Geologic Processes Affecting the Chemistry, Mineralogy, and Acid Potential on Particle Size Fractions: Examples from Waste Rock Piles in New Mexico, USA

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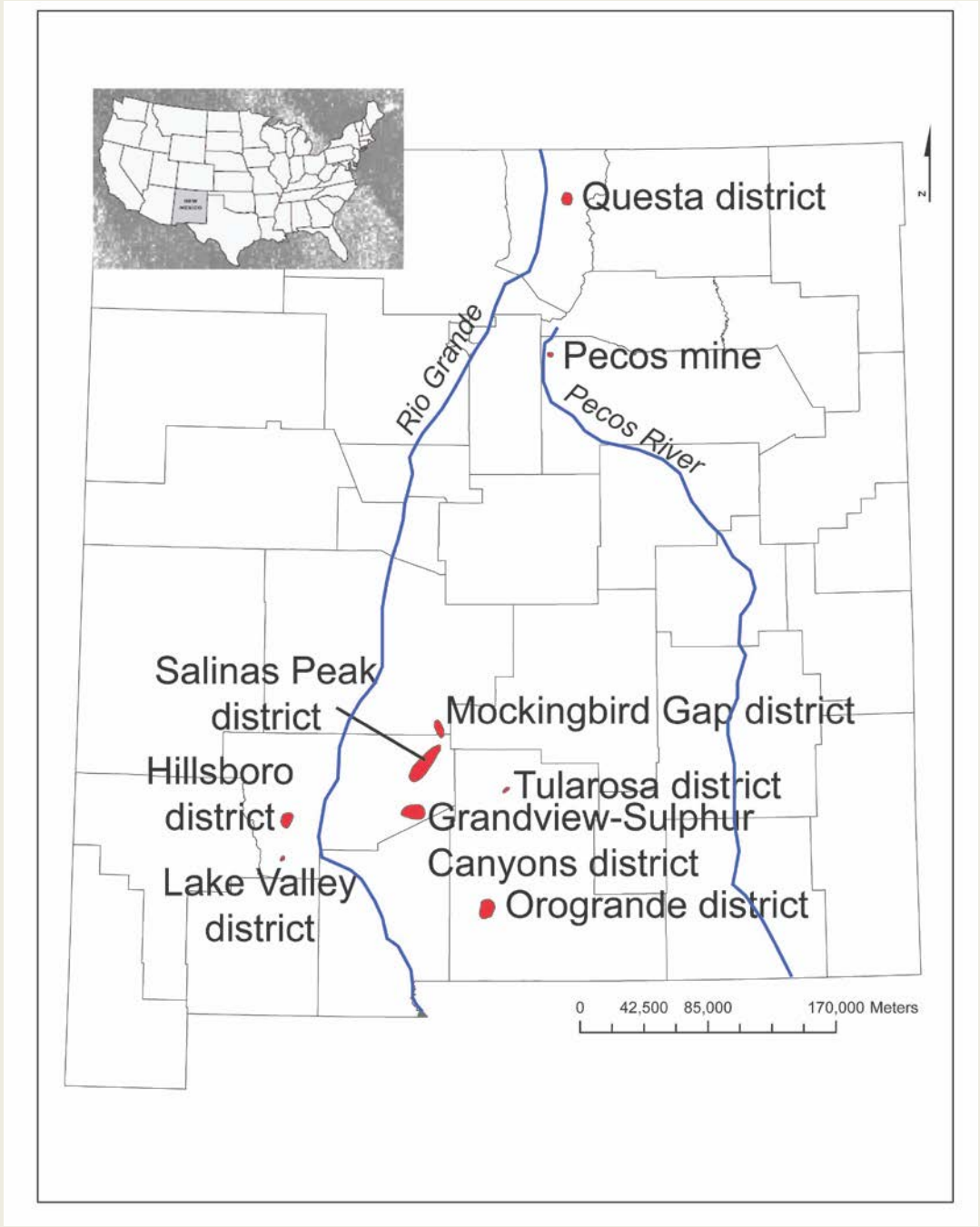
PURPOSE

- To describe the differences in mineralogy, chemistry, and acid potential between different particle size fractions from different materials
- To discuss some of the geologic, geochemical, pedological or man-influenced processes that controlled these changes between the different particle sizes

IMPORTANCE OF UNDERSTANDING COMPOSITIONAL DIFFERENCES IN SIZE FRACTIONS

- Help plan and assess reclamation procedures
- Compare trace-element concentrations in mined versus undisturbed areas
- Determine background concentrations
- Provide background data that can assist with the planning of future mining operations

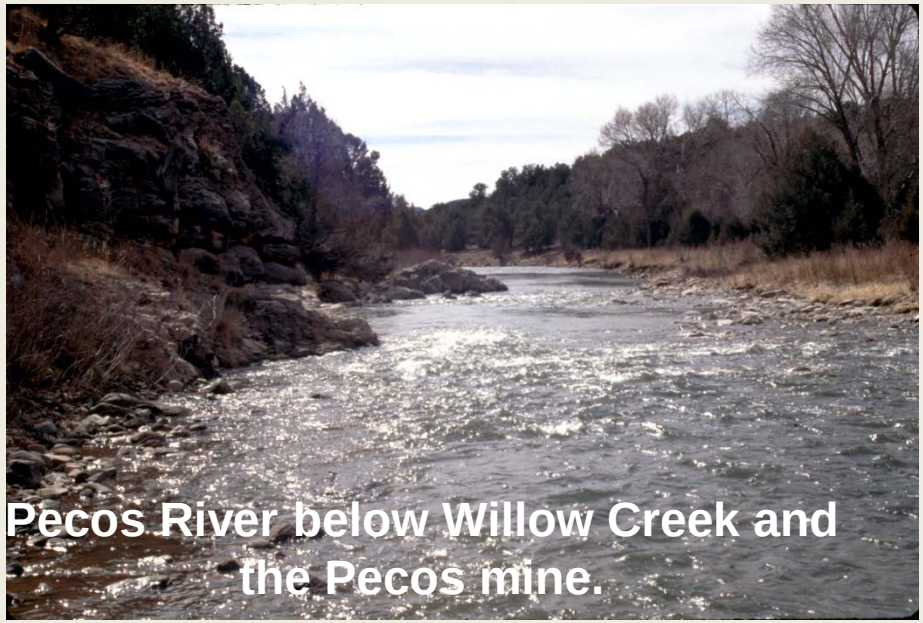


LOCATION OF STUDY AREAS

Pecos River area—stream sediments draining a VMS deposit

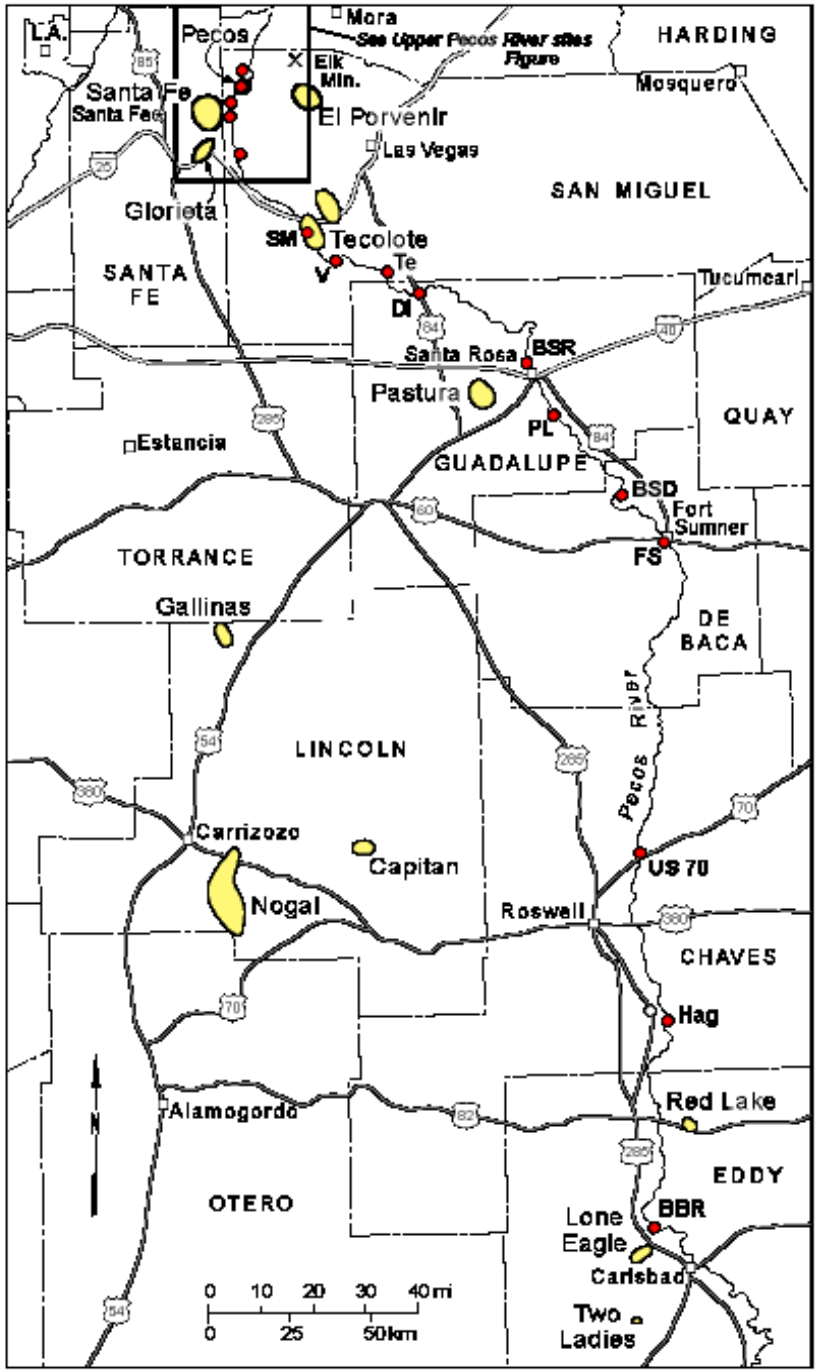
Dam at San Miquel on the Pecos River.

Numerous discrete and diffuse seeps occur along the base of the mine waste pile.



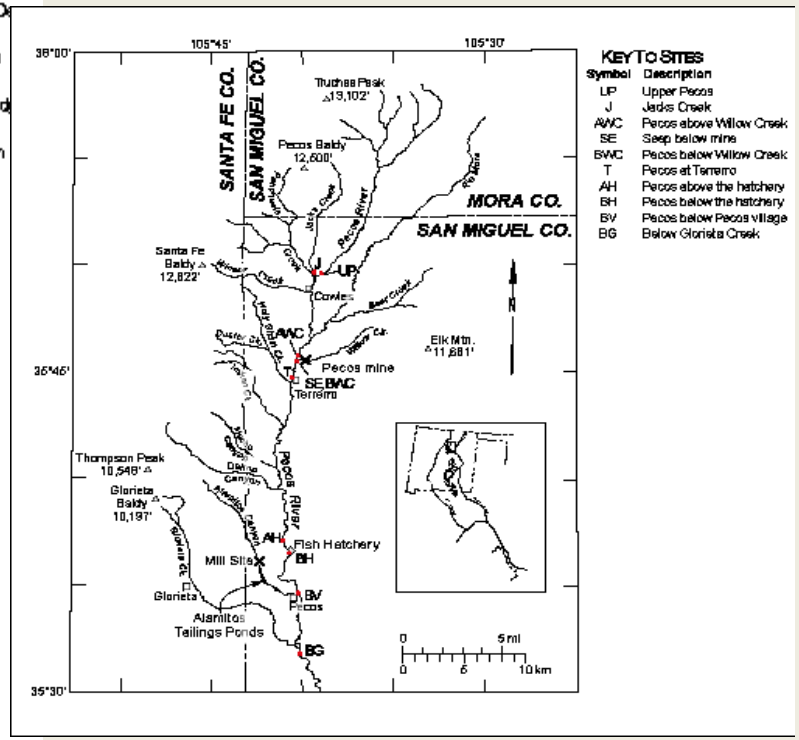
Pecos River below Willow Creek and the Pecos mine.

