



# Using ESRI Software for 3-Dimensional Mapping of Geochemical Data

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# Geochemical Data

- Complex dynamic datasets
- Point-source sample sites
- Multiple media types, analyses, laboratories
- Temporal changes (water quality, seasonal)
- One site, many parameters
- 55+ element, factor values possible
- Multiple units of measurement
- Limits of detection, censored data, validity
- Multiple data formats, software packages

# Software

- **ESRI ArcGIS**
  - **ArcCatalog**
    - Geodatabase, feature classes
  - **ArcMap**
    - Mapping, editing, elevation model, shaded relief
  - **ArcScene**
    - 3-D scenes, classification, fly-throughs, image export
  - **ArcGIS Server / ArcGlobe**
    - Serve 3-D scenes to data users
- **Microsoft Excel, Access**
- **Statsoft Statistica**

# Pebble, AK

## Porphyry Cu-Au-Mo deposit

- Unmined, only explored
- Main ore body 3+ miles across

## Western deposit near surface

- Concealed under glacial terrain

## Eastern deposit 5000+ ft depth

## Resource estimates

- 80 billion lbs copper
- 107 million oz gold
- 5.6 billion lbs molybdenum

## USGS Sampling

- 2007, 2008, 2009, 2010

## Traverses

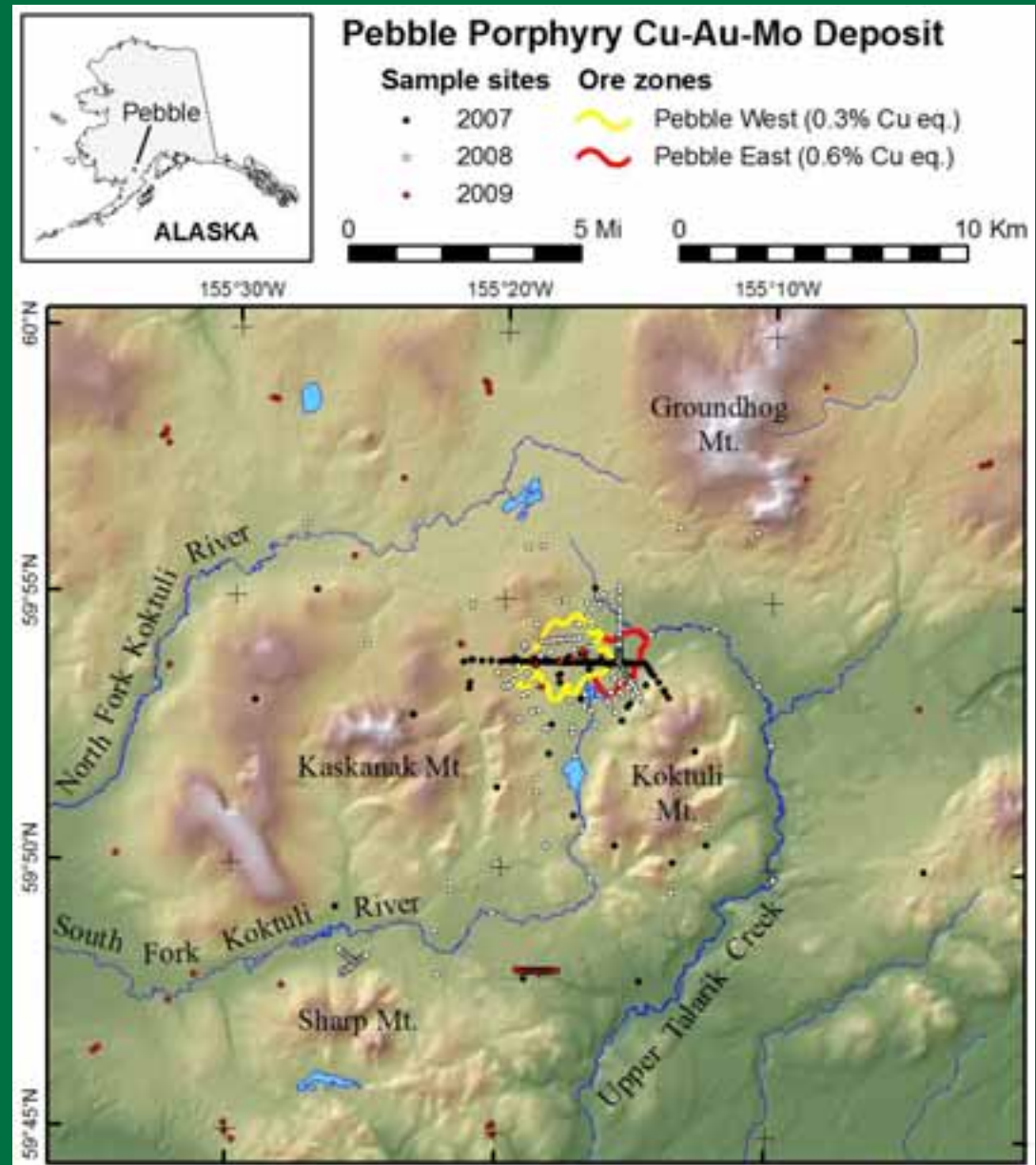
- Pebble, Pebble East, SP anomaly, other deposits

