

# *Acid-Mine and Acid-Rock Drainage in Colorado: Mining and Natural Sources*



Mining-related Acid-Rock Drainage

U.S. Department of the Interior  
U.S. Geological Survey

*18 Oct 2019  
Western States Water Council  
Breckenridge, Colorado*



Natural Acid-Rock Drainage

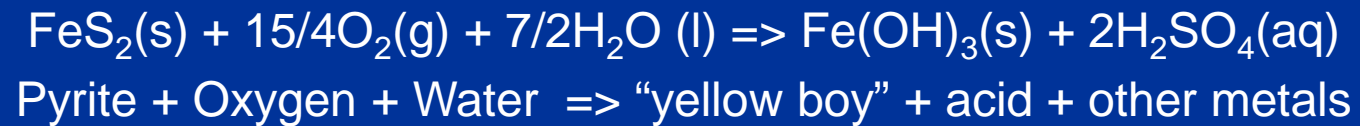
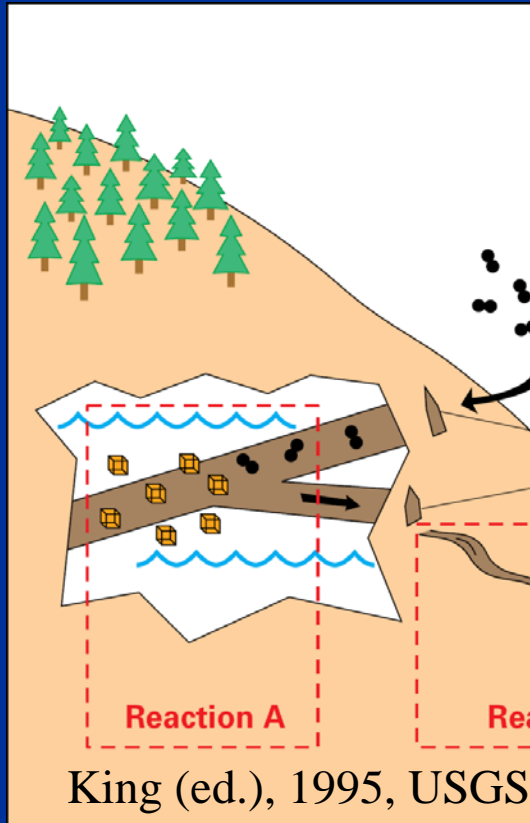
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# Outline

- Intro to acid rock drainage (ARD)
- Natural ARD and volcanic calderas
- USMIN
- Colorado: Extent of 303(d) listed waters and mine features
  - USMIN provides framework
- Natural and Mining ARD examples
- Summary



# Introduction to acid rock drainage (ARD)

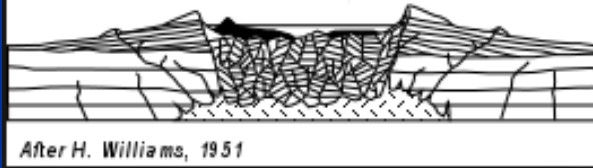




# Natural ARD and Volcanic Calderas



<https://www.nps.gov/thingstodo/yell-grand-canyon-of-the-yellowstone.htm>





# USGS Mineral Deposit Database Project (USMIN)

## Mineral Deposit Data

Prospects

Deposits

Mines

Districts

NI 43-101 Technical Report  
Mountain Pass Rare Earth Project,  
San Bernardino County, California

Report Date: May 1, 2012  
Mineral Deposit Database Project  
Nugget Corp., Inc.