Pecos Samples



KEY TO SITES

Symbol	Description
SM	San Miguel
V	Villanueva
Te	Tecolotito
DI	Dilia
BSR	Below Santa Rosa D
PL	Puerto del Luna
BSD	Below Sumner Dam
FS	Fort Sumner
US70	Highway U.S. 70 brid
Hag	Hagerman
BBR	Below Brantley Dam

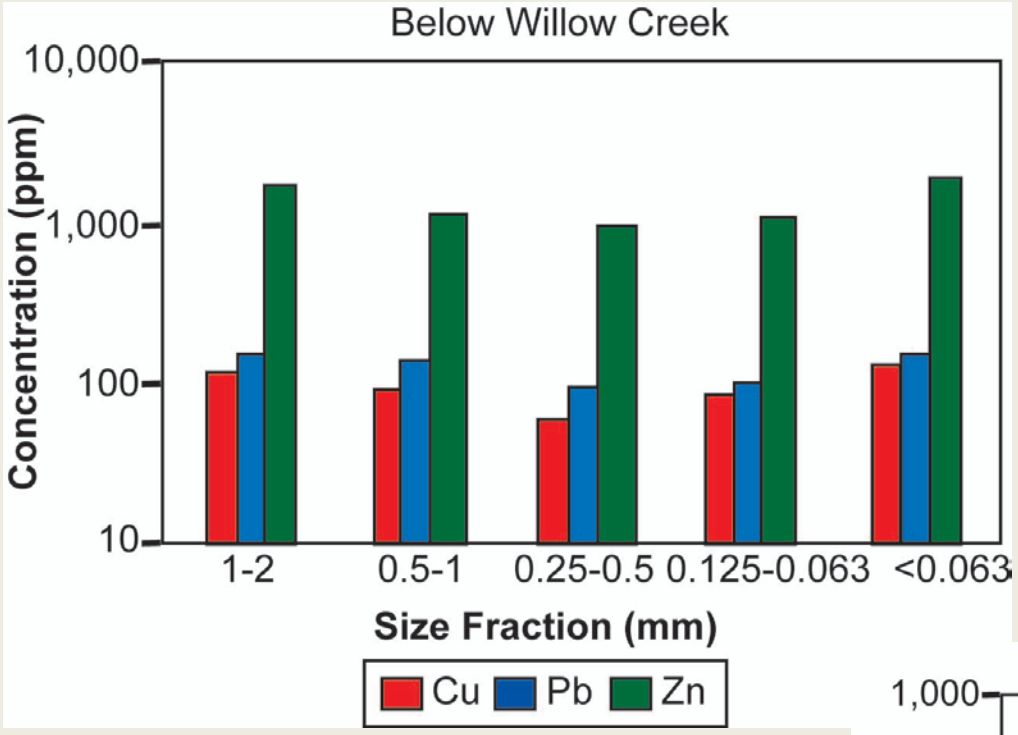


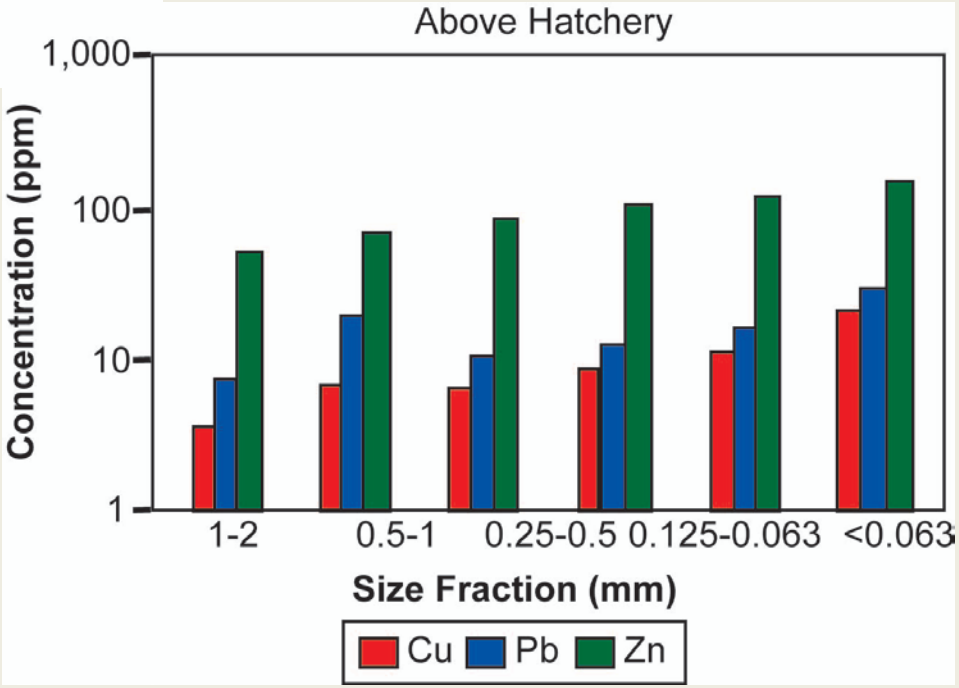
KEY TO SITES

Symbol	Description
UP	Upper Pecos
J	Jacks Creek
AWC	Pecos above Willow Creek
SE	Seep below mine
BWC	Pecos below Willow Creek
T	Pecos at Terrero
AH	Pecos above the hatchery
BH	Pecos below the hatchery
BV	Pecos below Pecos Village
BG	Below Glorieta Creek

- The finer-size fractions are typically the smallest proportion of the sample by weight (generally, <25% in the <2 mm fraction).
- In some samples, the concentrations of metals increase in the smallest size fractions, but not all.

Size fractions verses metal content—Pecos stream sediments





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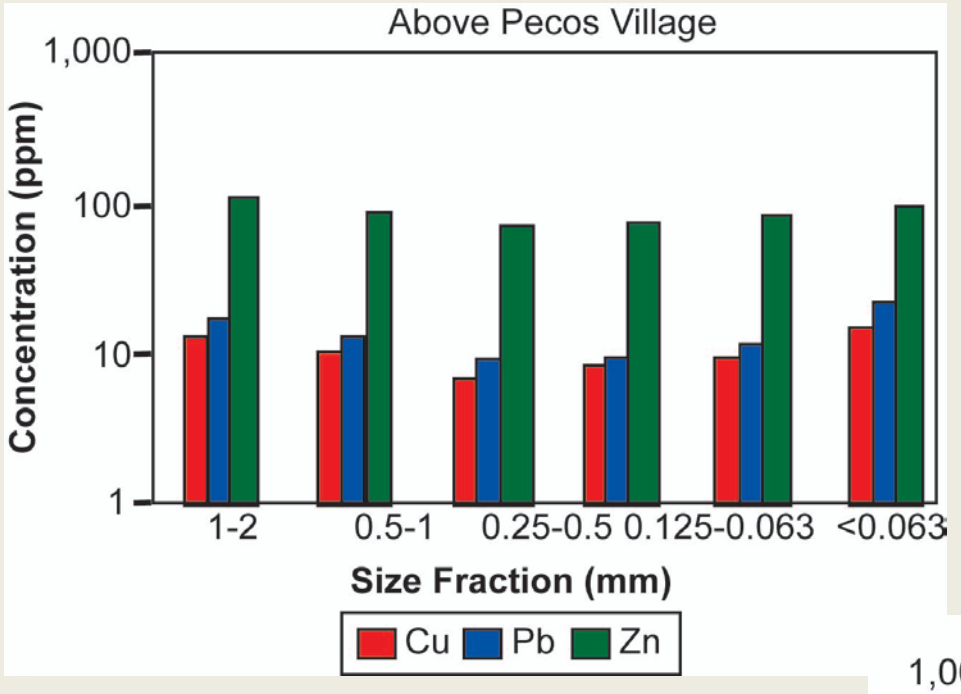

