# Recent Advances In Mineral Prospectivity Mapping And Analysis

**Gary L. Raines**

**U.S. Geological Survey, MS 176 c/o Mackay School of Mines, UNR, Reno, Nevada 89557**

**Email: graines@usgs.gov**

For the last decade I have been working on the problem of spatial modeling where the objective is to predict the location of something by combining various types of data. I have made predictive models of animal habitat, Mayan farming locations, and undiscovered mineral resources. This has lead to the development of two generations of spatial modeling extensions for Arcview, the first generation - ArcWofE and the second generation – ArcSDM.

Now I am interested in using probabilistic spatial models as controls in a spatial-temporal modeling.

**Cellular Automata provide a mathematical approach to spatial-temporal modeling that is easily implemented in the Arcview Spatial Analyst and apparently deals with the chaotic patterns in space and time.**

For those interested in the Spatial Modeling extensions, the next slide gives the reference and URL for the tools.

# Isaac Asimov

- Foundation Series – The future of large numbers on individuals can be foretold (Psychohistory)

---

- Standards for digital data, particularly geologic maps
- Methods and tools for spatial modeling
- Methods and tools for spatial-temporal modeling.

**USGS**

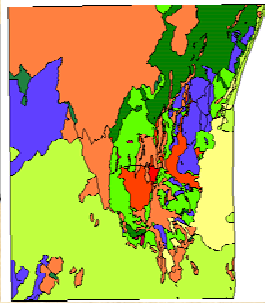## Standards for Digital Data
## Geologic Maps

- What is the purpose of a standard?
  - Cartographic standard
  - Information-content standard
  - Audience – geologists or wider community?
- Developing standards
  - North American Standard (USGS & GSC)
  - British Geological Survey
  - Geological Survey of Holland
  - Australian Geological Survey
  - ESRI – geodatabase standard for geology

**≡USGS**

•We already have standards for remote sensing data. These standards have helped with the rapid and wide application.

•Standards for geochemistical and geophysical data are by being dictated by the commercial organizations that provide such data or do the chemical analyses

•Standards for geologic maps are more problematical and controversial.

  •Is the purpose to reproduce the paper products (map and book report) or should the standard embrace the new democratication of information.

  •Who is the audience for such digital standards? Do we want biologists using our information to solve environmental problems?
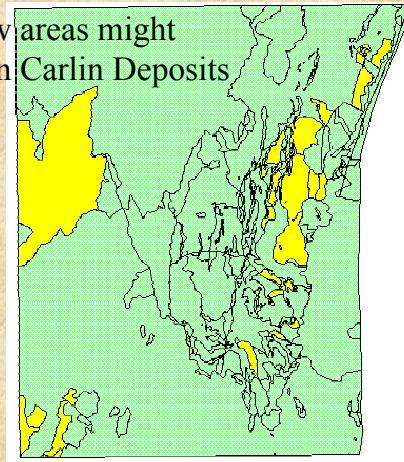
  •Should the standard include field observations?
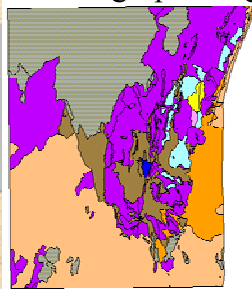
Complex Queries Involving Hierarchies

Dominant Lithology

Gravel
Conglomerate
Granitoid
Carbonate
Chert
Mudstone
Sandstone
Intrusive Rock
Felsic
Metasedimentary

Lithology = "Carbonate" and Age > 208 MA

Yellow areas might contain Carlin Deposits

Minimum Stratigraphic Age

Holocene
Pleistocene
Pliocene
Eocene
Tertiary
Mississippian
Silurian
Devonian
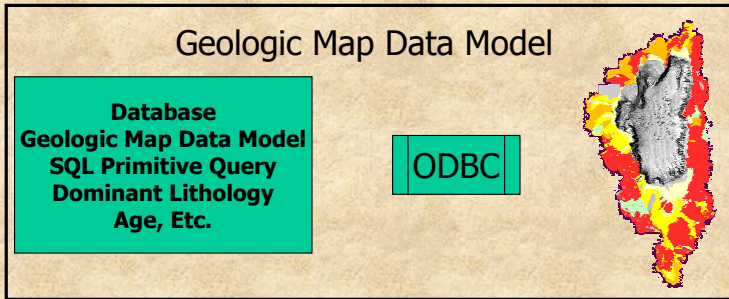Ordovician

•Automate primitive queries, Age, Dominant Lithology

> •**These involve geologic hierarchies. Want the database to know the hierarchies so can query Carbonate instead of Limestone and Dolomite and Age by number not by name and know that Triassic is part of the Mesozoic.**

•Complex queries done at the GIS interface – the right age and lithology

•Yellow is map units of the right lithology and of Triassic or older age that could contain Carlin Gold deposits.

•Swales Mountain quad of Jim Evans.

# Geologic-Map Expert System

Geologic Map Data Model

**Database**
**Geologic Map Data Model**
**SQL Primitive Query**
**Dominant Lithology**
**Age, Etc.**

ODBC

Bioavailable
Potassium

Reclassification

Erosion
Potential