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Geographic Information System – A Review

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Abstract

GIS stands for geographic information system, and the map is, of course, a visual representation of quantifiable data. Compared to traditional table maps, a GIS map is dynamic and interactive. Human eyes are shapes, a GIS map usually transforms real-world geospatial data into colored patterns or shapes. This speeds up processing of information, which leads to faster and better-informed decisions. Then spatial analysis measured the distance between these points and determines the relationship between them, to better understand the planet. The ability of GIS to bridge the gap between two and three dimensional display and analysis is especially useful in geosciences, because depth is such a fundamental quantity. The ability to integrate surface and sub-surface data is therefore an essential function of any digital mapping technology in geosciences. Most GIS software provide such visualization tools for the manipulation of surfaces, images and maps in pseudo three-dimensional space as well as the mathematical derivation of other products.

Key Words : *GIS, Geoscience, Geospatial, Digital Map.*

Introduction :

GIS is a very real need in the face of the rapid growth of digital spatial data in the geosciences . Many spatial datasets are now being generated by government agencies, private companies and university researchers, and they would be ineffectively used and result in wasted resources without good systems of data management. Satellite images are a prime example of this data explosion. Data collected from geophysical instruments, airborne, ship-borne, ground-based, sown-hole and others, also make up enormous volumes of numbers that reveal little until they are property organized and displayed. Similarly, geochemical surveys of rocks, soils, water, sediments and plants, often with thirty or more elements determined from each sample, yield huge amounts of spatial date whose information content cannot be assessed without efficient spatial data systems.

GIS has made a tremendous impact in many fields of application, because it allows the manipulation and analysis of individual "layers" of spatial data, and it provides tools for analyzing and modeling the interrelationships between layers. In environmental problems, the interaction of many processes must be considered, and the simultaneous analysis of multiple datasets is imperative. A relatively small proportion of the geoscience community was computer-oriented, working mostly with mainframe computers and locally-developed software. GIS technology is still in its infancy (1993) with the majority of applications being carried out by specialists. GIS courses are now part of the academic curriculum in many universities and technical colleges. There are a large number of GIS periodicals, many of them commercially-oriented, but some entirely for the publication of scientific papers, such as the International Journal of Geographical Information Systems.

Purpose of GIS :

The ultimate purpose of GIS is to provide support for making decisions based on spatial data, as illustrated by a few geological examples. The exploration manager may use GIS to assemble data in the form of a mineral potential map to decide priorities for future exploration; the mining geologists may evaluate the effects of acid mine drainage with GIS to decide the kinds of remediation that would be cost-effective; the engineering geologist may evaluate slope stability conditions with GIS to decide the best route for a new road. The geophysicist may employ GIS to study the spatial factors related to earthquakes. Of course, GIS is invaluable for collecting, maintaining and using spatial data in a database management role, as well as for producing both standardized and customized cartographic products.Application of GIS achieves these major goals through one or more of the following activities with spatial data: organization, visualization, query, Combination, analysis and prediction.

Organization :

Anyone who has collected a large mass of data for a particular purpose knows the importance of data organization. Data can be arranged in many different ways, and unless the organization scheme is suitable for the application at hand, useful information cannot be easily extracted. Data models must, therefore, organize observations both by spatial and non-spatial attributes. The efficiency and type of data organization effects all the other five activities and is therefore of fundamental importance.

Visualization :

The graphical capabilities of computers are exploited by GIS for visualization. Visual display is normally carried out using the video monitor, but other output devices such as color printers are used for hardcopy displays. Humans have an extraordinary ability to understand complex spatial relationships visually, whereas the same information may be quite unintelligible when presented as a table of numbers. For example, given a table of geochemical in the data, but when the same table is converted to an effective map display, spatial patterns are immediately revealed. Visualization is achieved in GIS with color and symbols, and by specialized methods using perspective, shadowing and other means.

Spatial Query :

Visualization reveals spatial pattern amongst collections of organized data items. However, visualization is not so helpful for answering questions about special instances in the data, such as the value of particular data items. Spatial query is a complementary activity to data visualization. For example, a particular display of a combination of mineral deposit points and a geochemical map might suggest the existence of a spatial relationship in some areas of the display, but not in other areas. Suppose an aeromagnetic map is displayed on the video monitor, one might wish to knows in detail the rock formation, the distance to the nearest road, the topographic elevation.

Combination :

Such statements are usually written in a programming language, sometimes known as **"map algebra"** specific to the GIS. The combined map can now be treated as a single map, revealing the spatial relationship of water bodies to radiometric patterns. One of the really powerful features of GIS is the ability to link several map algebra statements together to form more complex algorithms. Several maps and tables of attribute data can be combined in a single processing step. The process of combining maps together is often called map or cartographic modeling.

Analysis :

Analysis is the process of interfering meaning from data. Analysis is often carried out visually in a GIS, as already indicated. Analysis in a GIS can also be carried out by measurements, statistical computations, fitting models to data values and other operations. A statistical summary might be used to compare the mean and standard deviation of airborne uranium measurements by rock type. Two important close relatives of modern GIS are computer aided drawing (CAD) systems and image processing (IP) systems. Both kinds of system deal with spatial data, but they are based on quite different data models and functions. However both CAD and IP have played an important role in the development of GIS.

Computer Aided Drawing :

CAD systems were originally developed for engineering drawings. They employ a vector data structure for representing points, lines and graphical symbols. The use of vector means that a point in a drawing is defined by a pair of spatial coordinates (rather than a single number or scalar), and that lines are built up by a series of ordered points.

Database Management Systems :

Another important relative of GIS is DBMS, which stands for database management system. DBMS are computer systems for handling any kind of digital data. When the location of each site is recorded by a pair of spatial coordinate, such tables comprise one of the most important inputs to a GIS. Where a CAD system is used in conjunction with a DBMS, many of the data handling and vector functions of a GIS can be implemented, although the data structures are usually not sufficiently complex for the more advanced analysis and modeling operations.

Mathematical Morphology Programs :

Mathematical morphology refers to a branch of spatial analysis that deals with the sizes of geometrical objects in images, Serra (1982). The extreme features on satellite images and the analysis of features on maps is a methodology importance of GIS.

Conclusion :

Most GIS projects can be boiled down to three major steps or stages, as illustrated in mineral potential mapping. The first step is to bring all the appropriate data together into a GIS database. The second step is to manipulate the data to extract and derive those spatial patterns relevant to the aims of the project, which in this case are the patterns critical as evidence for VMS deposits. The third step is to combine the derived evidence to predict mineral potential.

STEP 1

BUILD SPATIAL DATABASE

STEP 2

DATA PROCESSING

STEP 3

APPLY INTEGRATION MODELS

Mineral potential mapping with a GIS as a 3-step process.

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