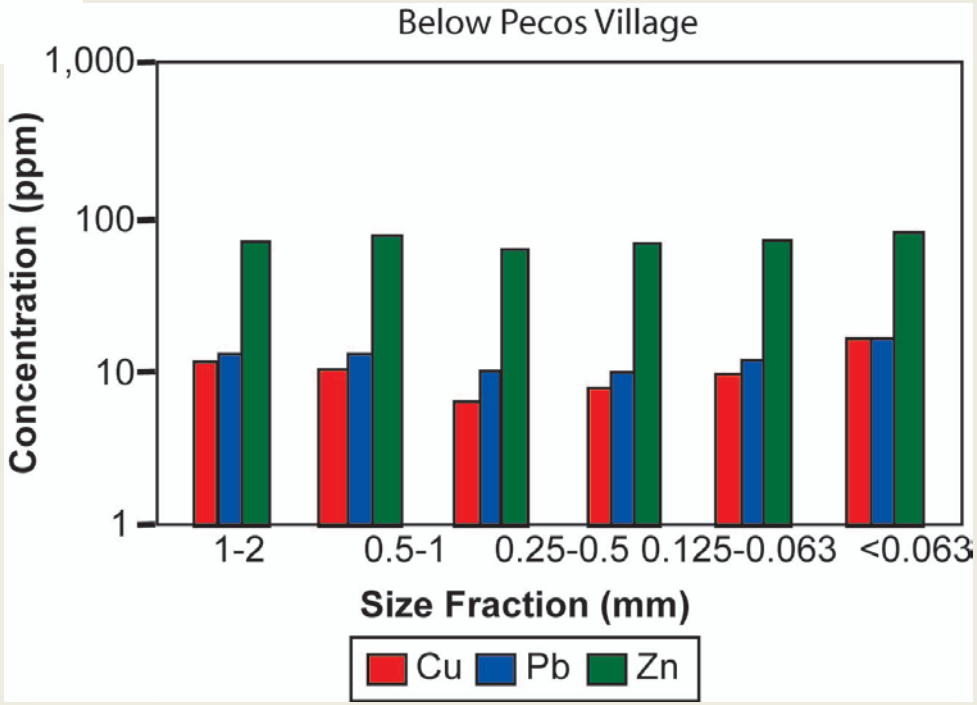

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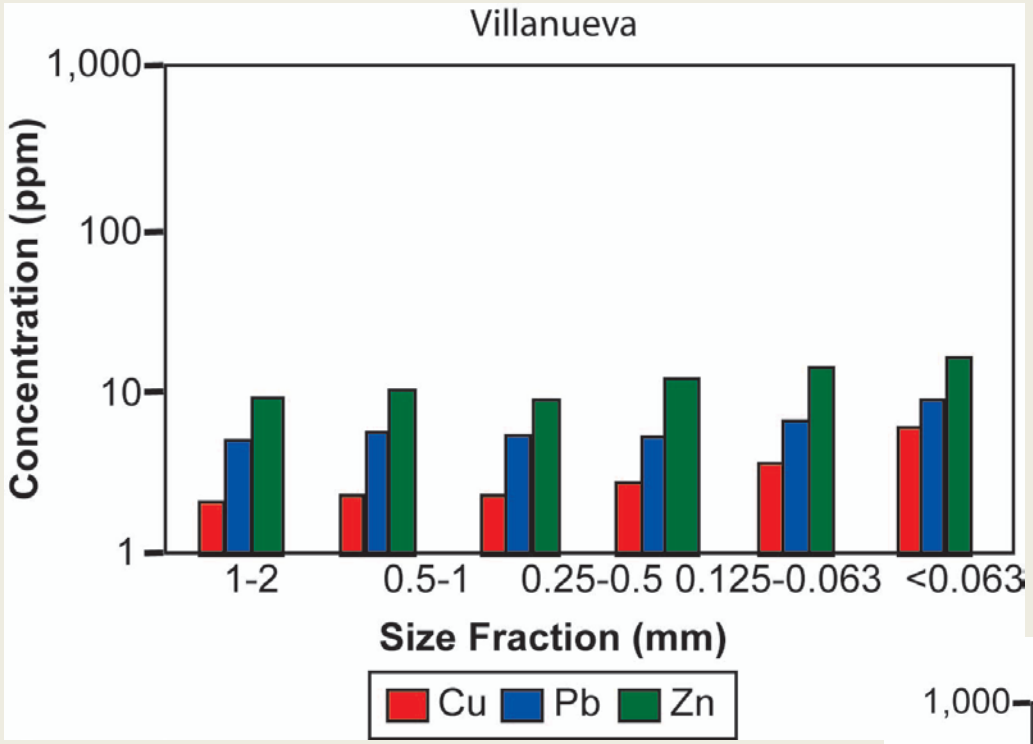
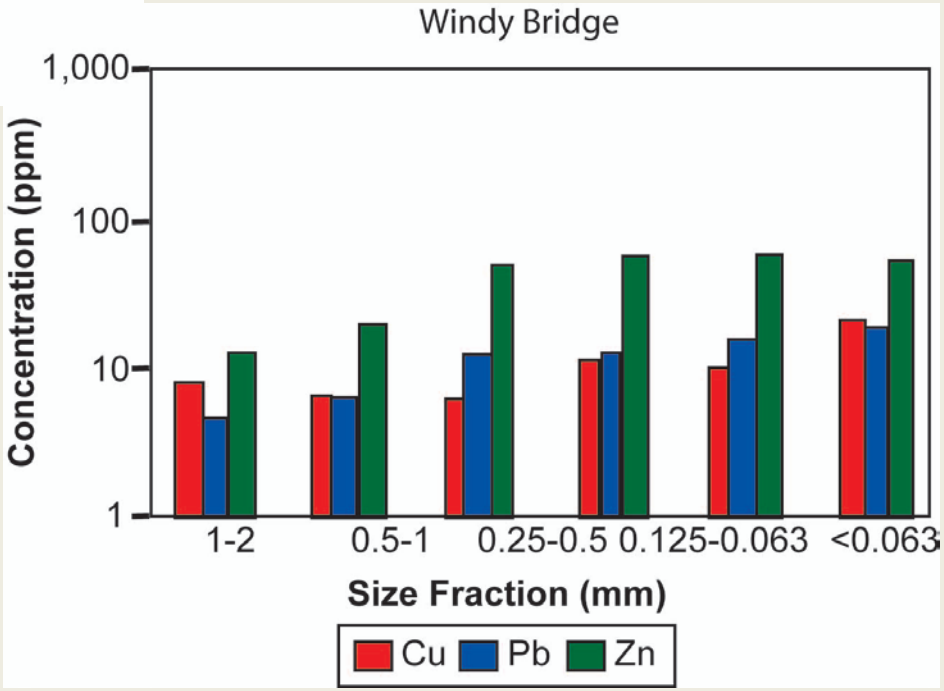
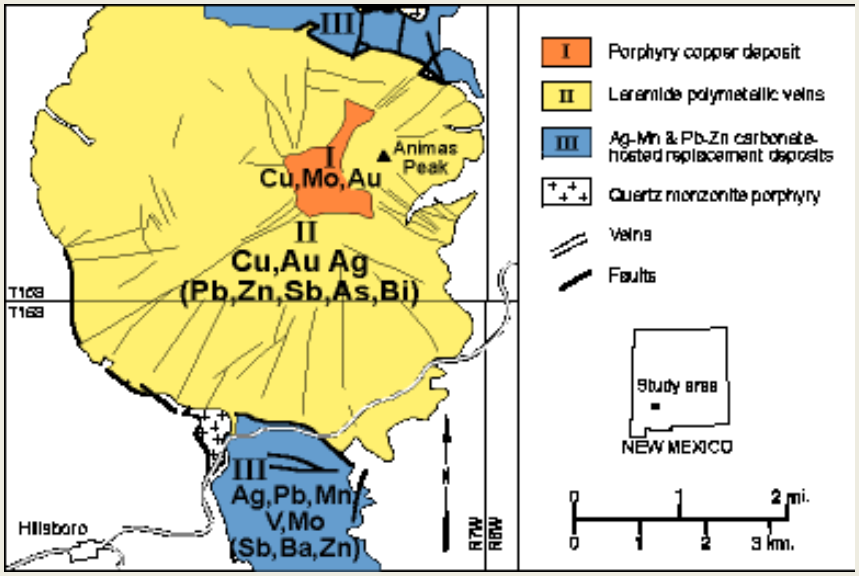
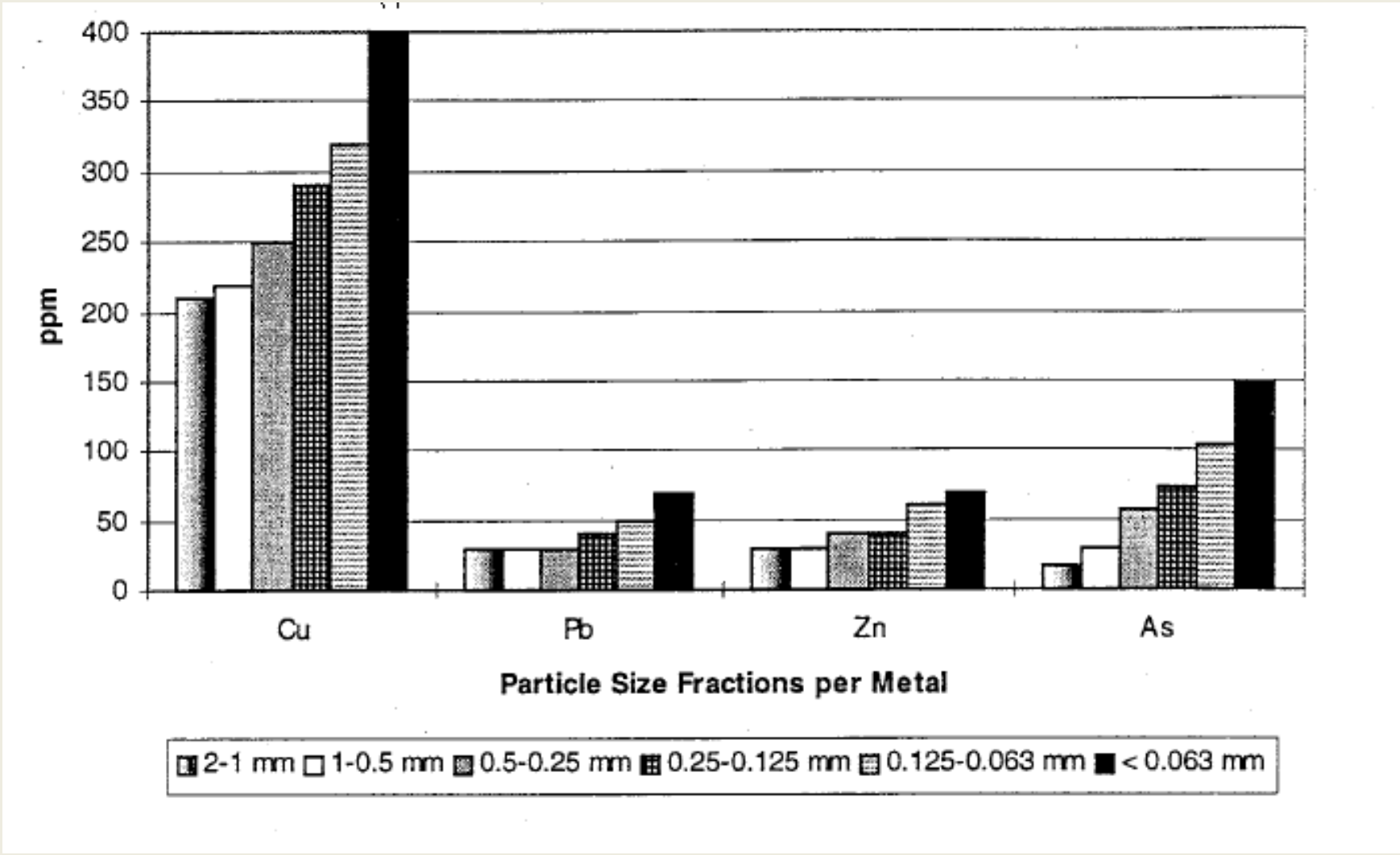




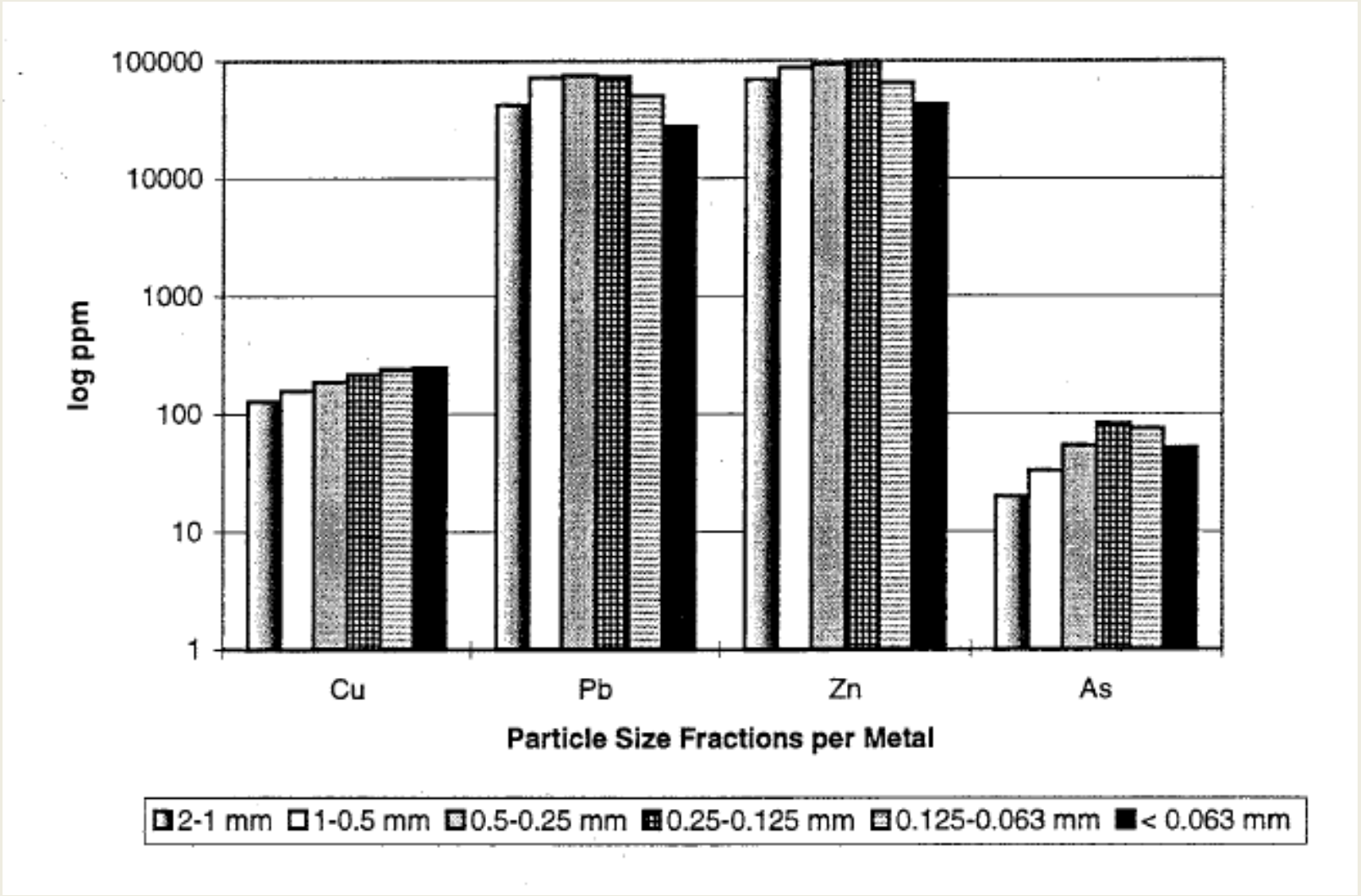
Hillsboro—porphyry Cu deposit with veins, carbonate hosted Pb-Zn deposits



- The finer-size fractions are typically the smallest proportion of the sample by weight (generally, <25% in the <2 mm fraction).
- The concentrations of metals generally increase in the smallest size fractions.

