ENVIRONMENTAL GEOCHEMISTY FOR THE MINING INDUSTRY

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SUMMARY

The Exploration Geochemist is the first and most important Environmental Geochemist on every property that has the potential to be a mine.

Need to broaden the Exploration Geochemists role in Environmental Geochemistry both functionally and fiscally

The mining industry needs to increase synergy between phases of mining

CRUCIAL GEOCHEMICAL NEED

1. "It is crucial that the pre-minining environmental **baseline conditions** (those that exist prior to the proposed mining)

and **background conditions**

(those that existed naturally prior to any mining or human conditions)

at a proposed mine site and within the watershed(s) surrounding the site be constrained in as much detail as possible prior to any mine development."

Plumlee and Logsdon, 1999

1969/1970 NEPA

National Environmental Policy Act

Use all practicable means to conduct federal policies that will promote the general welfare and be in harmony with nature.

Goal to assure healthful, productive and both aesthetically and culturally pleasing surroundings for all generations.

EIS - Environmental Impact Statement

BACKGROUND/BASELINE CRITICAL

Federal Water Pollution Control Act - 1972 Became Clean Water Act - 1977

National Pollutant Discharge Elimination System (NPDES) - Point Discharges

Total Maximum Daily Load (TMDL)

Adds Non-point Discharges

NEED GROUNDWATER AND SURFACE WATER BACKGROUND AND/OR BASELINE

Resource Conservation and Recovery Act (RCRA) - 1976

"Cradle to Grave" control of

Listed and

Characteristic

Hazardous Waste

BACKGROUND/BASELINE

CRITICAL

CERCLA = SUPERFUND

1980 CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act - Encompasses RCRA

Release or threat of release of a hazardous substance or pollutant or contaminant into the environment

Any amount of a listed hazardous substance will trigger jurisdiction

BACKGROUND/BASELINE CRITICAL

BEVILL AMENDMENT

1980 Mining Waste Exclusion

Ore and mineral extraction, beneficiation, and 20 mineral processing wastes "temporarily" exempt from RCRA Subtitle C - becomes Subtitle D

1986 EPA split waste types into

Extraction and Beneficiation Wastes

Mineral Processing Wastes

1986 SARA

Superfund Amendments and Reauthorization Act (SARA)

Emergency Planning and Community Right-To-Know Act

COMMUNICATION OF BACKGROUND AND BASELINE CRITICAL

COMMUNICATE

Actively seek to openly and honestly educate/inform the public about background and baseline results as simply and technically correct as possible in addition to the regulatory agencies through all media.

The public does not know that the soils surrounding their homes contain chemicals and certainly cannot differentiate between total and soluble concentrations (mineralogy).

QUESTION

If someone told you something was safe and someone else told you it was unsafe, who would you believe?

POLL ANSWER

68% Would believe it UNSAFE

22% Depends on who was speaking and what was being discussed

10 % Would believe it SAFE

Gregg, A.R., 2003

Gallup Poll on Drinking Water

Confident/Very Confident

79% - Doctor/Healthcare Professional

73% - State Environmental Agency

66% - Environmental Groups

64 % - Water Companies

57% - Newspapers/TV

56% - Federal Government

August 6, 2003

Communication

Number	Percent	Word or Element	Mineral
447M		Home	
61M	100	Car	
20-40M	33-65	Environment, Earth, Boy, Girl, Cat, Au	
10-20M	16-33	Dog, pH, Fe, Ag	
5-10M	5.5-16	Mining, Soil, Acid, Al, Ca, Cu, Pt, Hg	Clay
1-5M	1.6-5.5	Sustainability, Ecology, Mineral, Si, Ti, Mg, Na, K, S, Cl, N, PO4, Li, Zn, U, Co	Quartz
0.5-1M	<1-1.6	SO_4, NH_4, P, Mn, Pd, As, Cr, Cd, Rn, I	Carbonate
0.1-0.5M		CN, Sb, Tl, F, Sr, Bi, In, Ra, Th, Zr, Be, Mo, Ta, Nb, Ba, Cs, V, Br	Calcite, Dolomite, Feldspar, Kaolinite, Bentonite
10T-100T		Redox Potential, Rb, Sc, Ce, La, Eu, Te, Am,	Albite, Plagioclase, Montmorillonite
5-10T			Sericite

