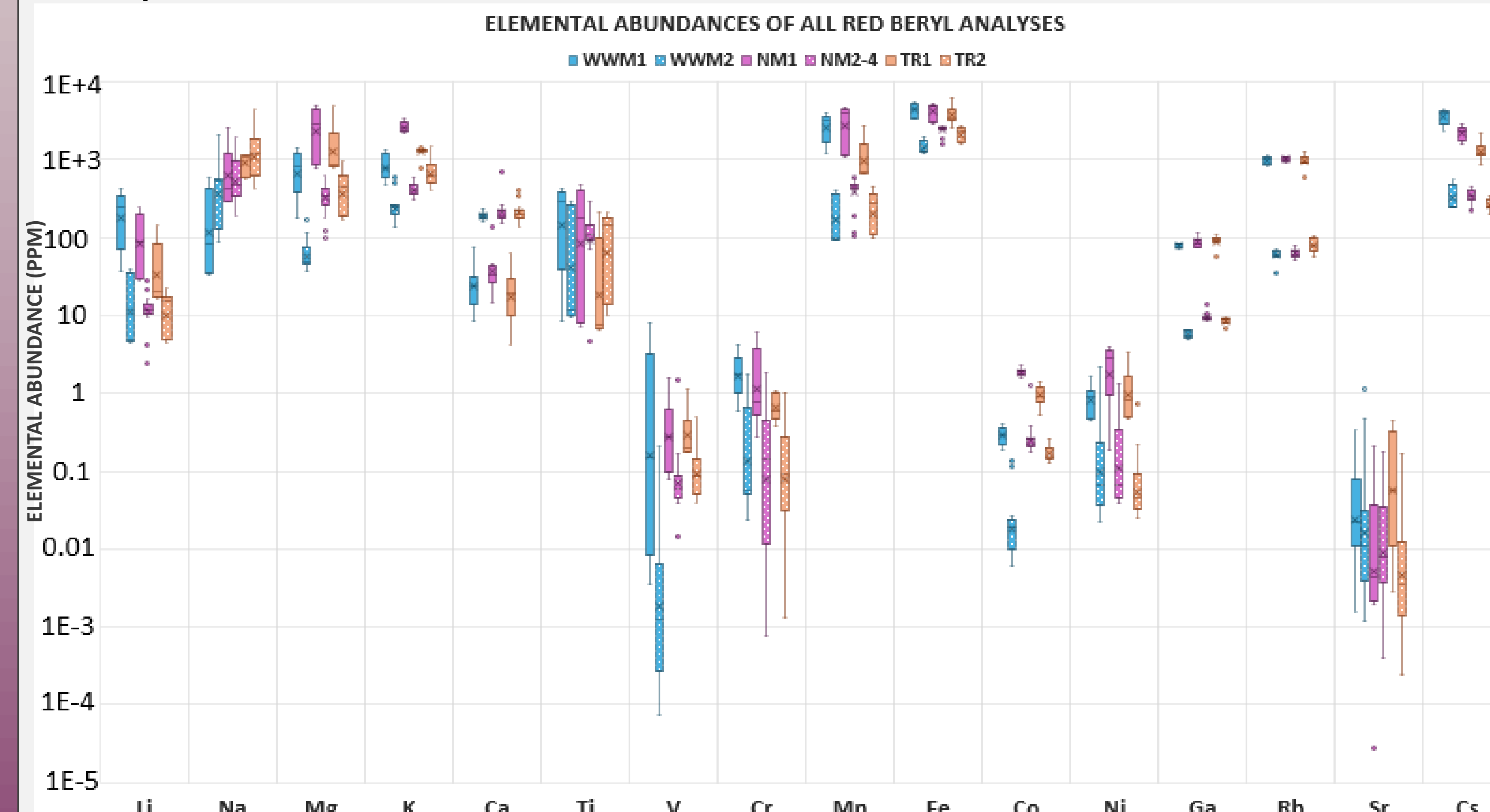


Figure 4: Compiled red beryl elemental abundances of this analysis compared to the Gavrilchik et al. (2023) analysis of several varieties of beryl.