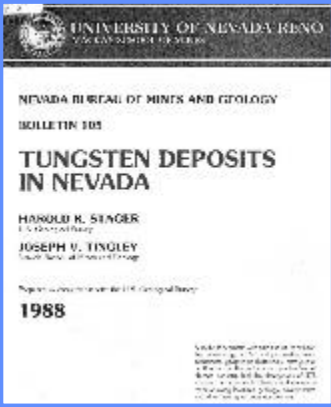
Report Prepared by  
**srk consulting**

Report Commissioned by  
Tungsten Deposits in Nevada  
1988

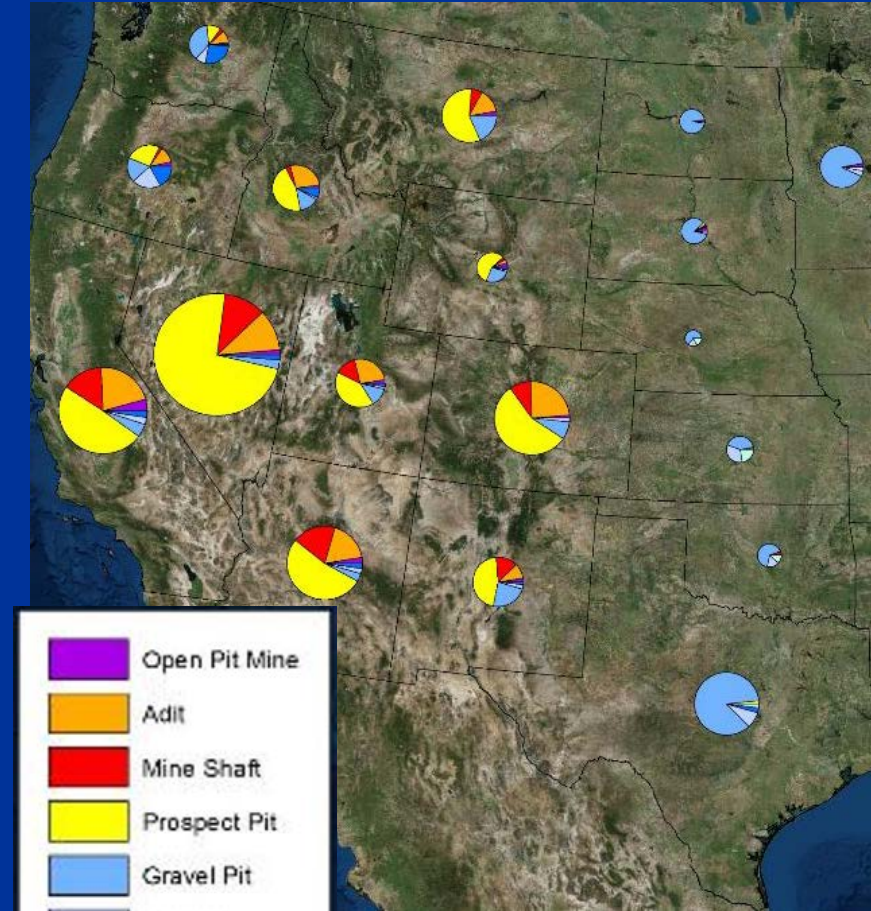
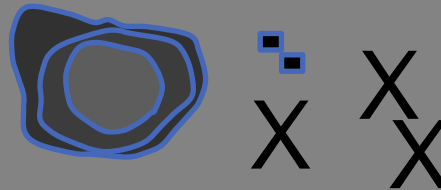
Report by USGS  
Scientific Staff  
1988