## Selected water sites

## Background sites

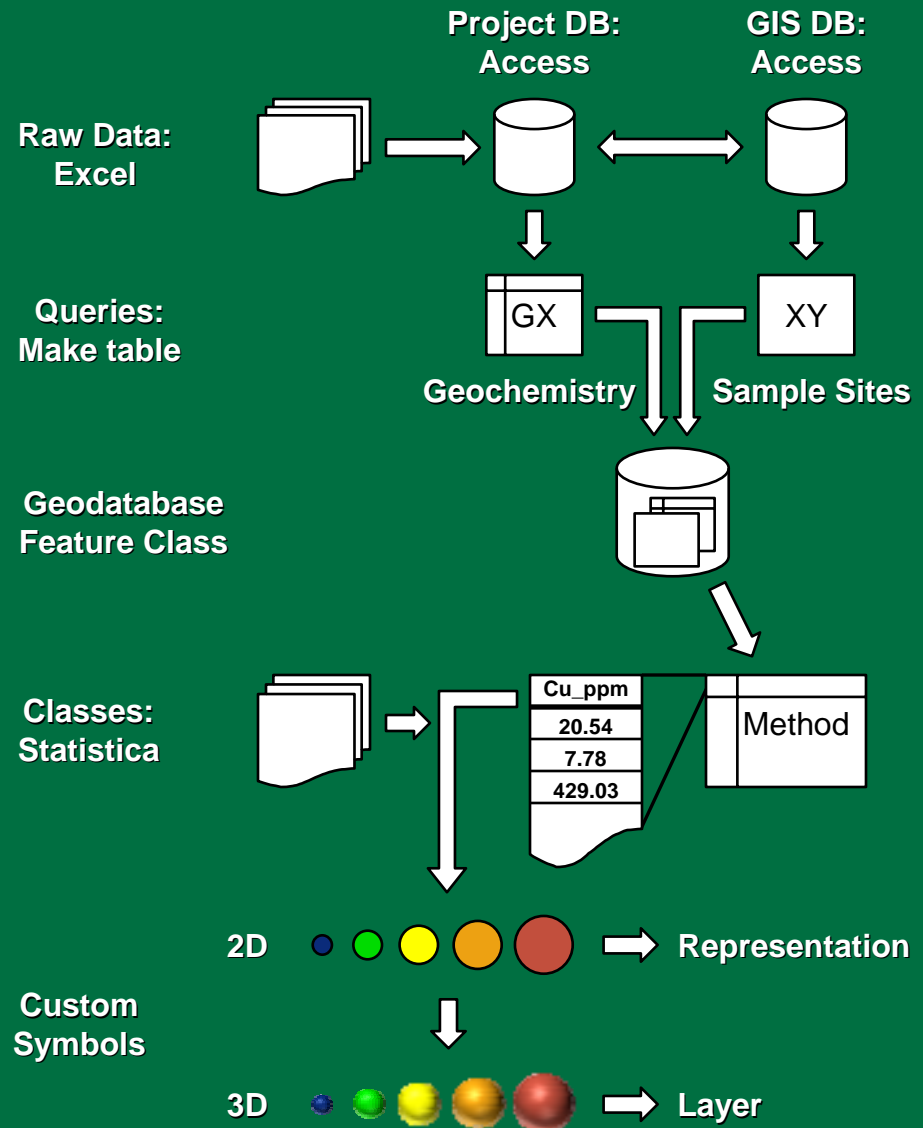
## Soil, till, rock, sediment cores

Pond, stream, spring water



# Samples

- Raw lab data
- Data storage
- Targeted queries
- Geodatabase
- Class divisions
- Classification
- 3-D symbol set



# Symbology

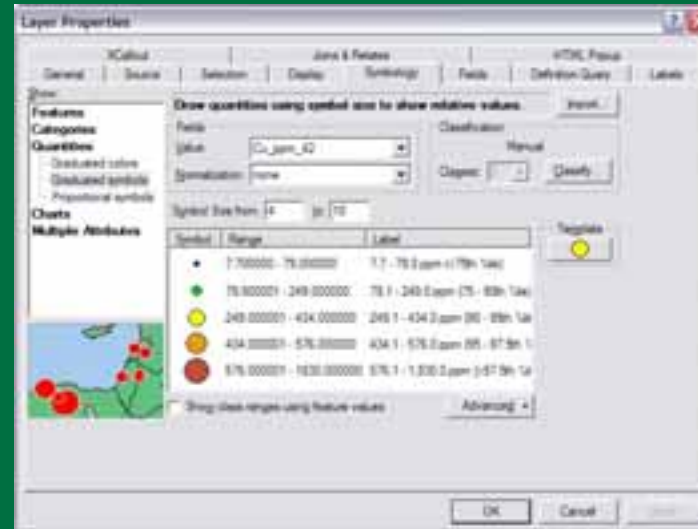
Method: Graduated symbols

Classification: Percentiles (5)

- Resistant to variation, units, etc.
- Calculated on  $n$ , not data range
- Exclude heavily censored data
- Manually enter break values

Class Label

- Absolute and percentile ranges

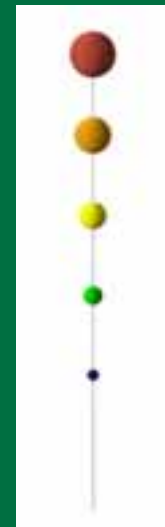
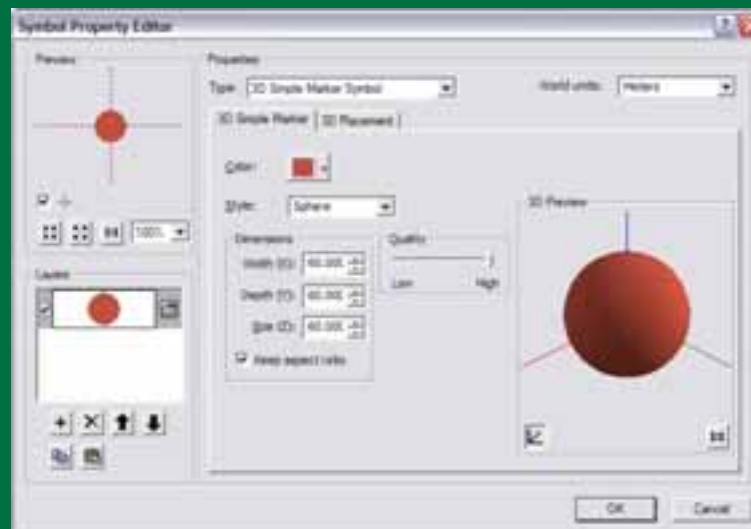


