Background, Baseline, and Premining Conditions

- Definitions
- Importance
- Examples: Pebble Mine, Questa Project

Definitions (not universally agreed upon)

- Background (USGS)
  - Usually considered to be “natural background” without man-made changes; doesn’t exist; too fuzzy a concept
- Baseline (USGS)
  - Current conditions at time of sampling
    - Regardless of whether mined or not
- Premining
  - Conditions existing before mining
    - Again regardless of whether otherwise influenced by man or not

IMPORTANCE of Premining Conditions

- Mine sites are mineralized areas with naturally elevated concentrations of metal contaminants in soils, sediments, water, vegetation, and animals
- Should be the goal for mine site remediation; not some standard that might apply to clean water usage but never occurred naturally

PROBLEM: What Were the Premining Conditions at Mine Sites Where No Premining Data was Collected?

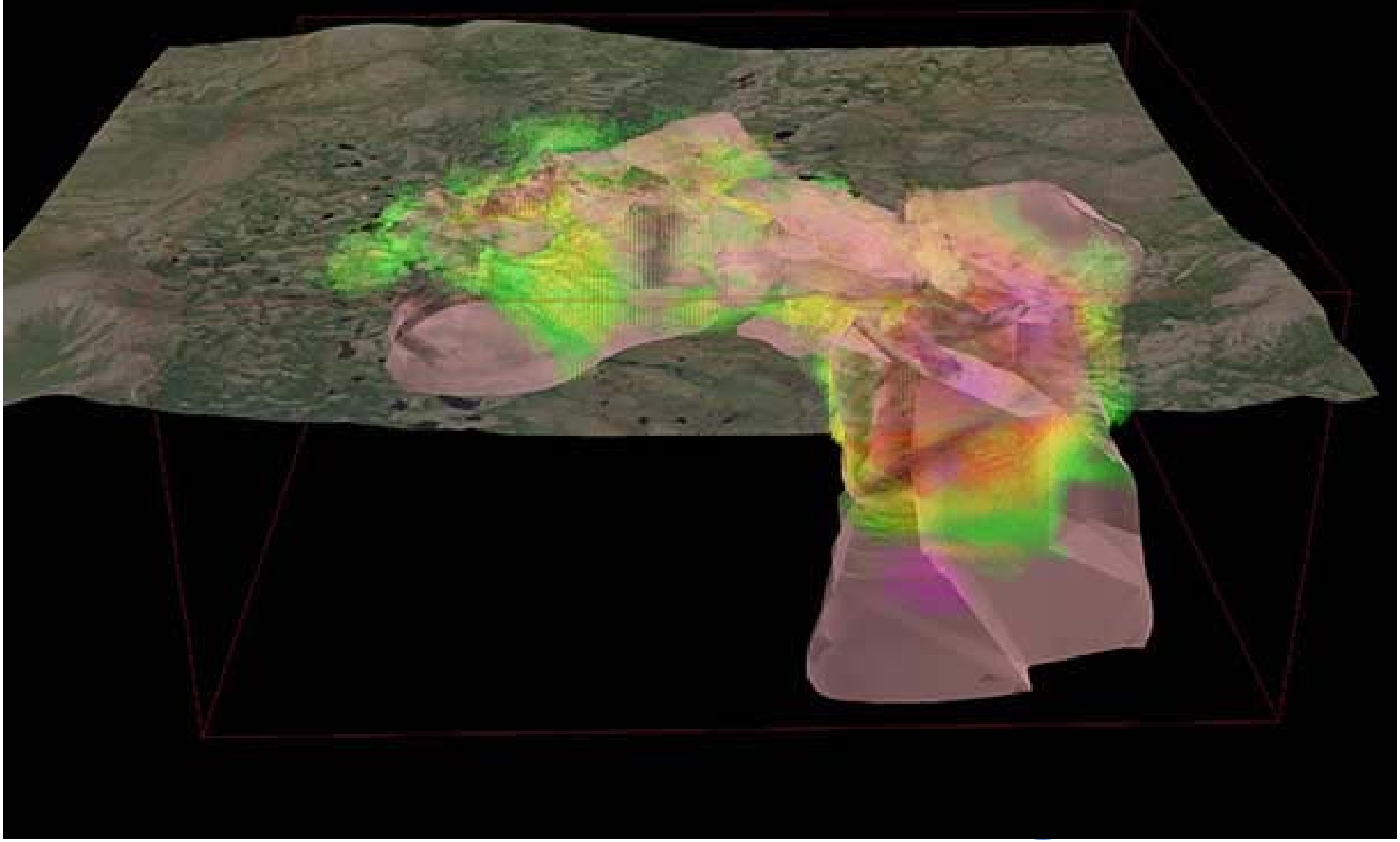
- Sometimes it is possible to infer these conditions for old mines