GOOGLE, Keyword Results, July, 2003

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Toxic Release Inventory

TRI

TOXIC RELEASE INVENTORY

1997 EPA includes Mining

DOES NOT RECOGNIZE BACKGROUND

Report material containing 25,000 pounds of a listed chemical **manufactured or processed** annually or 10,000 pounds of a listed chemical that is otherwise used annually

2001 Lowered Lead and Lead compounds to 100 pounds

TOXIC RELEASE INVENTORY

Metal Mining Report of Releases

Lead

1998 - 444,949 pounds

All Reporting Sources - 22,742,939 pounds

Lead Compounds

1998 - 208,929,887 pounds

All Reporting Sources - 289,602,994 pounds

Total Production-Related Waste Metals Category

Billion Pounds:

Cu 2.352, Zn 1.444, Pb 1.234

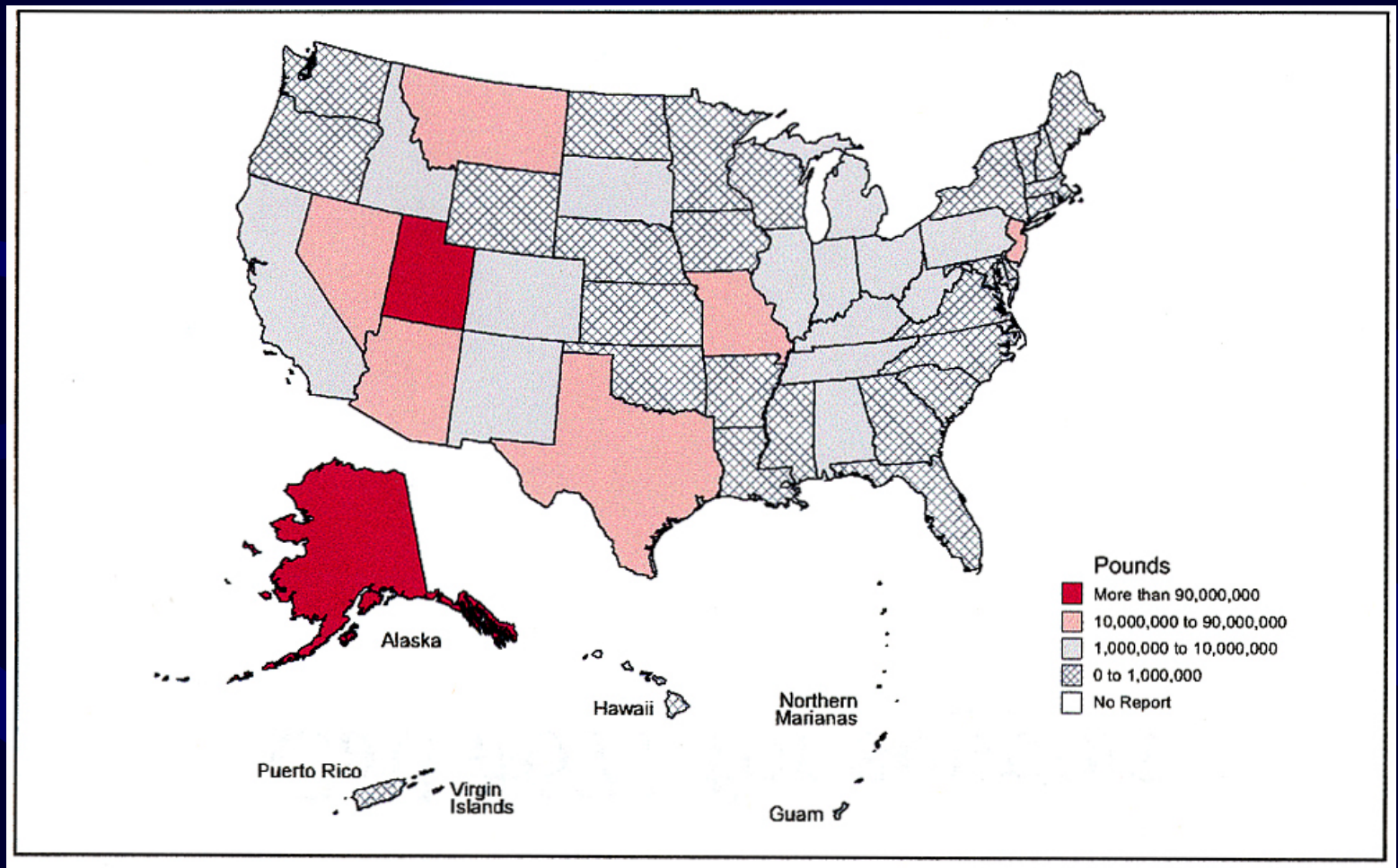
Mn 0.597, As 0.388, Ba 0.326, Cr 0.283, Ni 0.224