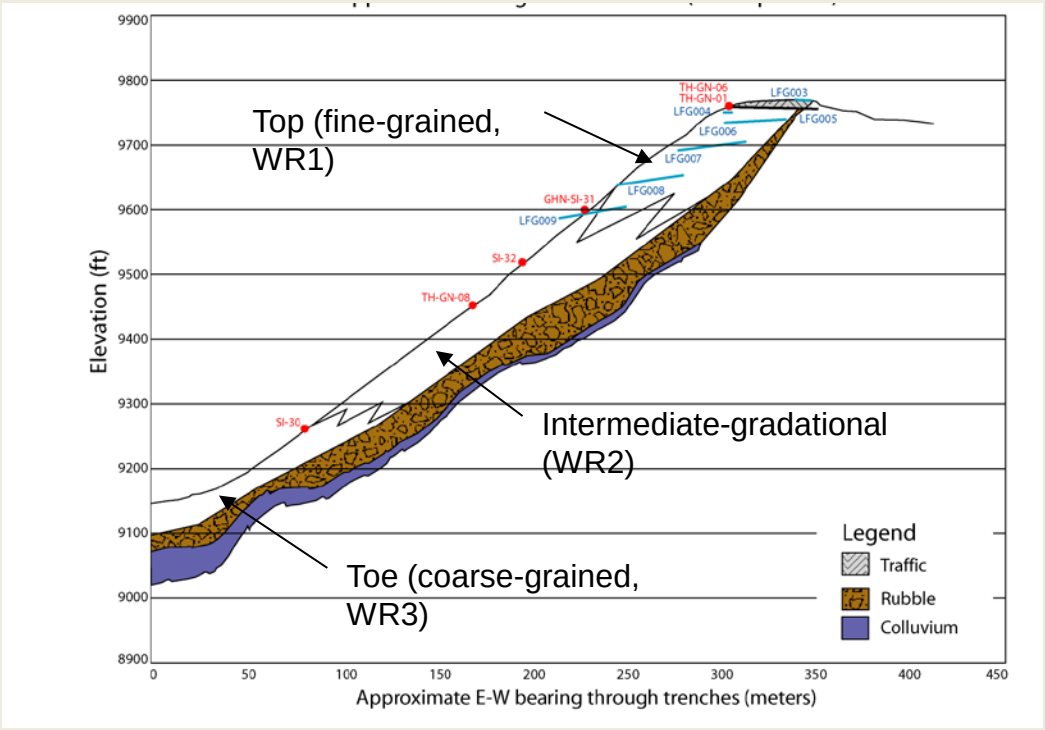


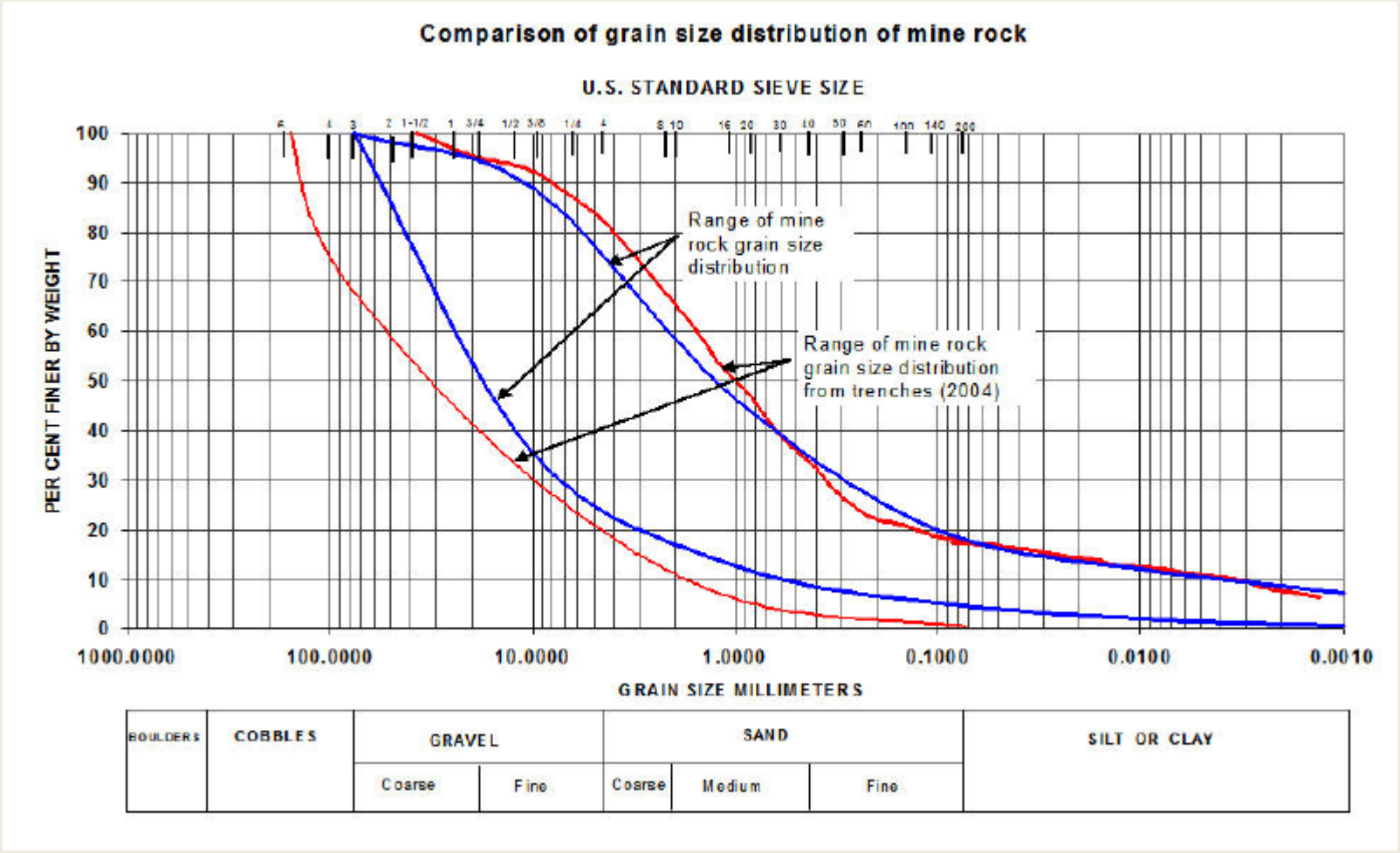
Hillsboro—increase in metals with decrease in grain size (vein rock pile, FAAS, Munroe, 1999)



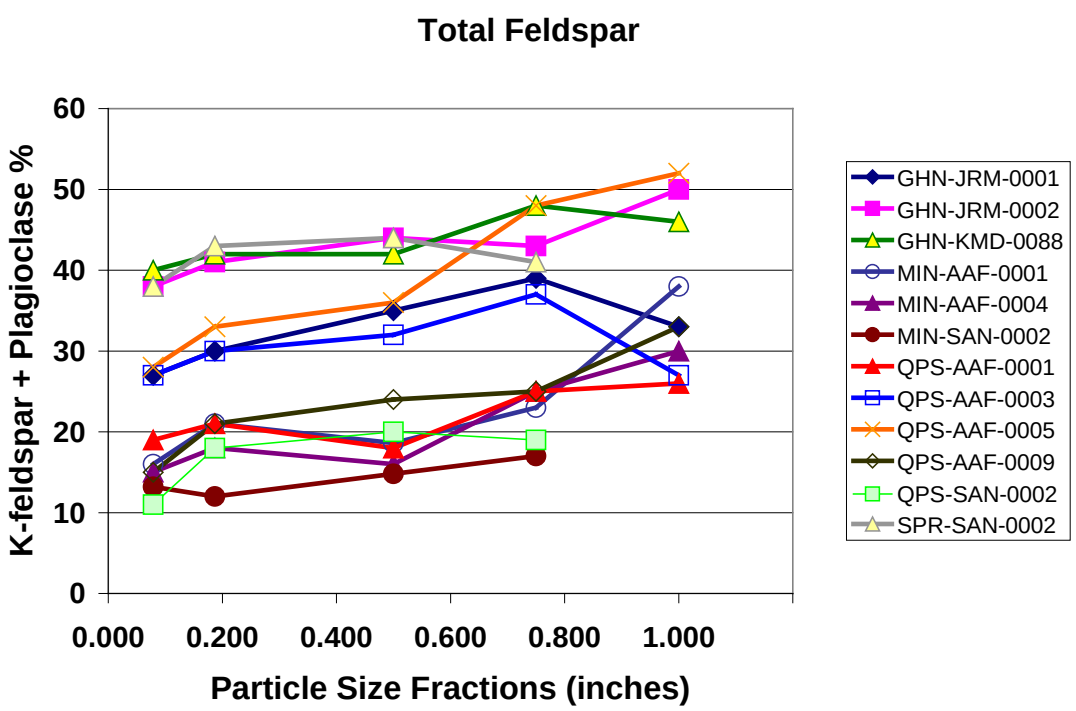
Hillsboro—increase in Cu, As with decrease in grain size (carbonate-hosted Pb-Zn rock pile, FAAS, Munroe, 1999)