Report by USGS  
Scientific Staff  
1988

Report by USGS  
Scientific Staff  
1988



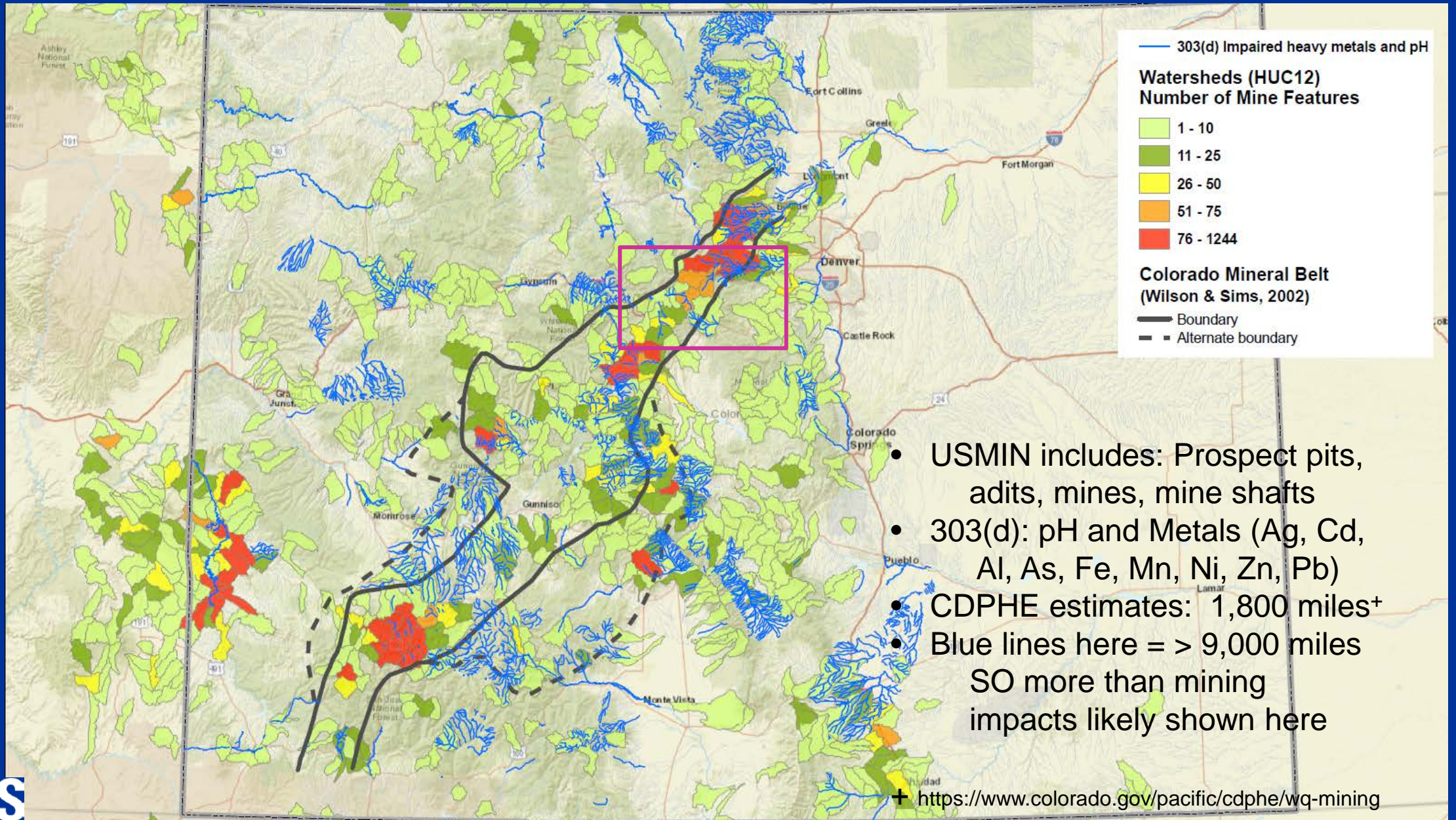
## Mine Symbol Data



- Open Pit Mine
- Adit
- Mine Shaft
- Prospect Pit
- Gravel Pit
- Quarry
- Borrow Pit
- Sand Pit



# Colorado





# Natural ARD example

- Low number of mining features
- Little to no mining in the watershed
- Porphyry Mo deposit has *extensive alteration*
- Elevated zinc concentrations = High background metal concentrations
- Difficult to impossible to clean up





# Mining ARD example

- High number of mining features
- Large extent of mining and prospecting
- Vein deposits have **limited alteration**
- Elevated zinc concentrations = mining related
- > \$60 million in cleanup → Trout!





# Techniques to separate Natural and Mining ARD

- USMIN example
- Understanding background geology/hydrothermal alteration and ore deposit character (porphyry vs. vein, e.g.)
- Locations of greatest metal sources
- Mining historical accounts
  - Rhonda (1876) described waters in both Mineral and Cement Creek in the Silverton area as iron sulfate waters that were undrinkable
- Evolving....



