Data, Evidence, and the Silver Bullet

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ABSTRACT

In our search for that single perfect measurement that will locate unknown deposits, i.e. the Silver Bullet, we have created huge volumes of data that are often poorly used. Similar to the average petroleum geologist, mineral explorationists spend 40–60% of their time assembling the existing data to solve a problem. Our general concept of evidence, that the Silver Bullet exists, however, leads to dismissing much of the data based on a subjective evaluation that the data are not good enough, i.e., they do not approach Silver Bullet status. Two challenges facing explorationists are how to integrate large volumes of data more effectively, and to define better the criteria for evidence. The Internet, electronic publishing, and GIS expedite access and use of abundant data. The USGS is currently creating Internet-accessible databases for existing geologic, geophysical, geochemical, paleontological, and geochronological data.

One basic problem with using these data is the multitude of data structures. To respond to this multiplicity of structures, the USGS and the American Association of State Geologists are developing standards including a data model for geologic maps. Similar efforts are currently underway in many parts of the world and will also be required for other types of geoscience data. The goal is to define a data model that will capture geologic-map information in a standard format. Acceptance of a data model and associated formats will greatly simplify the sharing, exchange, and use of geologic-map data. These standards issues are important and complex, but the principal difficulty lies in reaching consensus.

The more fundamental problem is that of defining evidence. This is, in part, difficult because our general approach has not utilized the powerful mathematical tools for dealing with uncertainty. For example, in gold exploration in the arid environment of Nevada, it is acceptable to say that proximity to a placer gold deposit is useful information in exploration for Carlin gold deposits. Placer mining requires access to water; consequently, the lack of placer mining in many areas is because of lack of water. Therefore, the lack of a gold placer is unimportant, but the presence is important. This is all acceptable as a subjective statement but has been difficult to utilize. Mathematical methods in a GIS, such as weights of evidence and fuzzy logic, can represent quantitatively this subjective information. Maybe with these concepts, we can redefine the Silver Bullet.

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