



**Rare and Unusual Minerals from the
Petaca Pegmatite District of New Mexico**

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Why Study the Petaca District?

- **Pegmatites host rare and unusual minerals containing rare earth elements (REE), U, and Th as essential constituents.**
- **District has not been studied in detail since the 1950s.**
- **REE content of the pegmatites not studied since 1988.**
- **Confirm minerals previously reported from the district. Emphasis on rare (Y,REE,Th,U)(Nb,Ta,Ti) oxides.**
- **Identify new minerals for the district.**

Method of Study

- **Locate suspect samples of rare minerals - often using radiation detectors.**
- **Samples mounted in epoxy and polished for electron microprobe analysis.**
- **Samples analyzed using JEOL 8200 Superprobe at UNM Institute of Meteoritics.**
- **(Y,REE,Th,U)(Ta,Nb,Ti) oxides classified via principle component analysis (three-group statistical model).**

Locating Rare Minerals Using Radiation Detection Equipment



Locating Rare Minerals Using Radiation Detection Equipment



Mining History of the Petaca Pegmatites

- **Earliest workings (17th century) at Cribbenville may represent the first recovery of sheet mica in the U.S.A.**
- **Granitic pegmatites mined for sheet and scrap mica chiefly from 1870-1960s.**
- **250,000 pounds of sheet and punch mica produced.**
- **9,300 pounds of beryl; 12,000 pounds of Nb-Ta minerals (chiefly columbite-tantalite).**
- **Recent interest as a resource for REE-bearing minerals.**

District Location and Geography

- **Rugged, forested country within the Carson National Forest in Rio Arriba County.**
- **District extends from Kiawa Mountain on the north, southward to the village of La Madera.**
- **Elevations range from 6,400 to 8,400 ft.**
- **Accessed from unpaved roads between La Madera, Petaca, and Vallecitos.**
- **District encompasses approximately 60 square miles.**

Location of the Petaca District



View of Petaca Looking West



View Looking East from Globe Mine, Alamos Group



Pegmatite Groups

Petaca pegmatites occur in 5 major geographical groups -- from north to south:

- **Kiawa**
- **Persimmon Peak-Las Tablas**
- **La Jarita-Apache**
- **Cribbenville**
- **Alamos**
- **A few mined pegmatites are outliers.**

Location of the Petaca District Pegmatite Groups



Petaca Pegmatites

- **Intrude Precambrian metasedimentary and metavolcanic rocks of Vadito Group.**
- **Emplaced approximately 1,400 MA.**
- **Form dikes, sills, pods and irregular bodies.**
- **Pegmatites crop out for 75 to 1,430 ft in length, average width 30 to 35 ft.**
- **Rare element type.**
- **Precambrian host rocks locally covered by Cenozoic volcanic and volcanoclastic rocks.**

Rare Element Pegmatites

Contain sufficient concentrations of rare elements to form mineral species that contain rare elements as essential constituents.

For example: (Li), Be, Bi, Nb, Ta, REE (such as Ce, La, Yb) in Monazite, Euxenite, Polycrase, Bismutite, and Beryl.

Composition of Petaca Pegmatites

- **Granitic pegmatites - composed chiefly of quartz, microcline (perthite), albite, and muscovite.**
- **Common accessory minerals: spessartine, fluorite, columbite-tantalite, monazite-(Ce), beryl, ilmenite and bismutite.**
- **(Y,REE,U,Th) (Nb,Ta,Ti) oxides, such as euxenite and polycrase, are rare.**

Structure of Petaca Pegmatites

- **Internally zoned:**
 - **Border Zone**
 - **Wall zone**
 - **One or more Intermediate Zones**
 - **Core**
- **Zones characterized by mineralogy, texture, or both.**
- **Replacement bodies and late-stage fracture fillings of albite and quartz are common.**

Pegmatite Zones From Jahns, Mica Deposits of the Petaca District, NMBMMR Bulletin 25, 1946