- New mines should be required to collect this information and have it reviewed by an independent and scholarly oversight committee; one example would be the proposed Pebble Mine site in Alaska

Alaska's Proposed Pebble Mine

- 2nd largest metal deposit ever found – possibly worth $500,000,000,000 in Au, Cu, & Mo
- Site of some of the best salmon spawning grounds in the world; also trout
- Fishing is the only source of income and the only skill for several communities of native Americans

Outline of the Pebble Deposit



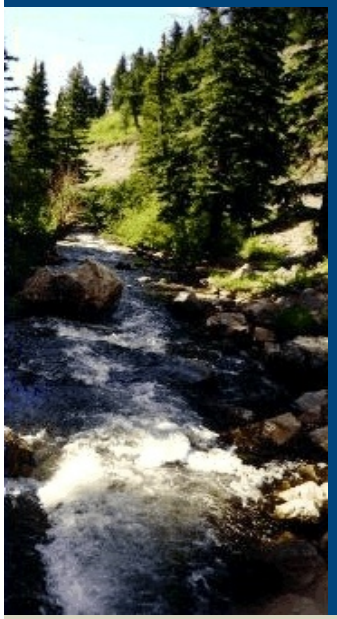
The Pebble Partnership reclaims drill holes as they are drilled, leaving behind no evidence of exploration visible by air. Virtually no cleanup is required once drill holes are completed as the helicopters remove everything safely.

Can Au-Cu-Mo be mined from one of the largest mines in the world without harming one of the best salmon breeding grounds in the world? ? ?

Stay tuned . . . . .

“Questa Baseline and Pre-Mining Ground-Water Quality Investigation”