Questa project—porphyry Mo deposit

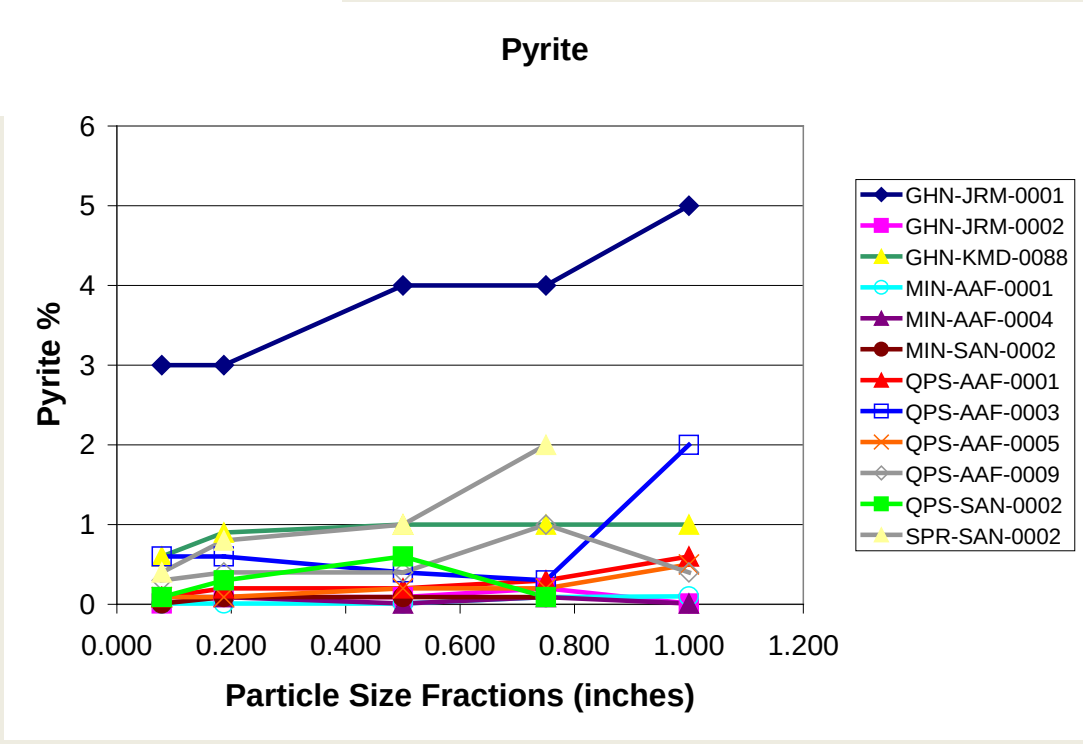


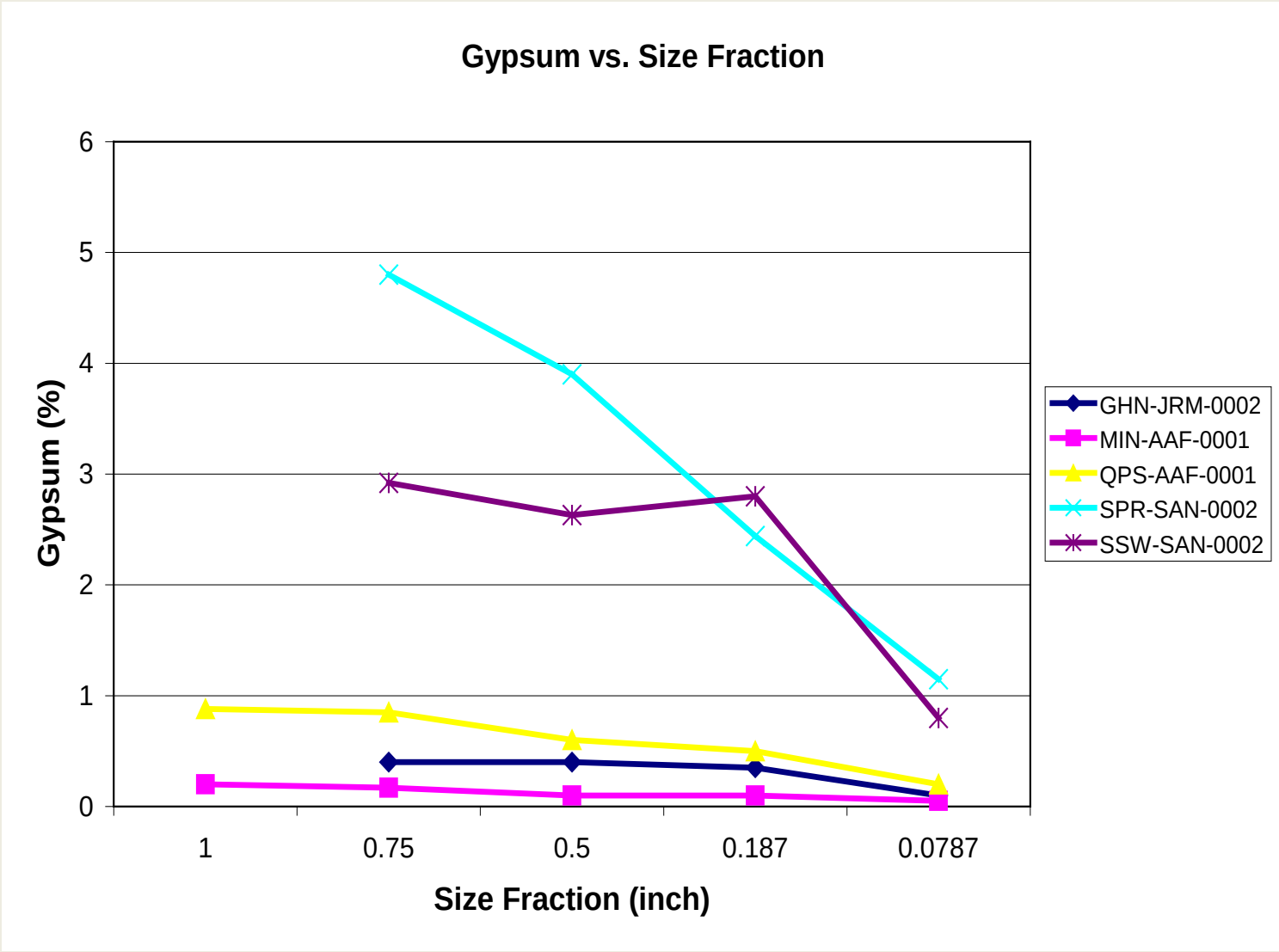


Questa rock piles—poorly-graded or well-graded sandy gravel with small percentage of fines