Million Pounds

V 97.7, Al 65.3, Sb 39.9, Co 31.1, Cd 17.6,

Se 10.9, Ag 6.81, Hg 5.82, Tl 3.98, Be 1.26

Lead and Lead Compounds TRI



Note: On-site Releases are from Section 5 of Form R. **Off-site Releases** are from Section 6 (transfers off-site to disposal) of Form R. **Off-site Releases** include metals and metal category compounds transferred off-site for solidification/stabilization and for wastewater treatment, including to POTWs. **Off-site Releases** do not include transfers to disposal sent to other TRI Facilities that reported the amount as an on-site release.

Toxic Release Inventory

Manufacture - produce, prepare, import, or compound including the coincidental production of a toxic chemical

If a toxic chemical is produced coincidentally as a byproduct in excess of the reporting threshold, reporting will be required.

TOXIC RELEASE INVENTORY

Barrick Goldstrike Mine Challenge - 2003

Waste rock generally ruled exempt from reporting

Toxic elements that persist and/or bioaccumulate like lead and mercury still must be reported; others present at concentrations >1 percent

Tailings are “processed” material and not exempt from TRI reporting

EPA preparing new TRI reporting procedures for the mining industry

REACH

EU Draft Legislation

Registration Evaluation and Authorization of Chemicals

Registration required depending on the volume of a substance produced and on the likelihood of exposures to humans or the environment

DUE DILIGENCE

Environmental Site Assessments

being required for

Funding for new or expanding mine projects, underwritings, public offerings, mergers and acquisions

Environmental background/baseline work is required.