3D Symbols

- 3D simple marker symbol
- High-quality sphere
- Size adjusted for map scale
- Color spectrum

Additional symbol part: "pin"

- Duplicate GX layer, unclassified
- Simple black 1-pt marker
- Extrude below sphere symbol (add negative height to base)



# Base Heights

## Height

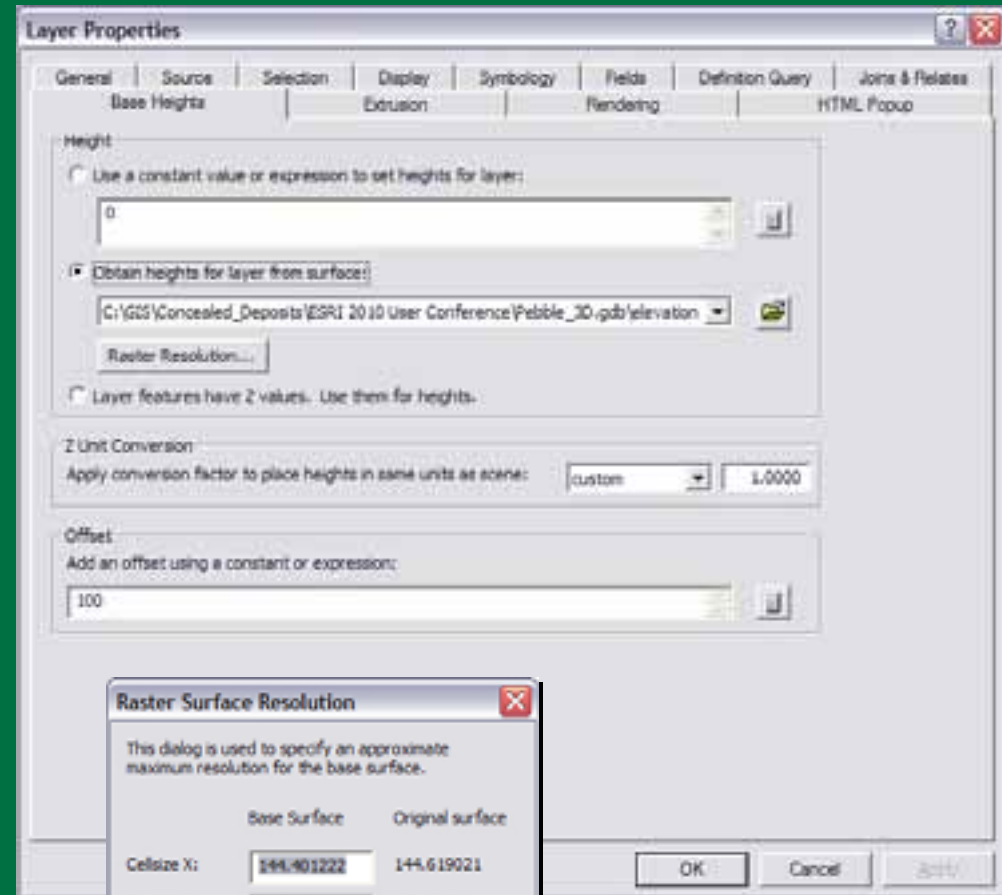
- Obtain from elevation surface
- Raster resolution = original
- Avoid using GX layer Z values