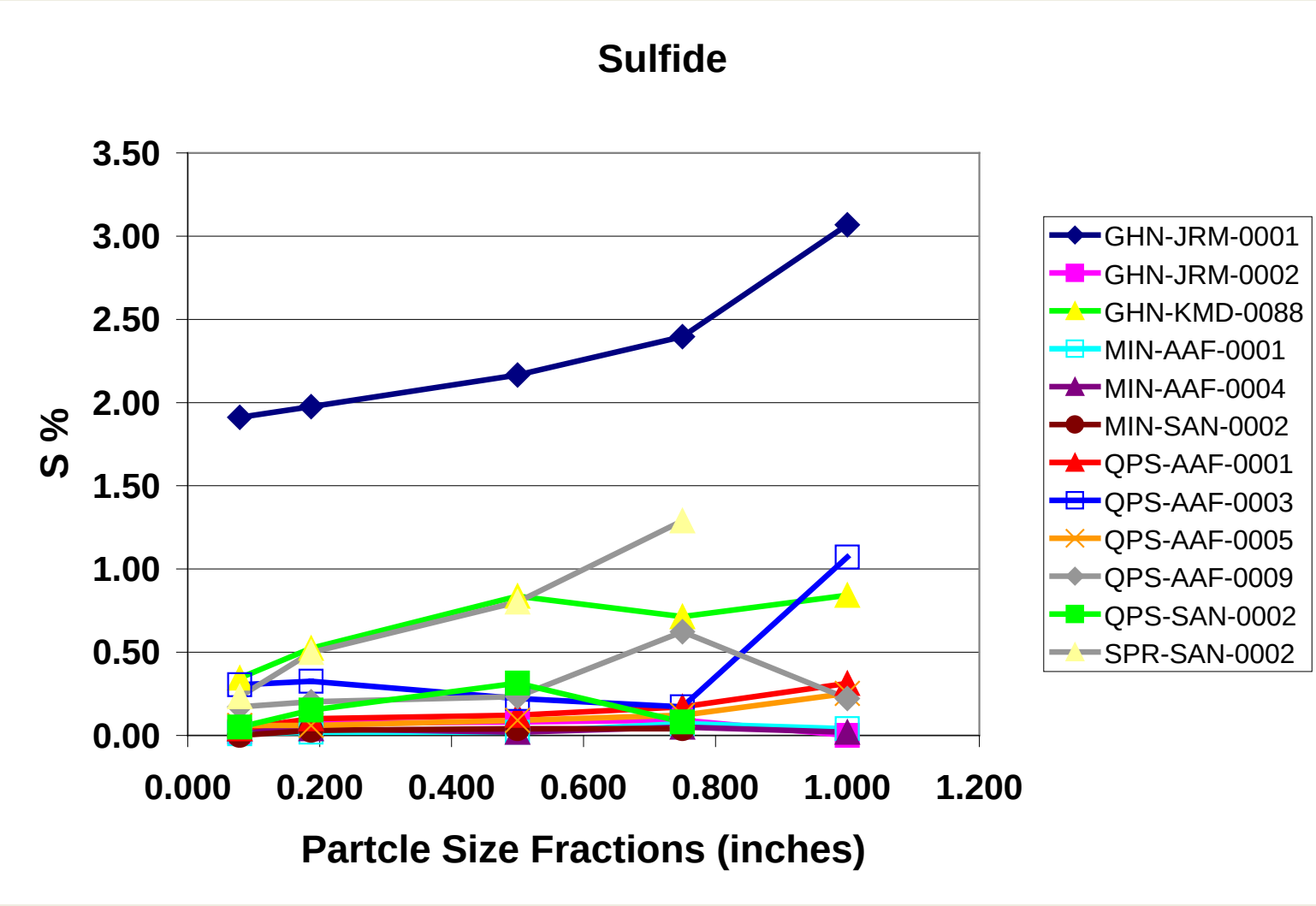


As the size fraction decreases K-feldspar, pyrite decreases

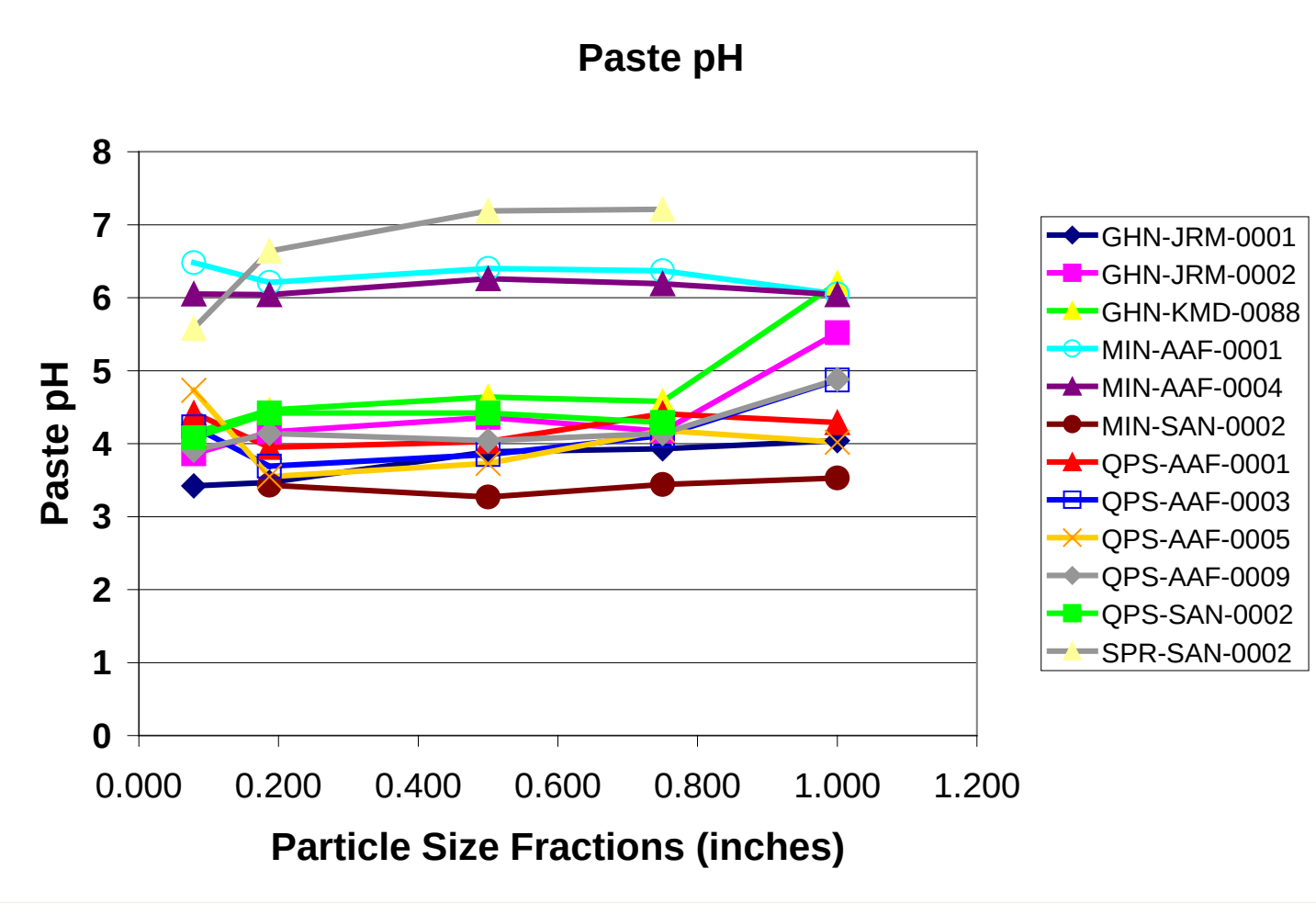




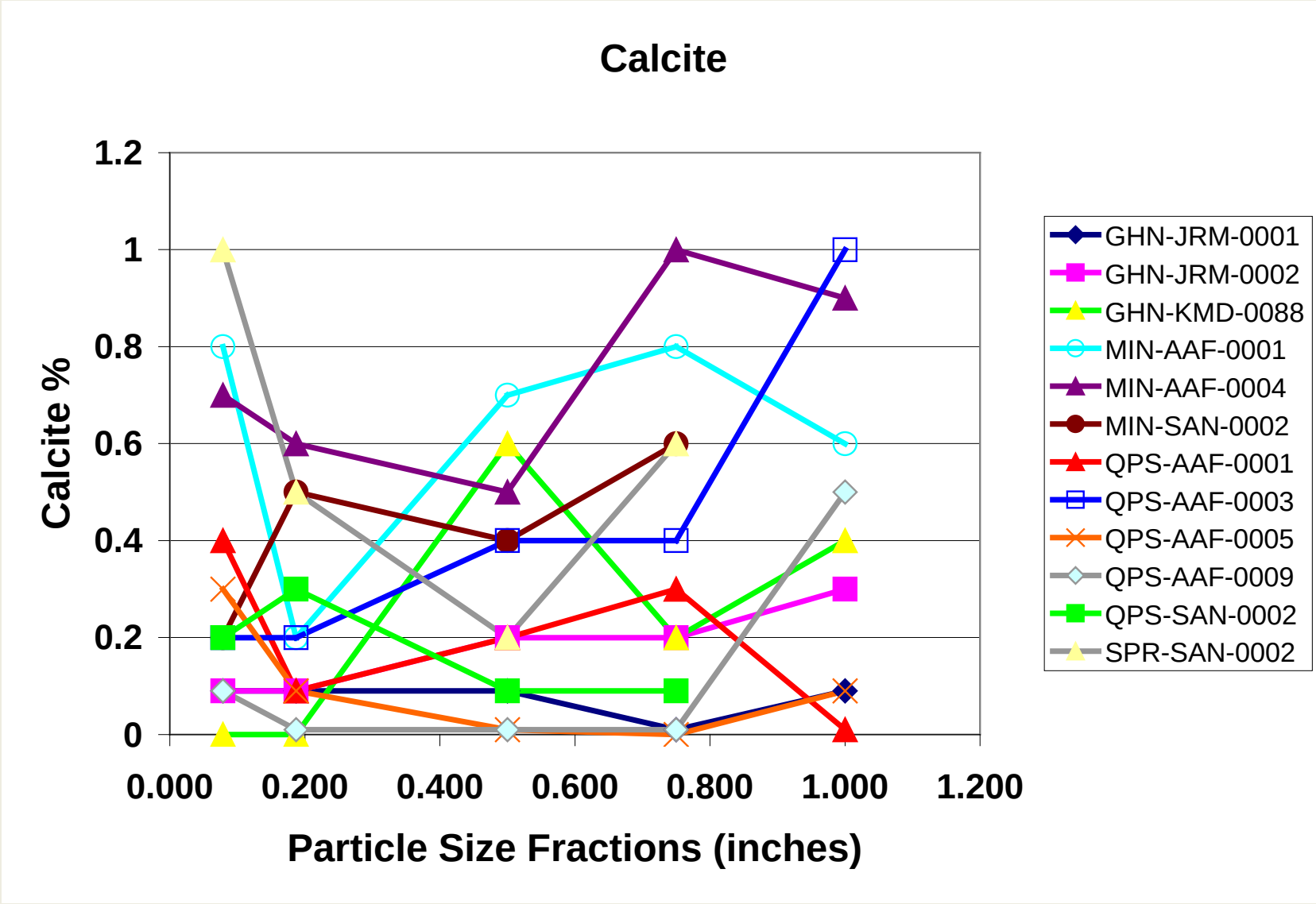
Gypsum decreases in concentration in the finer size fractions



High sulfide concentration in the larger size fractions



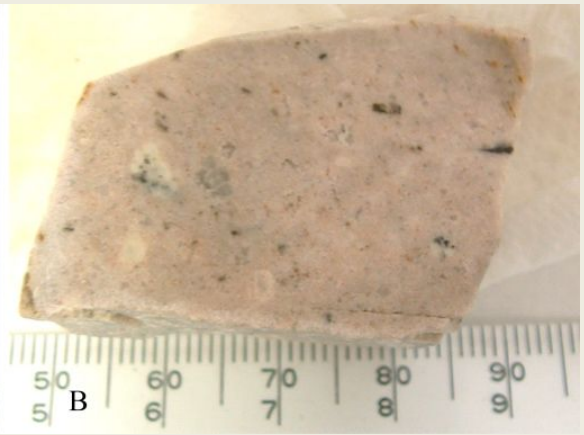
As the size fraction decreases the paste pH decreases in some samples, but not all



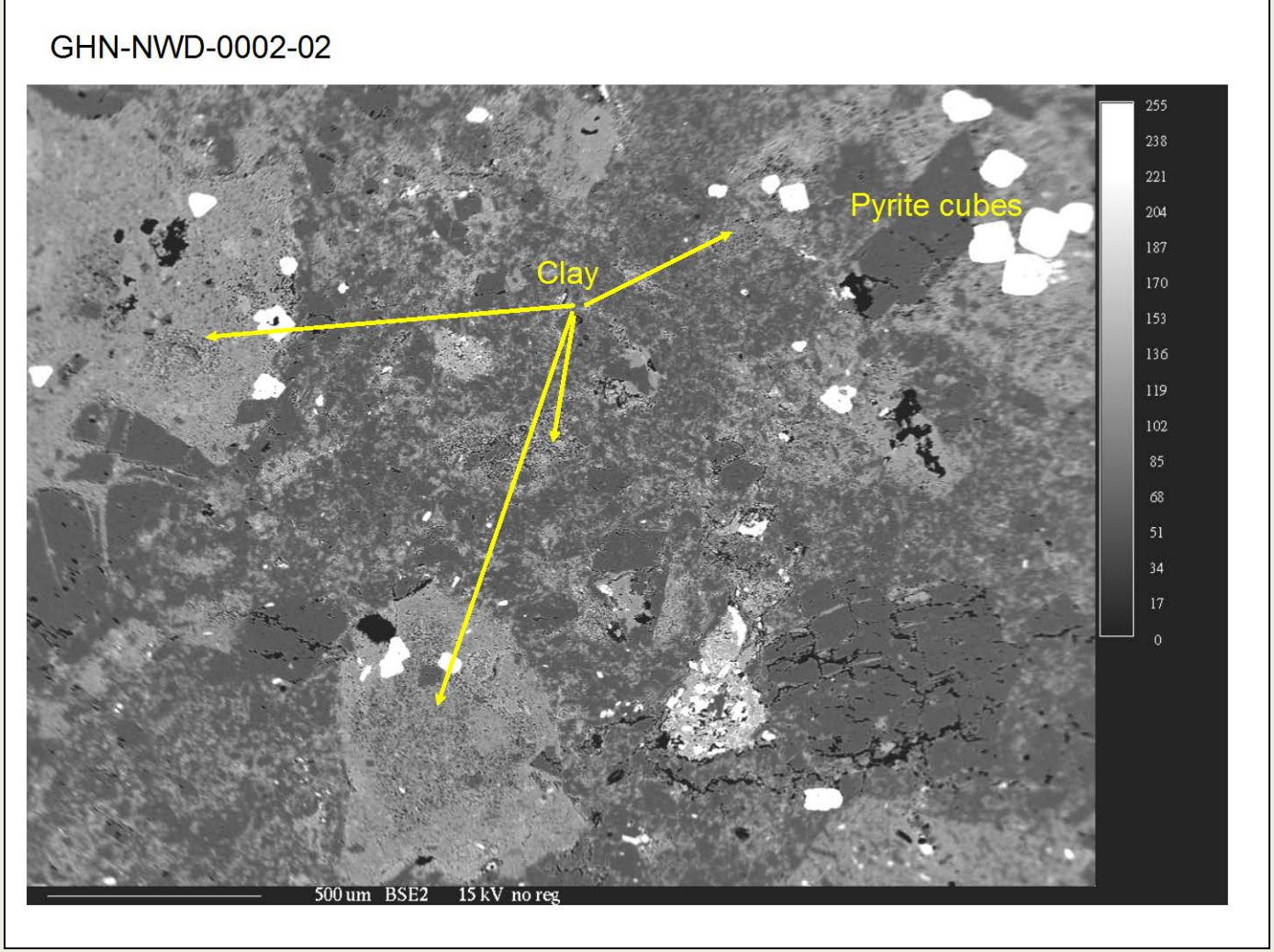
Calcite variable with size fraction sizes

- The finer-size fractions are typically the smallest proportion of the sample by weight (generally, <25% in the <2 mm fraction).
- The concentrations of metals generally increase in the smallest size fractions.
- Mineral concentrations change as well.

FACTORS CONTROLLING PARTICLE SIZE COMPOSITION

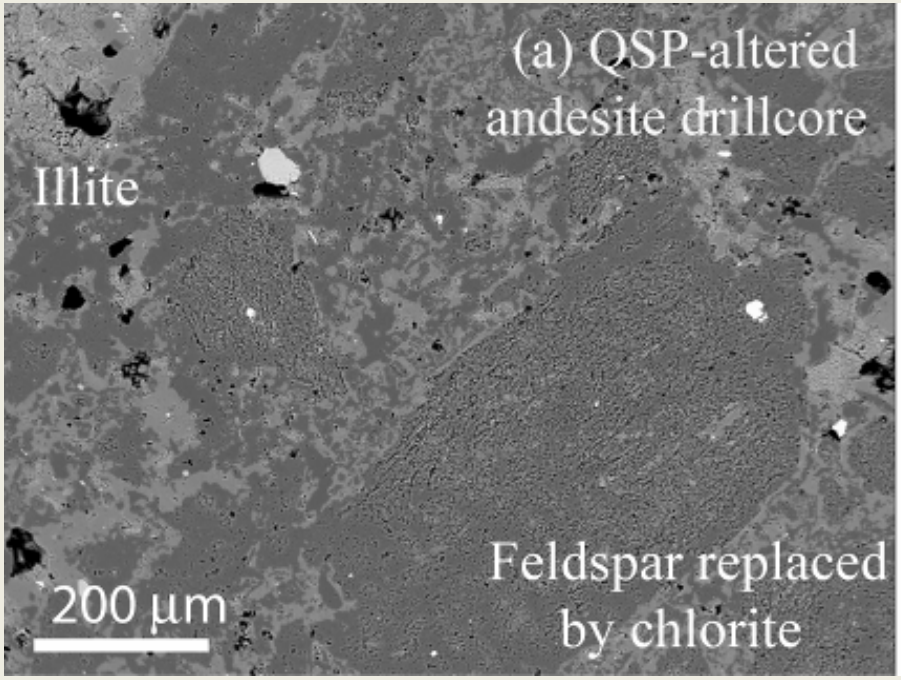


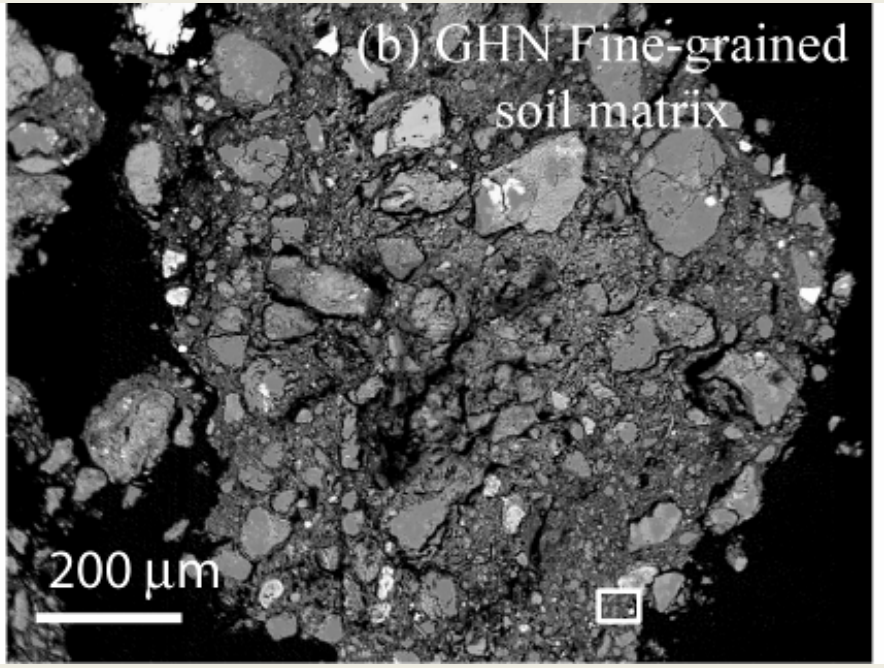
Primary igneous crystallization, pre-mining hydrothermal alteration and weathering