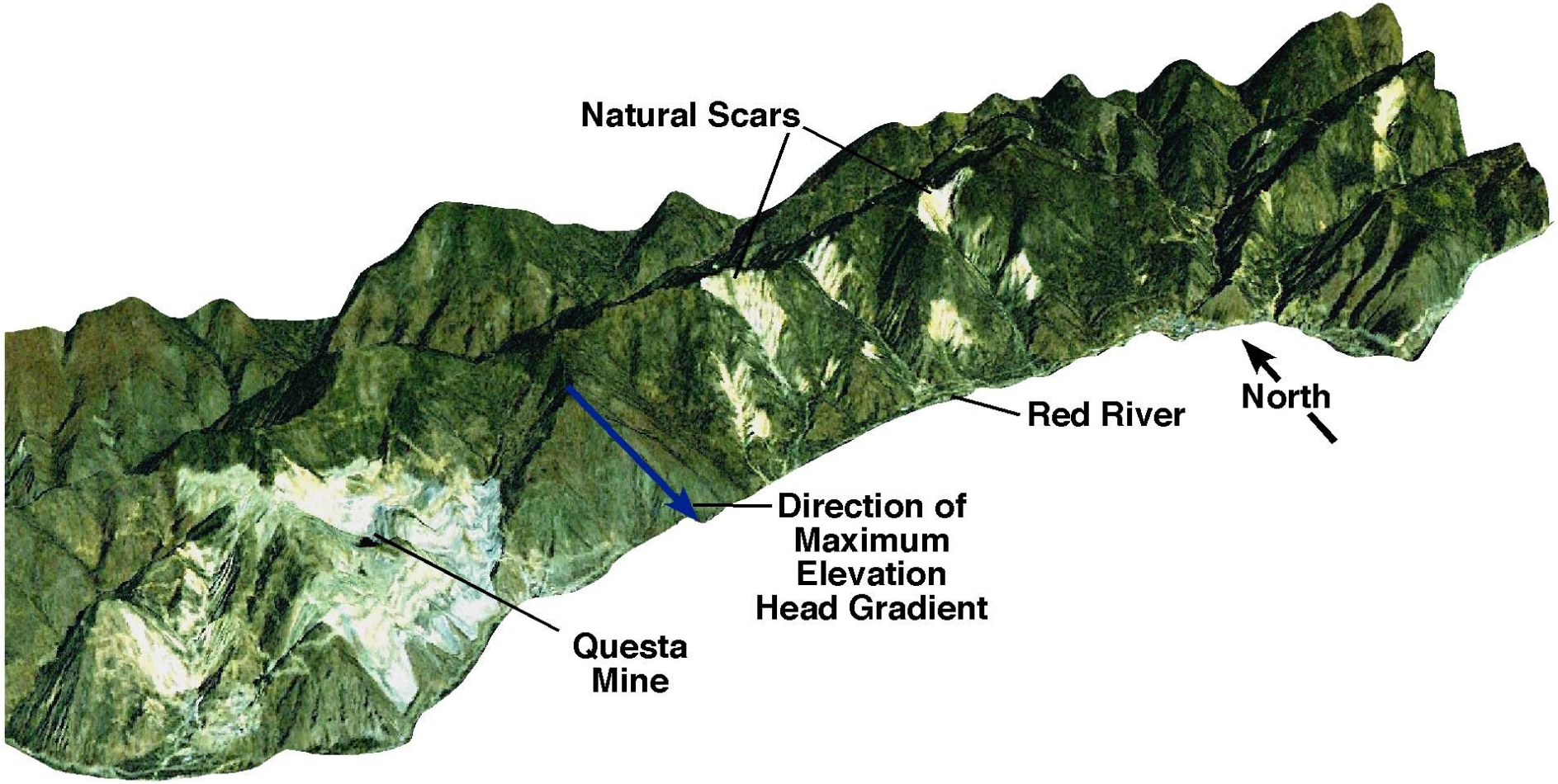
- $4 million, 5-yr (2001-2006), 30-person project
- 27 USGS reports
- In cooperation with the New Mexico Environment Department



Main Objective
To Determine the Pre-mining Ground-water Quality of an Active Mine Site:

- The State of New Mexico requires mines to meet GW quality standards on closure unless it can be shown that the GW quality was worse before mining – then those pre-mining GW quality parameters can be used as site-specific standards for close-out regulatory requirements.
- How? by studying a proximal analog site, *most direct and least ambiguous of possible approaches*

North side of Red River Valley – Area of Investigation



Questa Conclusions (1 of 3)

- Detailed study of a proximal analog site was successful in constraining the possible range of concentrations by detailing natural weathering rates and demonstrating solubility limits
- Comparison of the geology and mineralogy of the analog site to the mine site showed many similarities; some differences were found that were used to modify the constraints on water chemistry

Questa Conclusions (2 of 3)

- Concentrations for constituents of concern (Fe, Al, Mn, Cu, Pb, Zn, Cd, Co, Ni, Cr, F, SO_4, and TDS) average about 10-fold greater than the New Mexico ground-water quality standards. Mn can be 250 times the standard.
- Mineral solubility effectively controls concentrations of Fe(II) and Mn at neutral pH and high alkalinity (siderite and rhodochrosite)
- Mineral solubility effectively controls concentrations of Fe(III) at pH > 2.5 (ferrihydrite, schwertmannite, …)

Questa Conclusions (3 of 3)

- Mineral solubility effectively controls concentrations of Ba and Ca over a range of pH (barite and gypsum)
- For acid waters metal:sulfate ratios are relatively constant, indicating consistent weathering rates
- Cd/Zn ratios are relatively constant and correlate with that found in sphalerite, the main source.
- Co/Ni ratio is very constant and correlates with that found in pyrite
- Concentrations of metals are constrained by mineral solubilities, weathering rates, and abundance in mineral sources – providing estimates of pre-mining ground-water quality given a catchment with a known lithology and alteration mineralogy