## Z Unit Conversion

- Z unit conversion = 1.000
- Dependent on linear unit

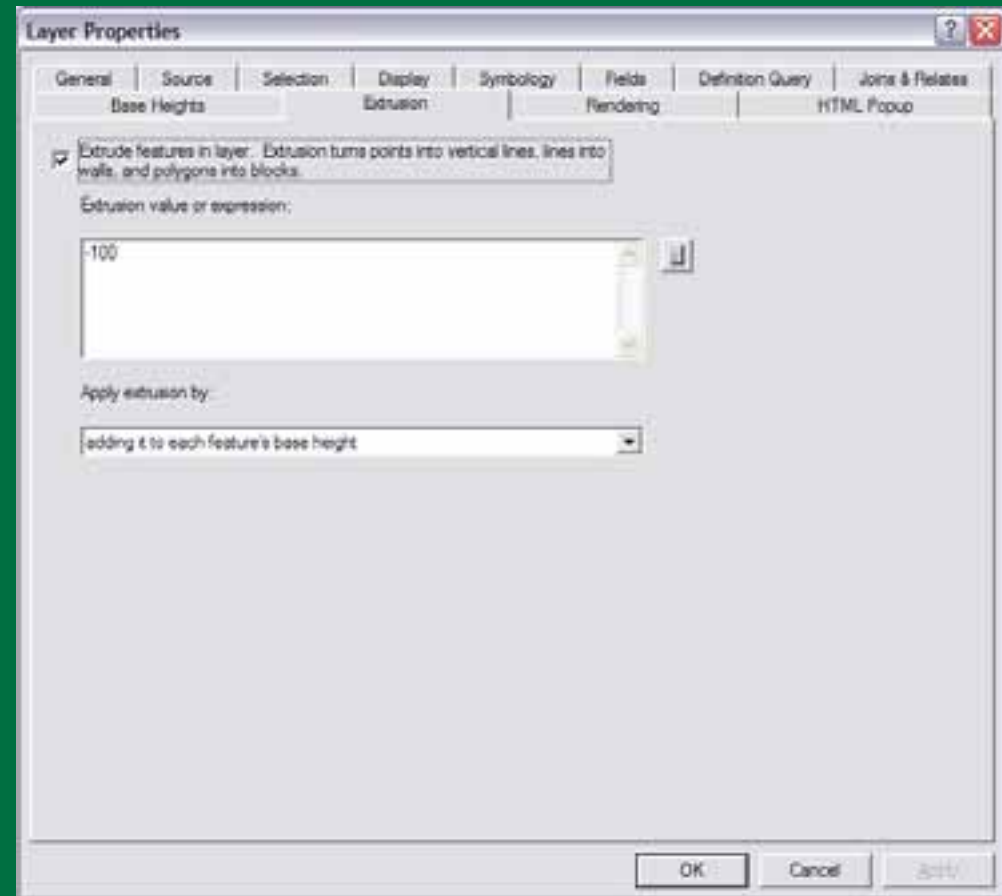
## Offset

- Offset = staggered layers
- Equal step for each GX layer
- Unit = Projection linear unit
- Pin offset = GX layer offset



# Pin Extrusion

- Extrusion is a negative value
- Add to feature's base height
- Amount = GX layer offset
  