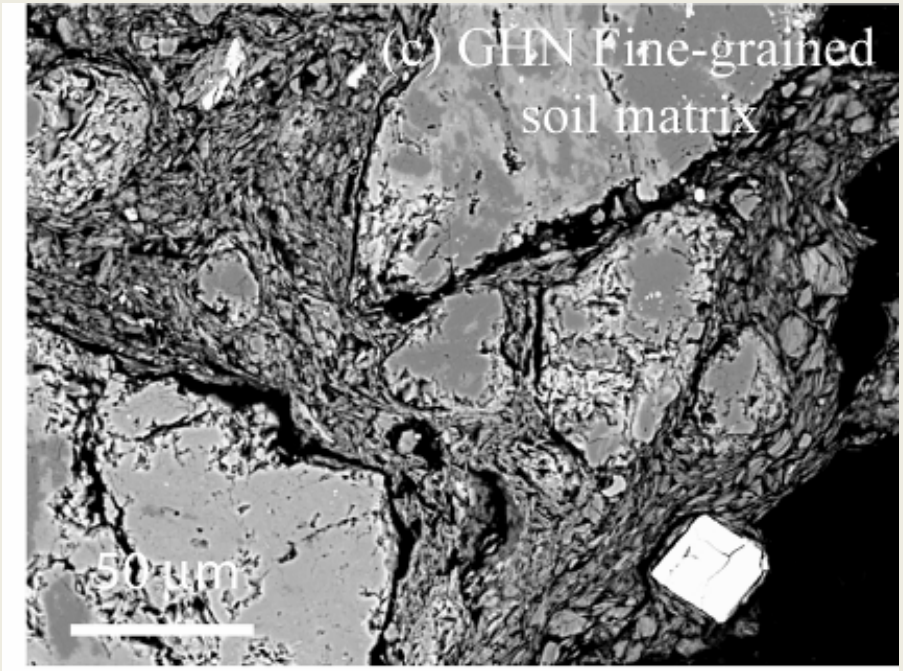


Alteration—This is an intensely altered andesite rock as evidenced by the presence of hydrothermal clay in the hachured-looking areas. Also, pyrite cubes can be seen. FOV is 2.5 mm

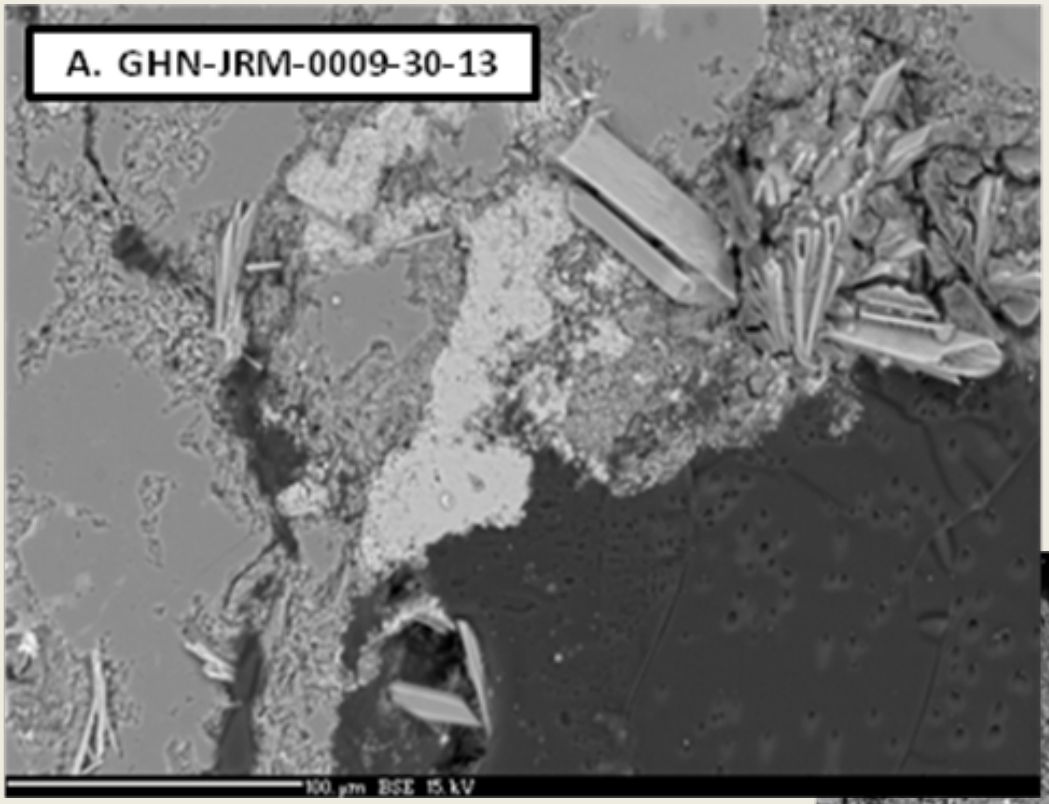
The breaking up of the rock material during blasting, hauling, and dumping during mining also contributes to differences in size fractions

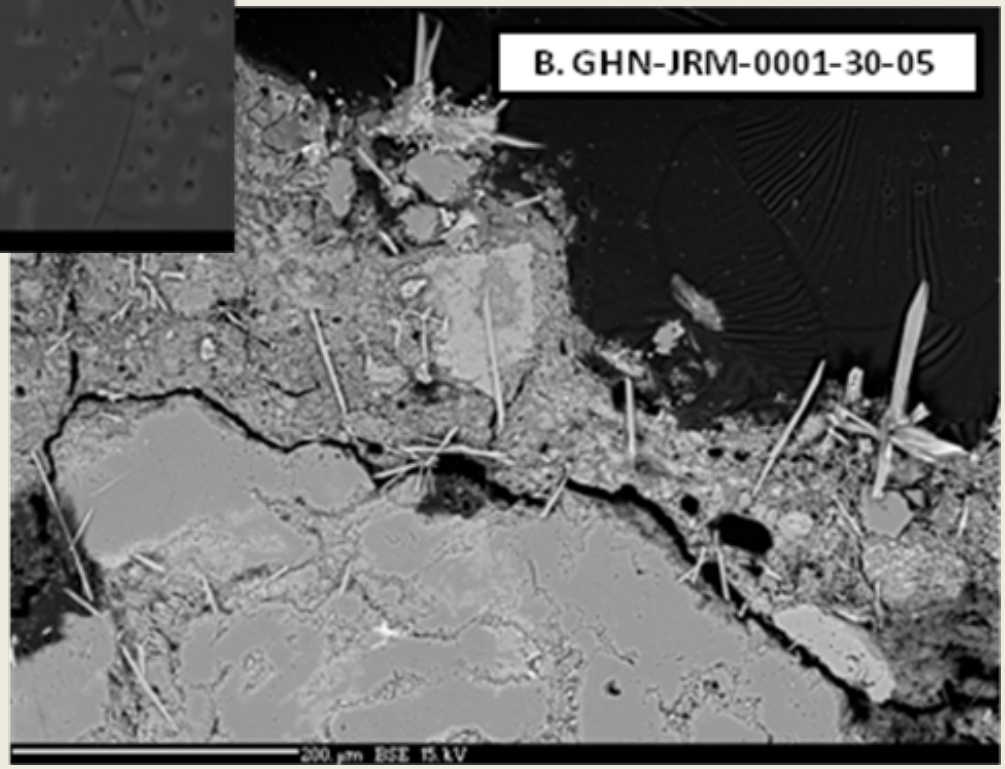




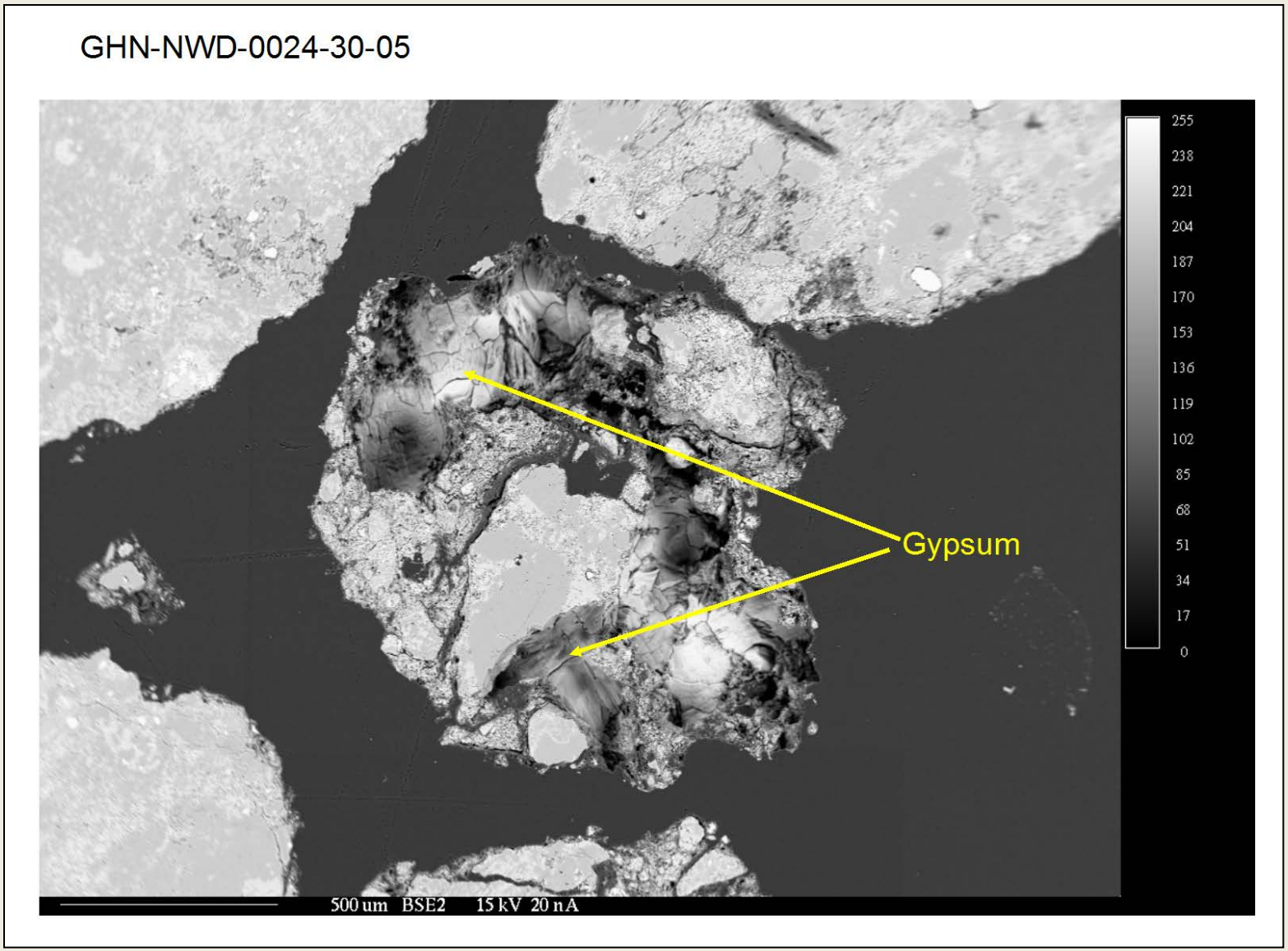


Weathering—In rock piles, the fine-grained soil matrix is weathered, while interiors of rock fragments are not