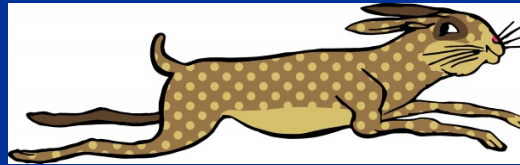
# Summary

- Acid rock drainage
  - Pyrite + water + oxygen → sulfuric acid and dissolved metals

- Natural ARD = Slow

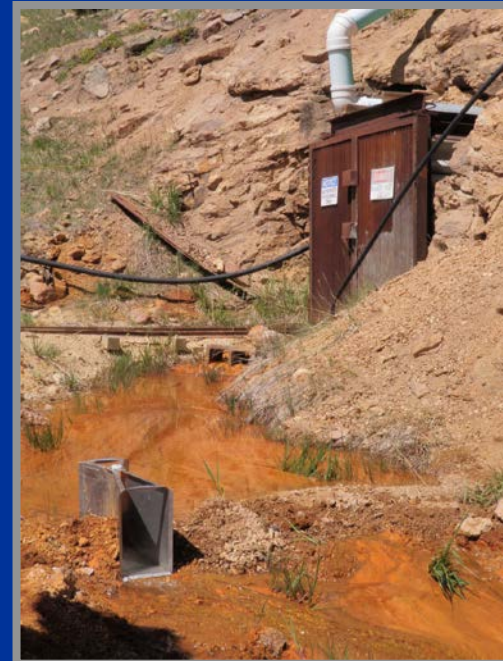


- Mining ARD = Faster



- Holistic geologic, water-quality studies help differentiate

- ***Natural ARD complicates remediation***





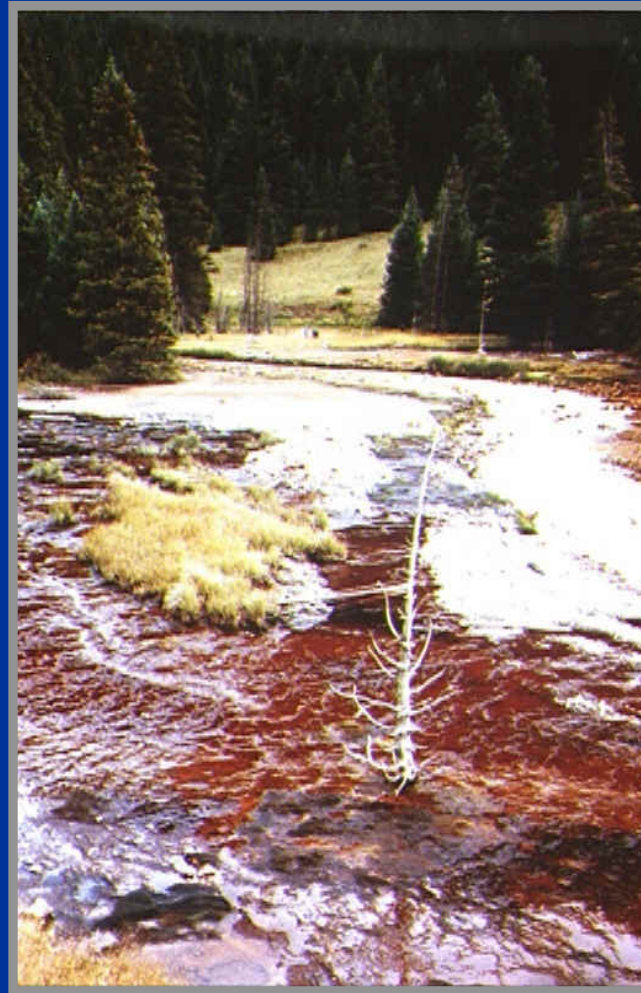
# Acknowledgements

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- Rob Runkel

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- Aimee Konowal
- Andy Witt



Natural iron bog/spring,  
Cement Creek, CO



Glengarry Mine, MT

[http://ecore restoration.montana.edu/  
mineland/photo/](http://ecore restoration.montana.edu/mineland/photo/)