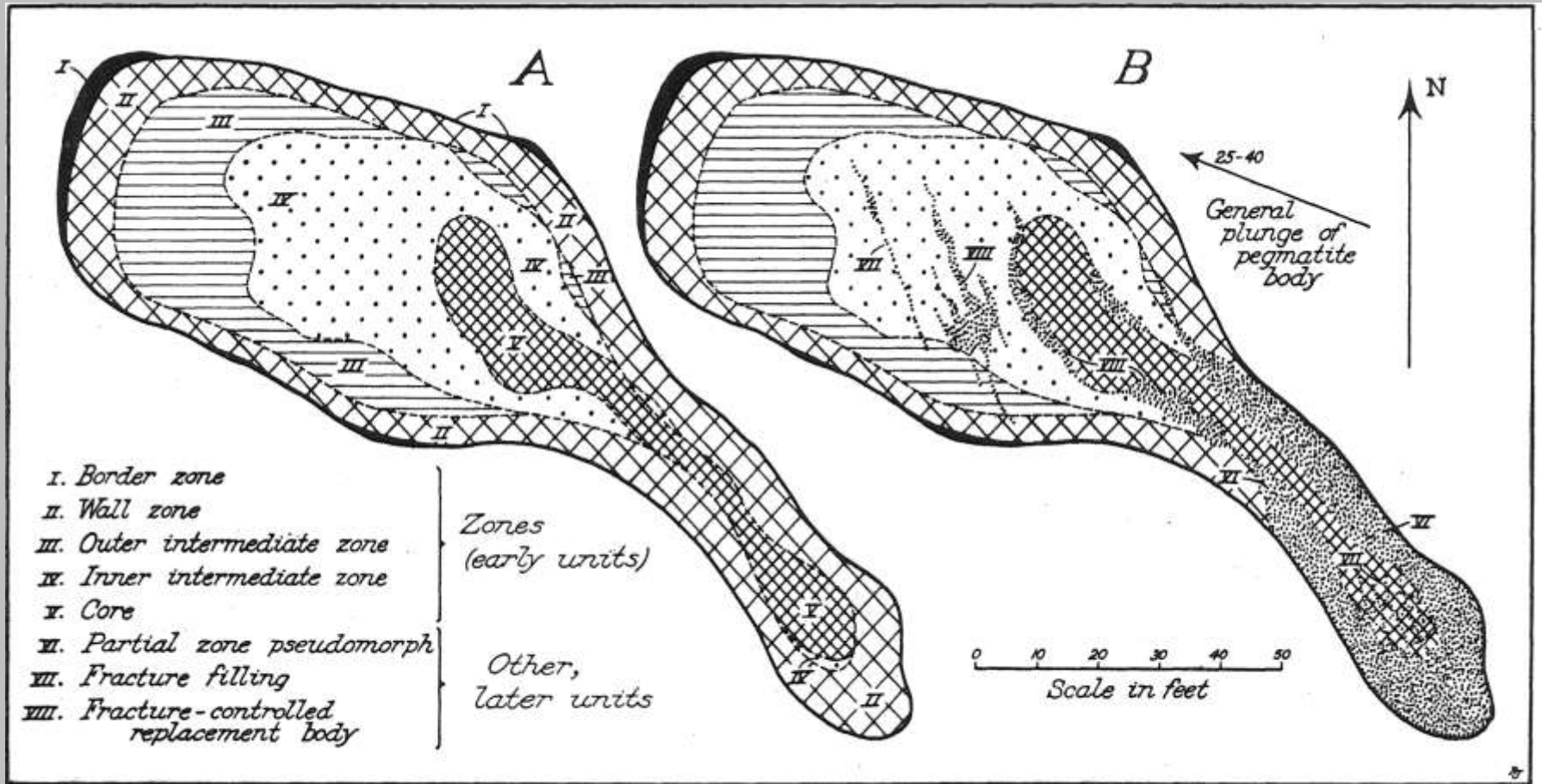


FIGURE 3. Idealized plans of pegmatite body showing distribution of zones (A) and other units superimposed on zones (B).

