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
Dam at San Miquel on the Pecos River.

Pecos River area—stream sediments draining a VMS deposit.

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

Pecos River below Willow Creek and the Pecos mine.
• 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 versus metal content—Pecos stream sediments
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Size fractions verses metal content—Pecos stream sediments
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

Sampling a trench

Top (fine-grained, WR1)

Intermediate-gradational (WR2)

Toe (coarse-grained, WR3)
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
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