- Group pin with GX layer





# Rendering

## Visibility

- Render layer at all times

## Vector layer effects

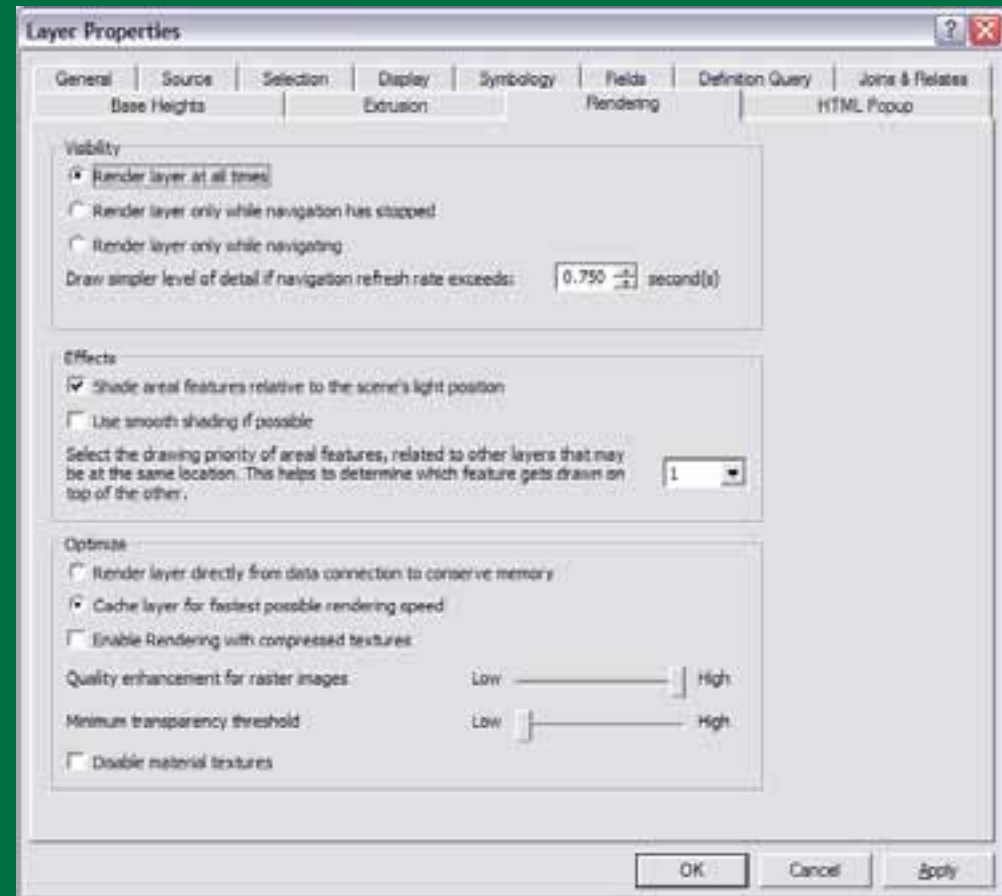
- Shade areal features
- Drawing priority = 1

## Raster layer effects

- Do not shade
- Elevation Drawing priority = 10
- Shade drawing priority = 7-8
- Adjust value to clean view