BACKGROUND/BASELINE ISSUES

How do we know we have not and will not increase and/or change the

Elemental Concentrations

AND/OR

Mineralogy

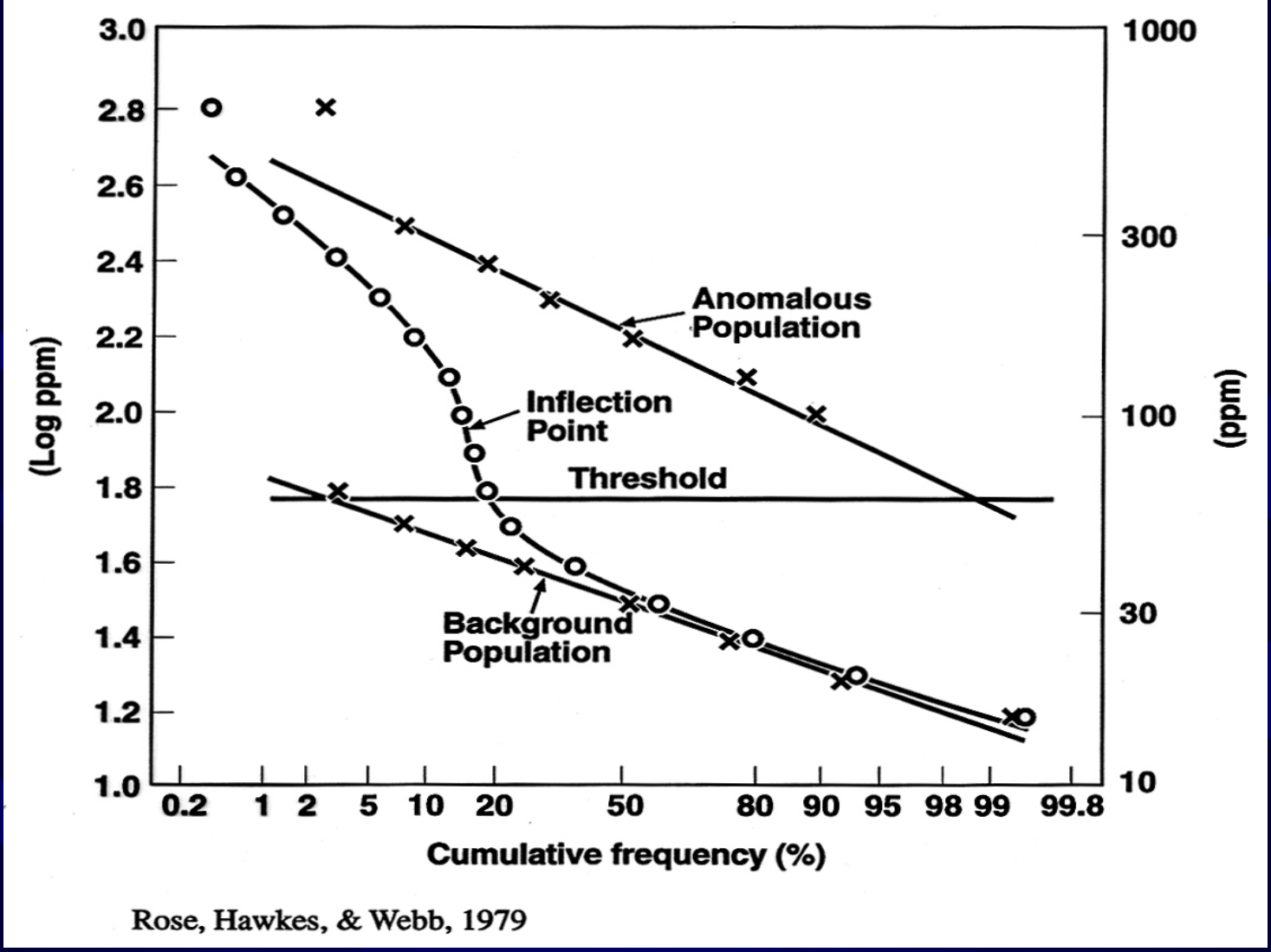
from background/baseline conditions?

GEOCHEMICAL BACKGROUND

"The normal abundance of an element in unmineralized earth materials….In the simplest case, the threshold is the upper limit of normal background fluctuations."

Rose, Hawkes and Webb, 1979

Determining Background



Rose, Hawkes, & Webb, 1979

GEOCHEMCIAL BACKGROUND

The concentration of a given chemical parameter (element or species, inorganic or organic) in a given sample of geological material having no component from human influence.

David Smith, USGS, 2003

ORIGINAL SUPERFUND BACKGROUND

"… a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, from a location where it is naturally found."

Sara, 1986

SUPERFUND BACKGROUND

A background level is the concentration of a hazardous substance that provides a defensible reference point that can be used to evaluate whether or not a release from the site has occurred. It should reflect the concentration of the hazardous substance in the medium of concern for the environmental setting on or near the site.

Hazard Ranking System Guidance, 1992

SUPERFUND BACKGROUND

1) Naturally occurring - substances present in the environment in forms that have not been influenced by human activity

2) Anthropogenic - natural and human-made substances present in the environment as a result of human activities.

Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites, 2002

GEOCHEMIST TOOLS

FIELD PORTABLE XRF for screening elemental concentrations EPA Method 6200

IR for screening mineralogy

No EPA method yet

Remote Sensing for site to regional mineralogical screening

Undergoing Technological Evaluation

Field Portable XRF

REMOTE SENSING

USABLE DATA

Known Quality

Information is accurate, reliable and unbiased involving the use of best available science and supporting studies conducted in accordance with sound and subjective scientific practices.

Data are collected by acceptable methods or best available methods. The reliability of the method and the nature of the decision justifies the use of the data

U.S. EPA, October, 2002

QUALITY ASSURANCE

1. Quality Assurance Manager
2. Quality Management Plan
3. Acceptance Criteria applicable to all projects
4. Annual Assessment of System
5. Verify that existing data are of sufficient quantity and adequate quality for intended uses
6. Provide appropriate training for all levels

MINERAL INDUSTRY

Continue to form a united support of public education that the industry provides a necessary basic value and is environmentally responsible

Increase synergy by forming teams from multiple compartments of mine development particularly the exploration and environmental groups

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THANK YOU

Welcome all Questions