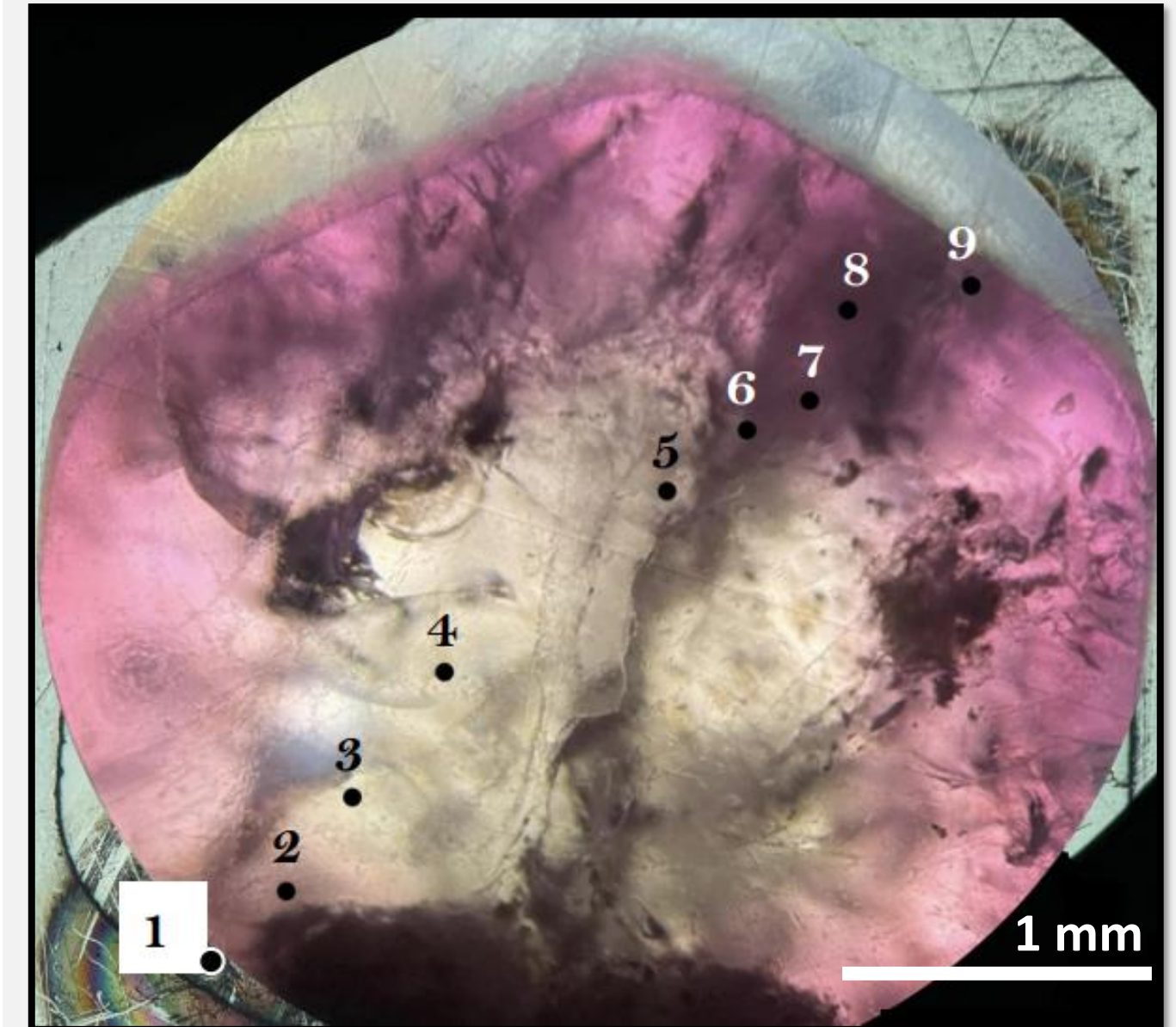
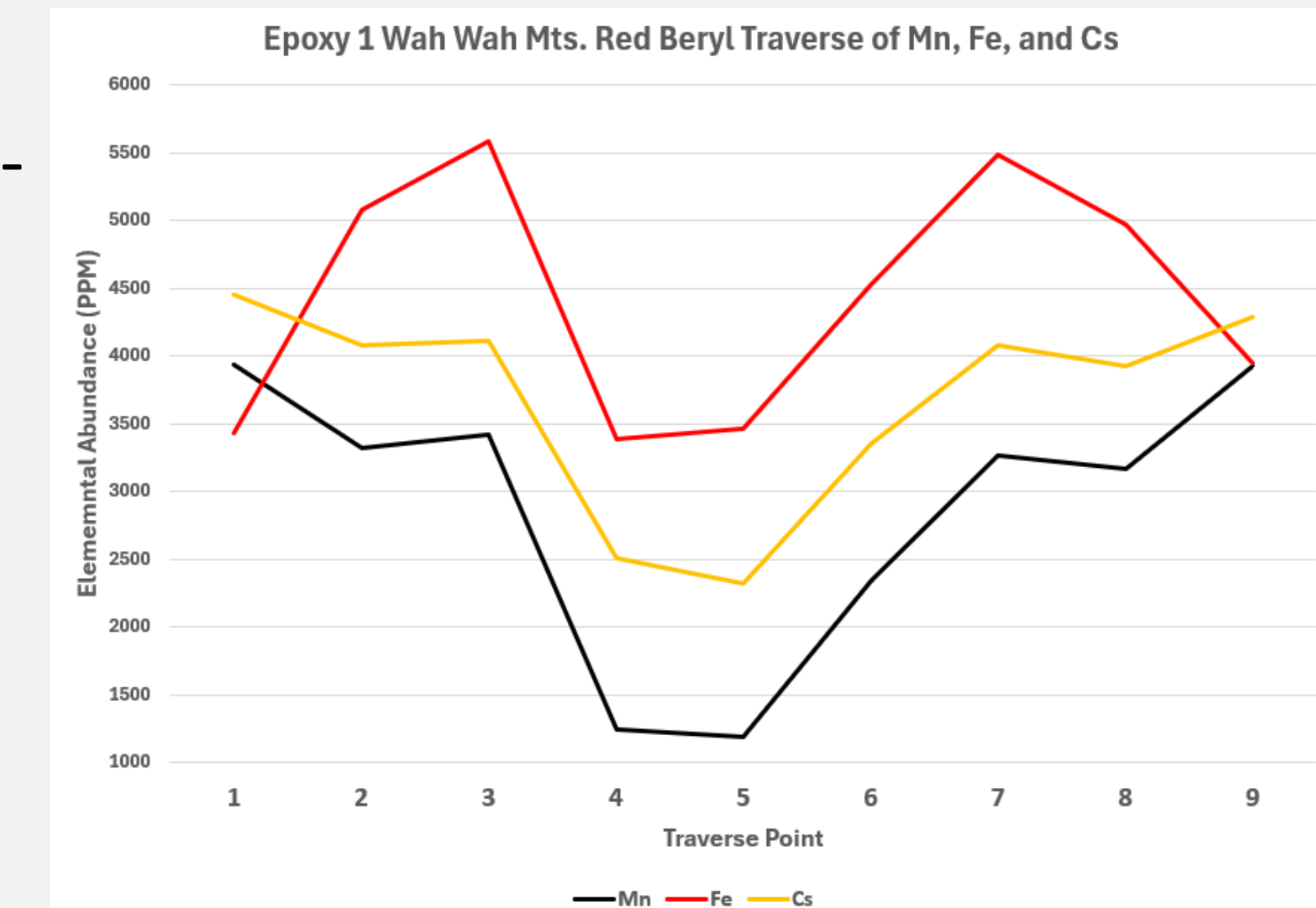
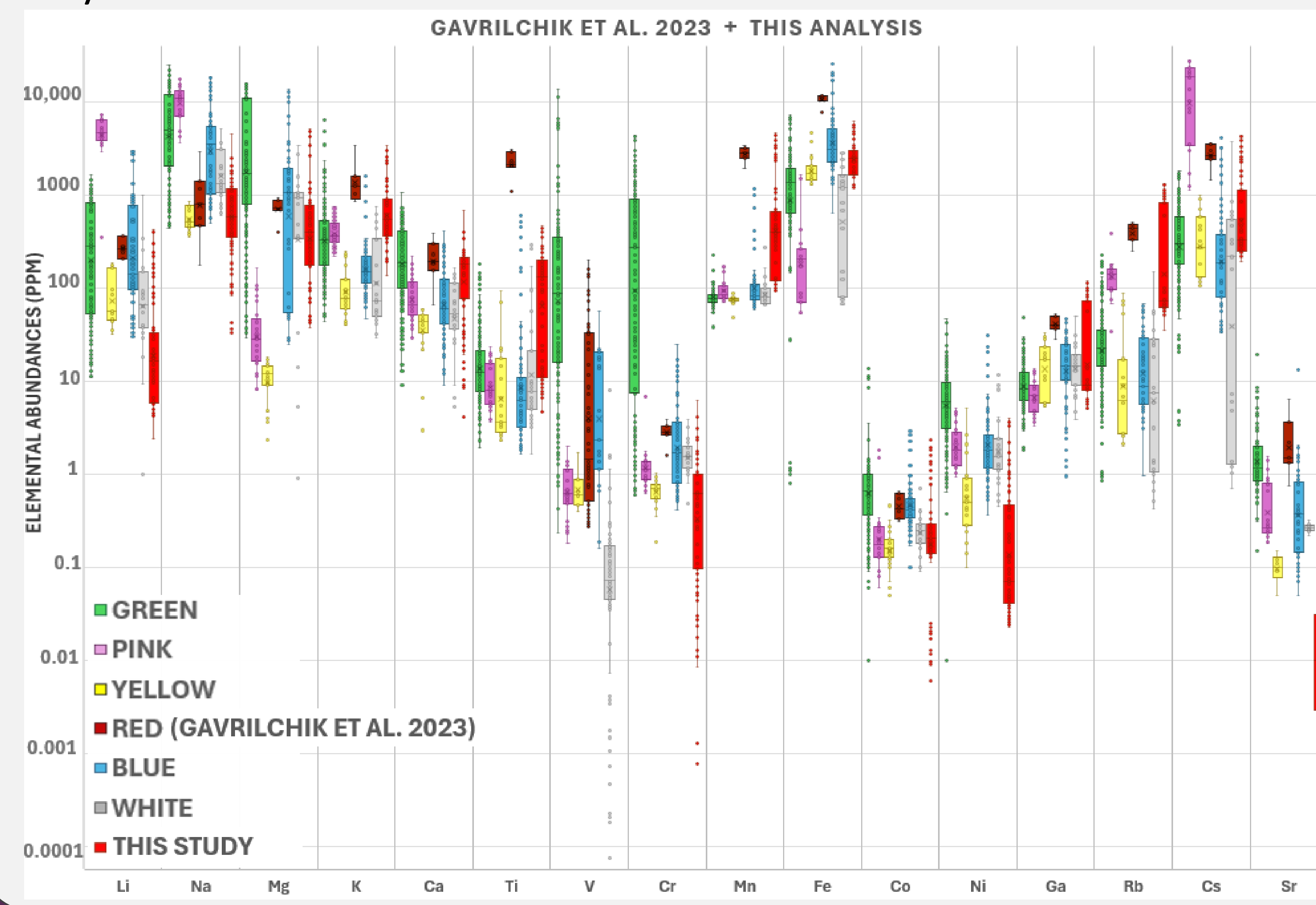


Figure 5a: A traverse showing chemical zonation of three elements of a red beryl. Represented by black is Mn, Fe is in red, Cs is in yellow.

Figure 5b: A close-up of a Wah Wah Mts. red beryl. Labelled are the traverse points that correspond with the traverse in **figure 5a**. Note the visual zonation.

Discussion

• Variation?

Elemental abundances of red beryl within a red beryl locality and even within individual samples may vary by orders of magnitude. Despite this, there is overlap of the abundances of the chromophore elements across nearly all red beryl samples.

• Red beryl vs. Morganite vs. Pezzottaite?

Morganite and pezzottaite are pink beryl. If red beryl can be pink, is there a difference between the three? *If so, where should the line be? Can chromophore elemental abundances answer this?*

Conclusions

- Red beryl from all localities are chemically indistinguishable among the chromophore elements.
- Red beryl elemental abundances overlap with specific varieties and specific elements, but not all. It is distinguishable from other beryl varieties. Its depletion of Cr, Ni, Sr, and Li, as well as its enrichment in Fe, Cs, Mn, Ti, and Rb sets it apart from other beryl.

Acknowledgements

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