## Optimize

- Cache layer
- Quality enhancement = high



# Base Map

## Elevation surface

- Base heights
- Cell sizes
- Display level 10

## Shaded relief

- 70% transparent
- Display level 9-8

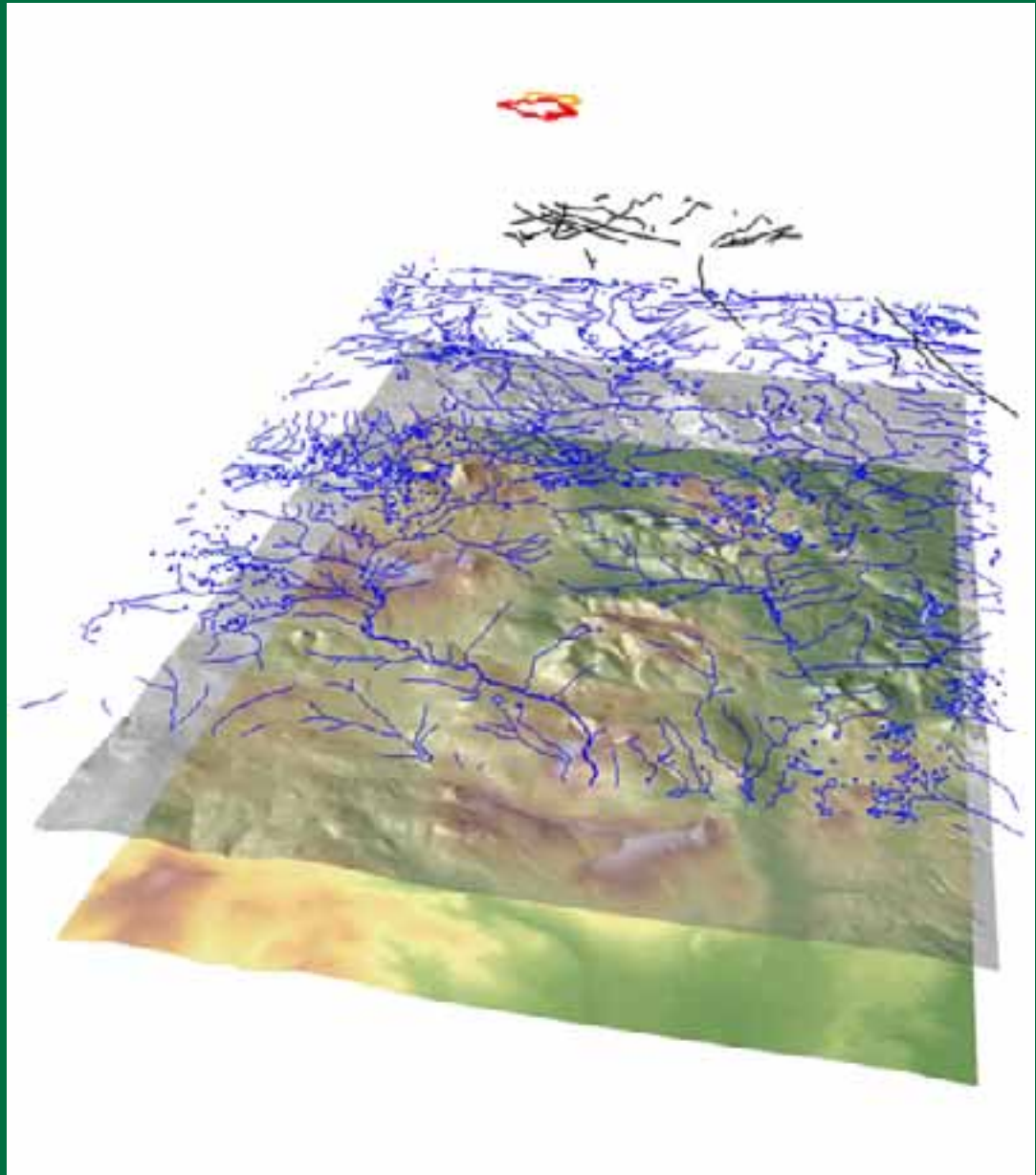
## Hydro

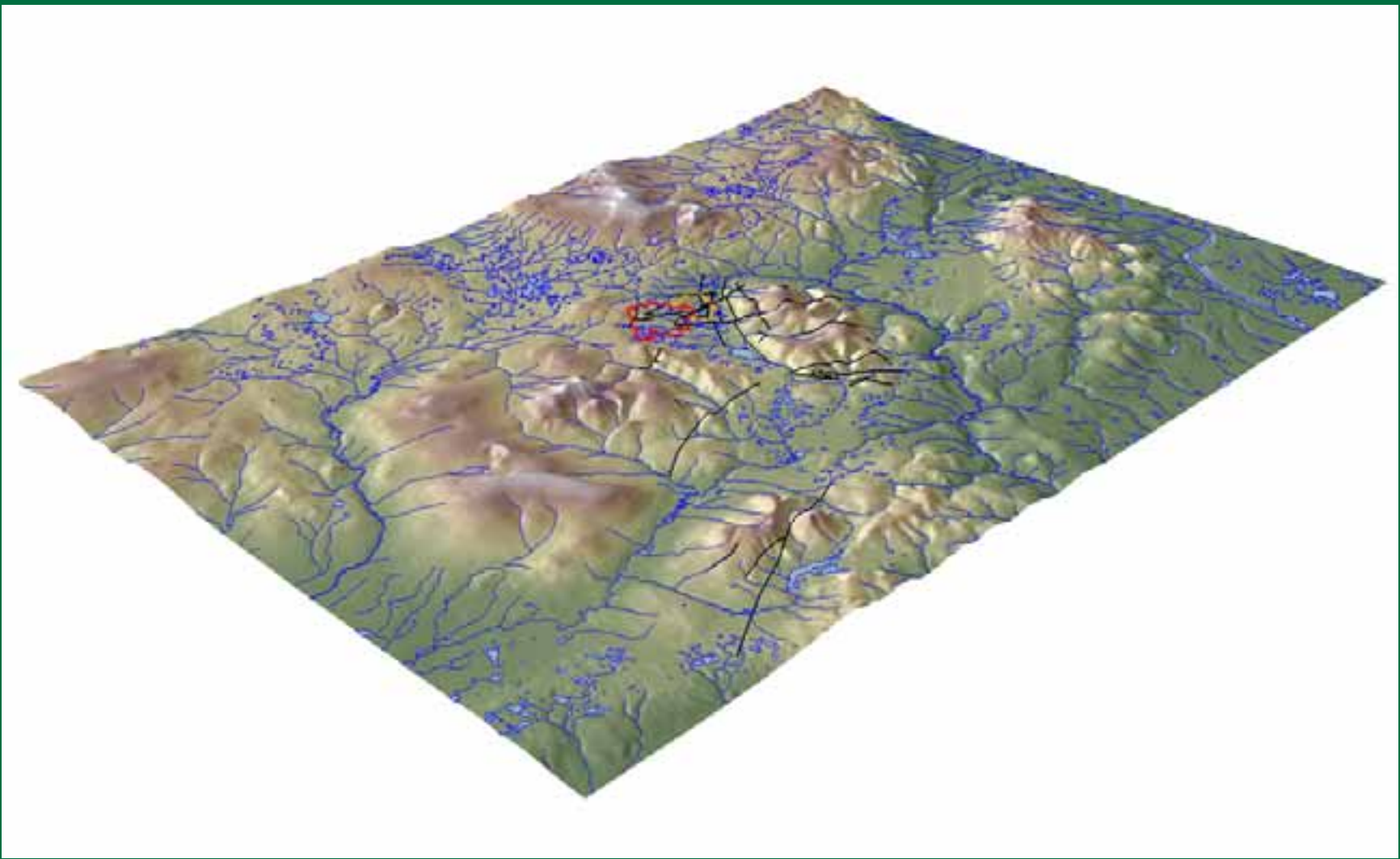
- Necessary for water sites
- Vector or raster