Zoned Pegmatite, Cribbenville Group



Pegmatite Textures

- **Complex assemblage of fine to coarse or even giant crystals of minerals.**
- **Larger crystals usually found near central region (inner zones) of pegmatites.**
- **Crystals range from anhedral to euhedral in form.**

Large Muscovite Crystals, Keystone-Western Mine, La Jarita-Apache Group



Large Muscovite Crystals, Sandoval Mine, La Jarita-Apache Group



Large Microcline Crystals in Quartz, Mica Lode Mine, La Jarita-Apache Group



Anhedral Fluorite Mass Cut by Albite Veinlets, Globe Mine, Alamos Group



Mine Workings

Usually small open pits or trenches, some have collapsed shallow shafts.

Some larger mines have large open cuts and open underground workings (for example, the Coats, Cribbenville, and Globe mines).

However, many are difficult to find due to small size and vegetation overgrowth.

Navajo Mine, La Jarita-Apache Group





North Star Mine, La Jarita-Apache Group

Werner Mine, La Jarita-Apache Group



Carmelita Mine, Alamos Group



Hoyt Mine, Persimmon Peak- Las Tablas Group



Minerals of Special Interest

Rare minerals usually found in albite-rich pegmatite or fracture fillings in smoky quartz

- **(Y,REE,U,Th)(Nb,Ta,Ti) Oxides**
- **Monazite-(Ce): $(\text{Ce,La,Nd,Th})\text{PO}_4$**
- **Columbite-Tantalite: $(\text{Fe,Mn})(\text{Nb,Ta})_2\text{O}_6$**
- **Beryl: $\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$**
- **Bismutite: $\text{Bi}_2\text{O}_2(\text{CO}_3)$**
- **Amazonite (K-feldspar): $(\text{K,Na})(\text{AlSi}_3\text{O}_8)$**

Beryl from Various Petaca Mines



Microcline (Variety Amazonite), Mica Lode Mine, La Jarita-Apache Group



Monazite-(Ce), Coats Mine, La Jarita-Apache Group



Monazite-(Ce), Persimmon Peak- Las Tablas Group



Monazite-(Ce), Persimmon Peak- Las Tablas Group



Monazite-(Ce), Persimmon Peak- Las Tablas Group



Columbite-Tantalite (Feather Type) Associated with Monazite-(Ce), Coats Mine, La Jarita-Apache Group