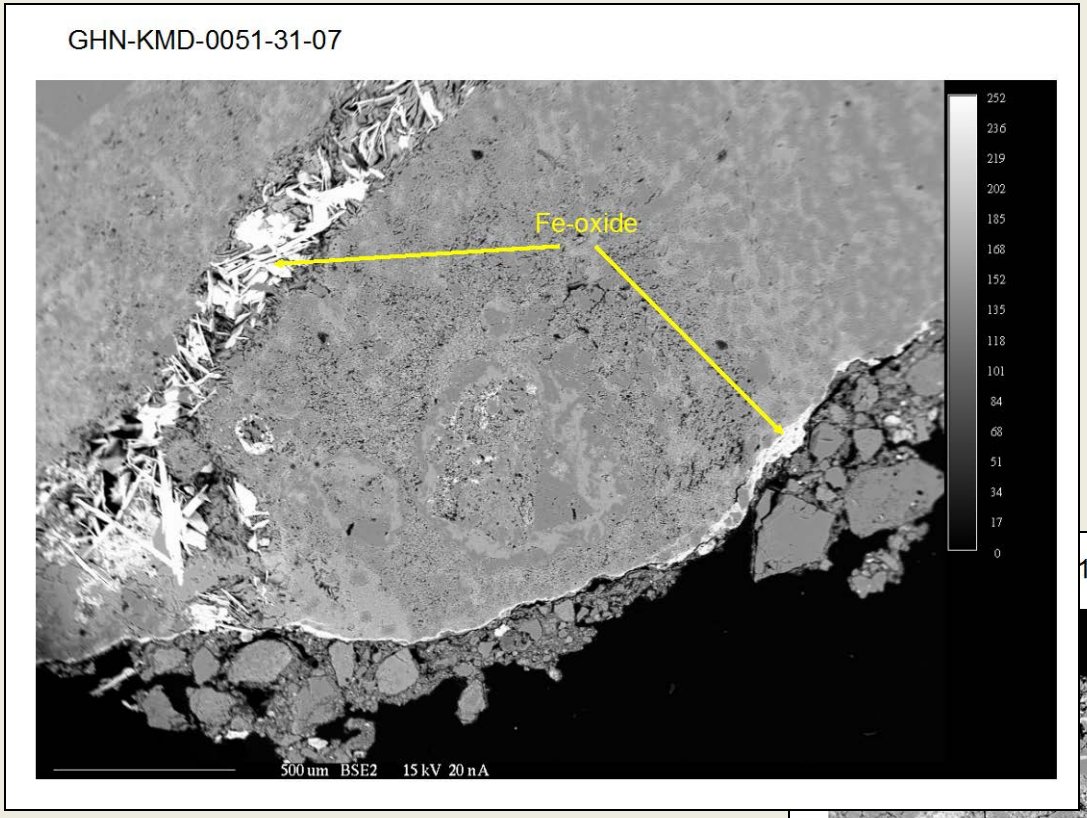


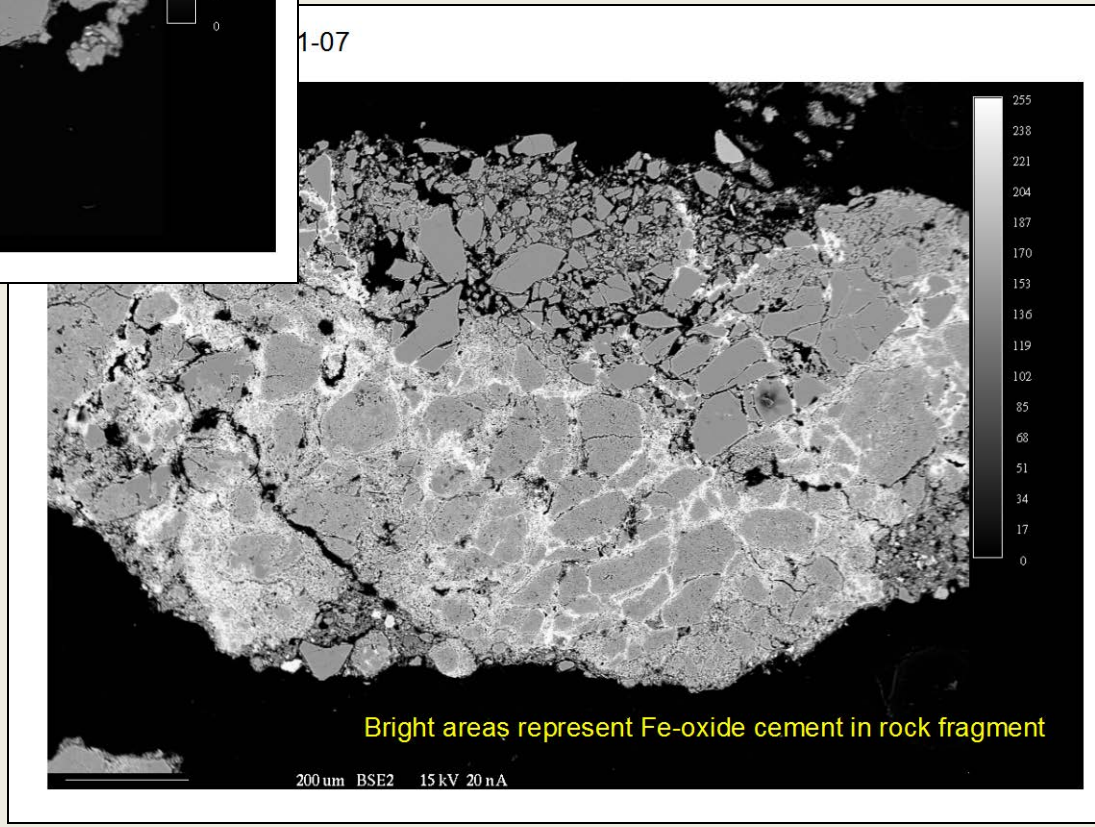


These are typical weathering textures. Note the lack of weathering of the rock fragments.



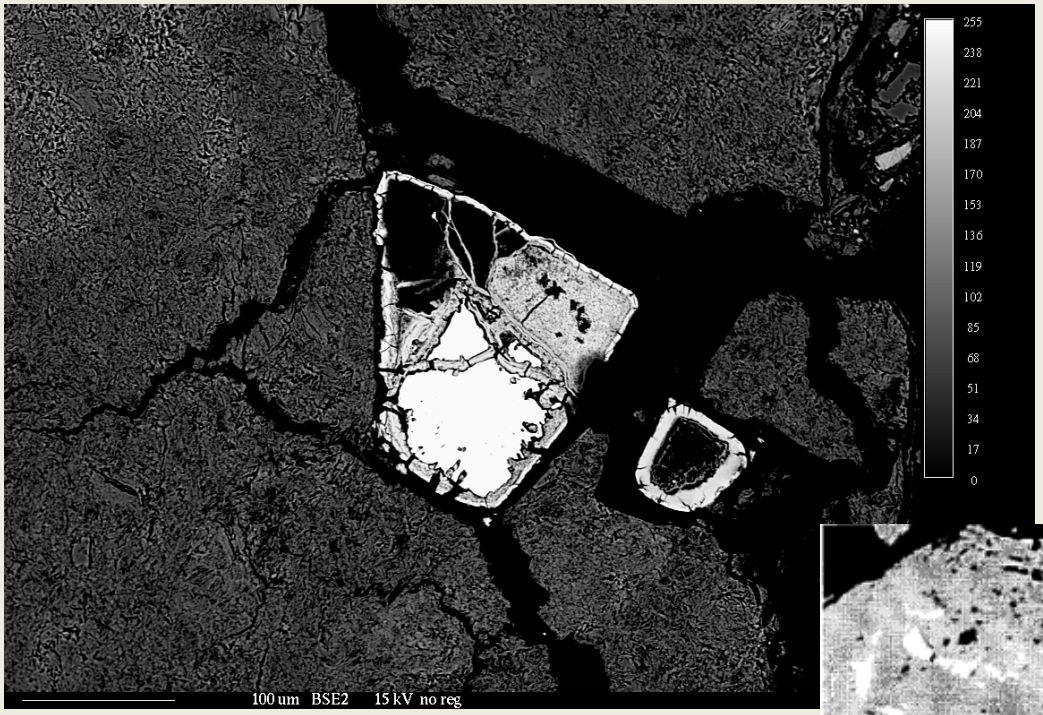
Gypsum cementation in soil sample. FOV 2.5 mm Cementation=cohesion

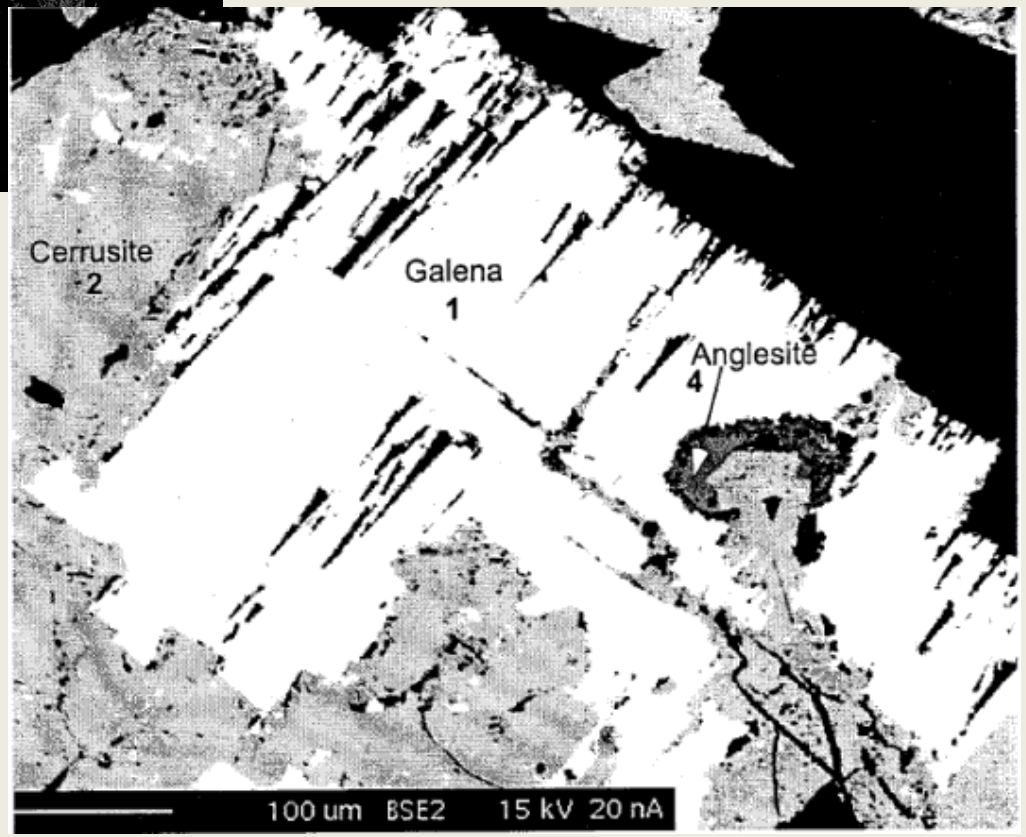




Questa rock piles—Fe oxides (weathering) cement grains on the exterior and interior of rock fragment

Precipitation of weathered minerals, such as gypsum, along fractures and veins, which increase the mineral volume and breaks apart the rock





Other minerals can armor the original crystals and prevent further weathering of sulfides

Ore material can be more friable and less cemented, compared to other more resistant, typically silicified material that can form the wall rock in many districts

CONCLUSIONS

- Primary igneous crystallization, pre-mining hydrothermal alteration and weathering, and post-mining blasting, hauling, dumping, and emplacement into the rock pile and subsequent weathering affect the composition of each size fraction

CONCLUSIONS

- The finer-size fractions are typically the smallest proportion of the sample by weight (generally, <25% in the <2 mm fraction)
- Paste pH values decrease from the coarser-size fraction to the finer-size fraction
- The sulfur concentrations are higher and the NP lower in the finer sizes than larger particle sizes

CONCLUSIONS

- Weathering can be more pronounced in the finer-size fraction than the coarser-size fraction
  - Amoring
  - Cementation

Acknowledgements

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  - U.S. Bureau of Reclamation (cooperative agreement no. 3-FC-40-13830)
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  - Gabriel Graf
  - John Morkeh
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