## Geologic structures

## Ore zones

## Other layers





# Symbol Variety



**Soil**

**Vegetation**

**pH**

**Till**

**Element**

**Rock**

**Pond**

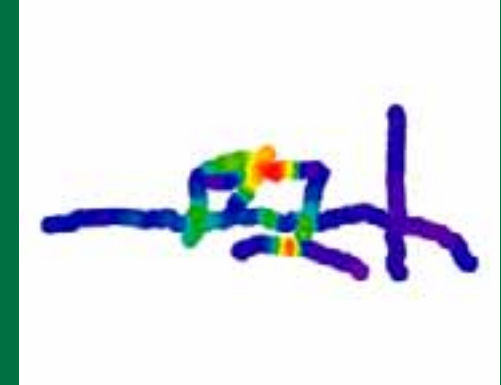
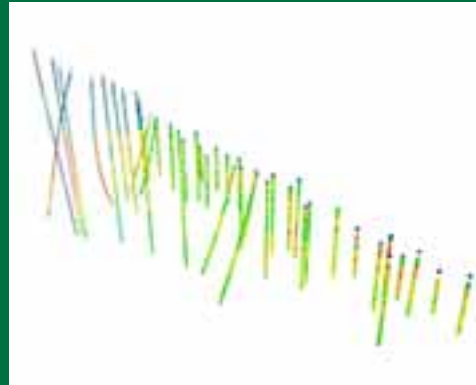
**Stream**

**Spring**

**Concentrate**

# Additional Layers

- Drill core assay data
- Geophysics data
- Geology
- Aerial photography
- Remote sensing
- Topographic maps



# Links and Acknowledgments

- **USGS geochemical data from Pebble**
  - 2007 <http://pubs.usgs.gov/of/2008/1132>
  - 2008 <http://pubs.usgs.gov/of/2009/1239>
- **Pebble Limited Partnership**
  - <http://www.pebblepartnership.com>
- **Base map geographic data**
  - <http://www.nationalatlas.gov>
  - <http://seamless.usgs.gov>