Columbite-Tantalite (Feather Type), Globe Mine, Alamos Group



Columbite-Tantalite, Carmelita Mine, Alamos Group



Large Crystal of Columbite-Tantalite, Cribbenville Group



Another Large Columbite -Tantalite Crystal



Bismutite, Globe Mine, Alamos Group



Bismutite Occurrence, Globe Mine, Alamos Group



Polycrase-(Y) (?) from Various Petaca Mines



Polycrase-(Y), Bluebird Mine, La Jarita-Apache Group



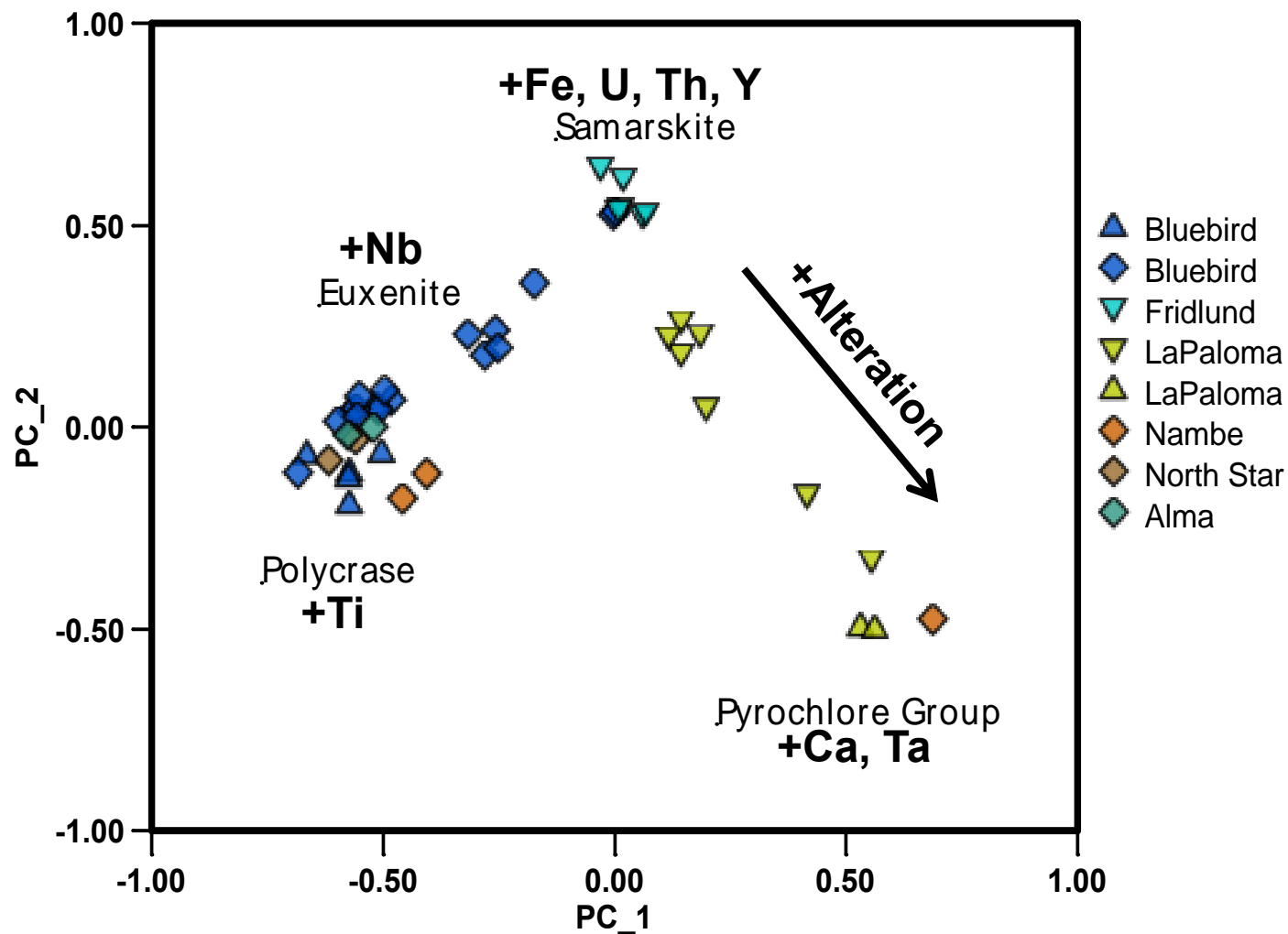
Polycrase-(Y) Occurrence, Bluebird Mine, La Jarita-Apache Group



Suspect (Y,REE,U,Th)(Nb,Ta,Ti) Oxide, La Jarita-Apache Group

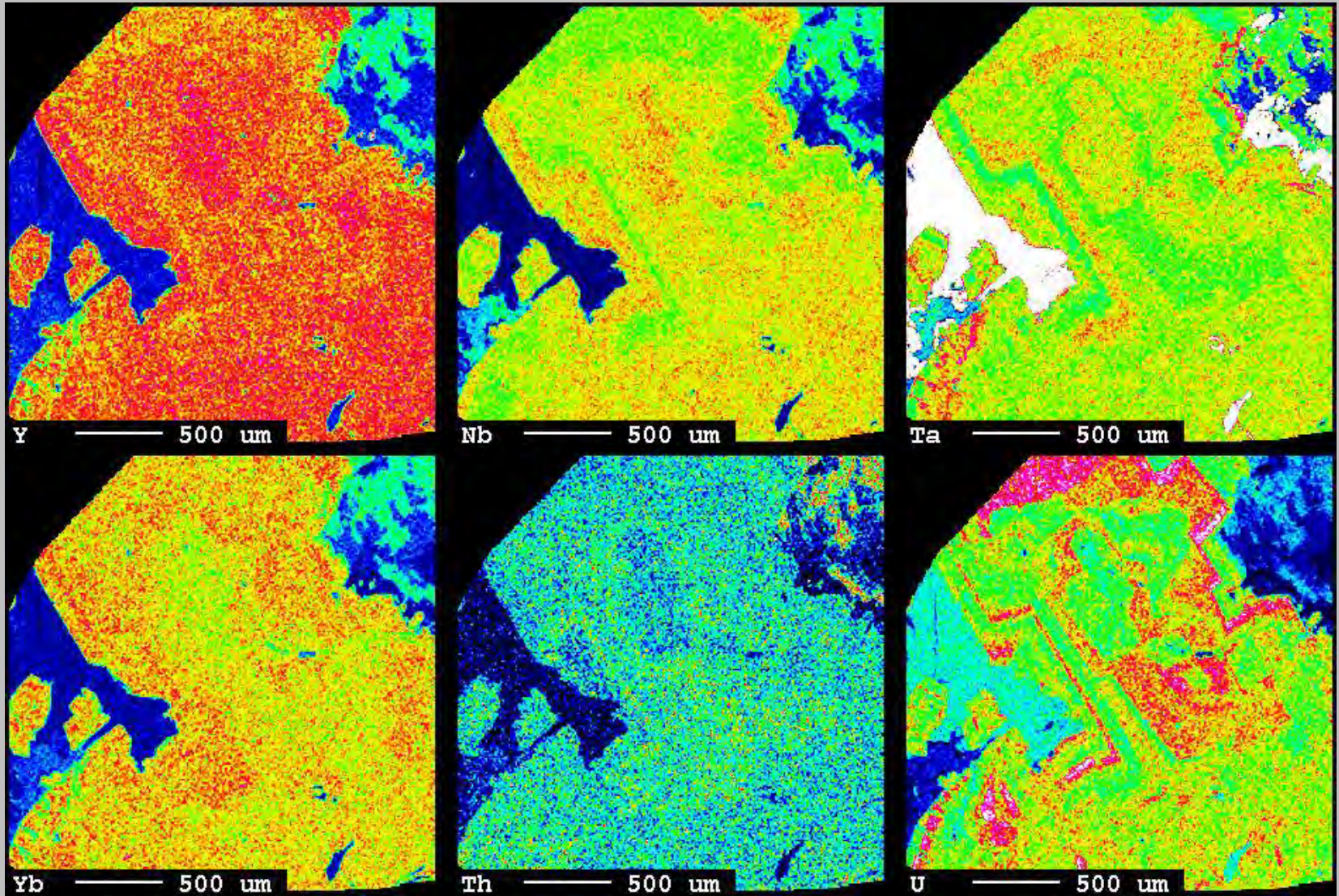


Plot of scores for Canonical Variables Using Three-Group Model of Principle Component Analysis

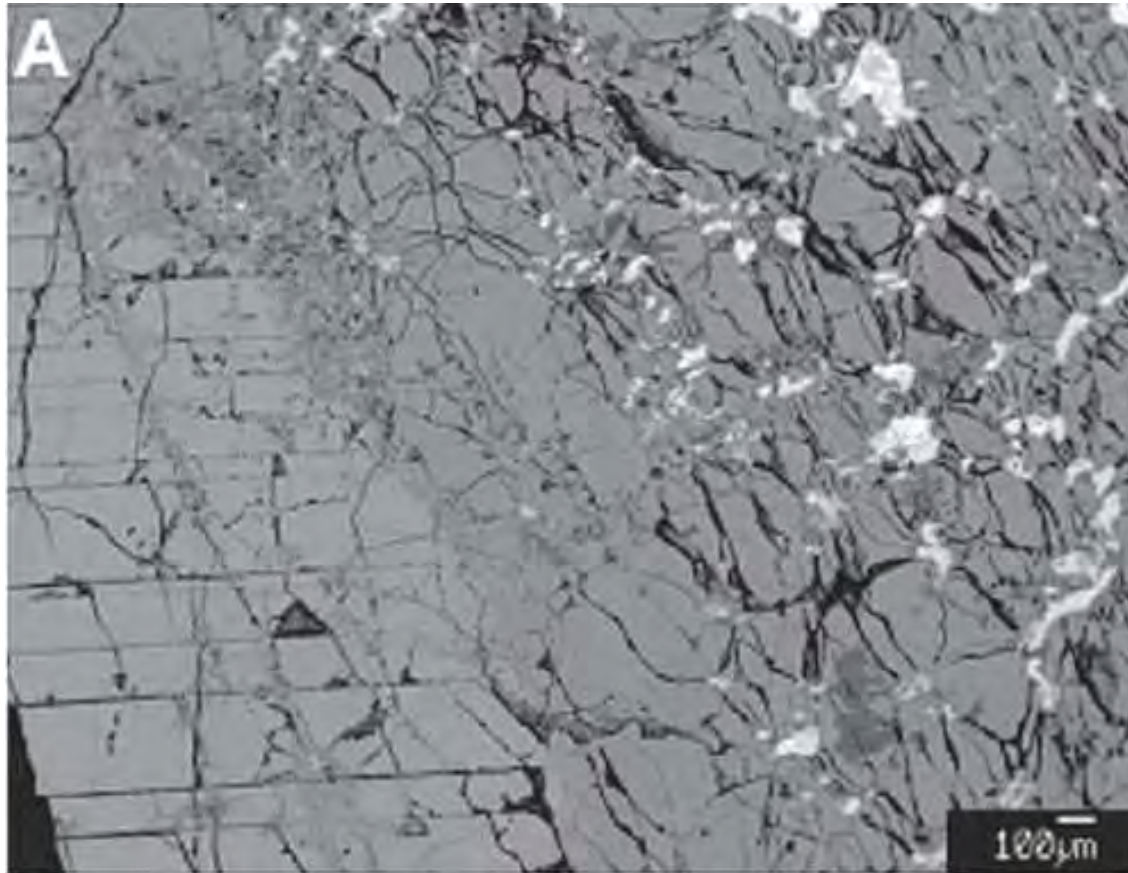


Complex Zoning within Polycrase-(Y) from the Bluebird Mine

Red – Orange – Yellow – Green – Blue: Highest to Lowest Concentration



Shattered Monazite due to Thorite Inclusions

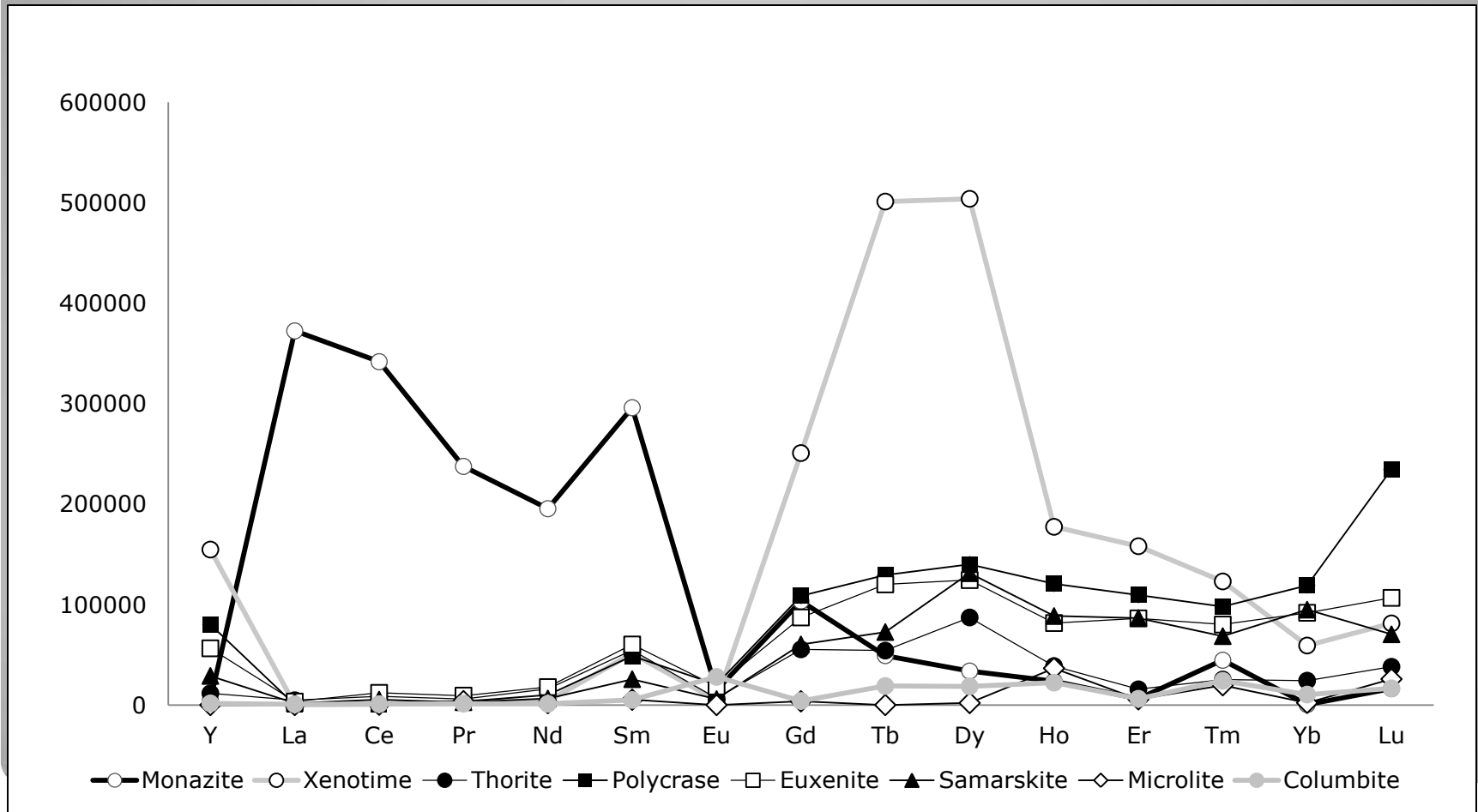


(A) Thorite inclusions (white) in Coats monazite (medium gray). Compare cleavages in the unaltered monazite at the left with the shattered appearance in the inclusion-rich region on the right.

Radially Shattered Quartz due to Samarskite-(Y) (?) Crystal



Distribution of Chondrite-Normalized REE



New Minerals for Petaca and NM

- **Polycrase-(Y) (cm-sized from Bluebird mine, new mineral for NM)**
- **Microlite (minute amounts as inclusions)**
- **Xenotime-(Y) (minute amounts as inclusions)**
- **Zircon (mm-sized crystals in a single specimen from La Paloma mine)**
- **Euxenite-(Y) (intergrown with Polycrase-(Y))**
- **Samarskite-(Y) (cm-sized)**

Previously Reported (Y,REE,U,Th)(Nb,Ta,Ti) Oxides and Other Minerals and Current Status

- **Euxenite – confirmed as euxenite-(Y)**
- **Samarskite – confirmed as samarskite-(Y)**
- **Thorite – confirmed**
- **Gadolinite – not confirmed**
- **Aeschynite – not confirmed**
- **Fergusonite – not confirmed**

Conclusions

Pegmatite Classification

Petaca Pegmatites are of the NYF-type (Niobium, Yttrium and REE, and Fluorine) because they contain:

- Y and Nb-bearing minerals**
- Fluorite**
- Amazonitic potassium-feldspar locally common**

The study suggests that the pegmatites are associated with a nearby granitic pluton that is not exposed at the surface.

Conclusions

- **New minerals for the District: Euxenite-(Y), Samarskite-(Y), Polycrase-(Y), Xenotime-(Y), Microlite, and Zircon.**
- **New mineral for New Mexico: Polycrase-(Y).**
- **Petaca pegmatites are NYF type.**
- **Investigation continues on (Y,REE,U,Th)(Nb,Ta,Ti) minerals.**
- **Samples from new locations await analysis.**
- **Bring attention to an overlooked rare element pegmatite field in New Mexico.**

Acknowledgements

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For More Information

Rare Earth Bearing-Minerals of the Petaca District, Rio Arriba County, New Mexico

**Spilde et al, New Mexico Geological Society
Guidebook, 62nd Field Conference, Geology of the
Tusas Mountains – Ojo Caliente, 2011, p. 389 -
398**