

COMPUTER TECHNOLOGY OF GEOLOGICAL MAPPING

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Abstract

The computer technology of geological map building which is based on the field notes, existing maps and on the results photogeological interpretation of the materials of aerospace survey, is described. It uses an information model of geological object.

1 Introduction

The problem of the automatization of geological cartography is rather complicated both theoretically and practically. Many geological problems, that are to be solved on a computer in the automatized or dialogue modes, require a digitized presentation of a geological map. Producing a digitized map by digitizing and coding or by scanning devices isn't efficient enough. One of the promising ways of doing it is to create a special automatized system, which, according to the generally accepted geological source data, produces a digital geological map and presents it graphically in an accepted system of symbols. A group of researchers of the State University "Lvivska Politechnika" have worked at this problem [1,2] since 1986.

2 Information model

An information model of a geological object has been chosen as a theoretical basis for the proposed solution.

This model describes both quantitative and qualitative aspects of a geological body as a material object. The position of this body in the three dimension space is presented by a set of points with known coordinates X,Y,Z and / or by a functional presentation with known parametrs. The qualitative characteristics: the composition of the substance, age, structure are formalized, arranged and interrelated.

It's a fact that a geological map does not provide all the information. Part of the necessary information is found in accounts and archives and is often inaccessible due to the lock of systematization.

The use of an information model of a geological object removes this disadvantage; part of the data are used directly for the graphic presentation and photointerpretation, the rest is used as a basis for information searching systems.

3 Technological stages

The technology of the automatized construction of a geological map involves following stages:

- preliminary study of a geological object and the development of complex work;
- geological study of the object by field, laboratory and remote methods;
- loading of the data into a computer ;
- building of a digital and graphic geological maps.

Now let's say a few words about each of them. At the stage of the preliminary study the selection of necessary data and their analysis is carried out. Then comes the laboratory photogeological interpretation of space-, aero -and phototheodolite photos. After the construction of a schematic geological map, an optimal complex of geological work is planned to obtain necessary qualitative and quantitative characteristics as well as to verify the accepted hypotheses and ideas. At the same time methods of remote studies of geological objects are developed, which is very important for obtaining generalized characteristics of the objects when working in difficult mountain regions.

The complex interpretation of geological and geophysical data together with the photointerpretation of the material make up the information basis for further construction of the geological map on a computer. Space-, aero -and phototheodolite photos with traces of photogeological interpretation are measured with stereophotogrammetric devices with the automatic registration on a computer. The results of digitizing existing maps and geological data from the filled documents are stored into a computer. The main part of this method is a programme -mathematical complex, executed on IBM PC. The complex consists of applied programmes for solving topogeodetic problems, photogrammatic constructions, logico-mathematical checking of input data.

4 Database of field geological notes

The materials of the field geological studies are presented in the form of an interrelated system covering all the types of objects and their characteristics (Fig. 1). Four main levels were determined: characteristics of geological bodies, routes, folds, jointings, hydrogeology; as well as standardized parts of the geological description of the body components. These information arrays have been organized in the database GEOBAZ.

Display forms of documents have been developed for loading of the field work materials, the operations of processing and storing for which are performed with the help of the databases. The software has been developed in the form of menu to simplify the communication of the user with his computer.

The system helps to obtain reference data and to release them as documents accepted in geological organizations.

5 System INFOKART

The construction of a geological map was executed in the automatized system INFOKART.

The information arrays of the system contains data about the area mapping, information about topological relations, data of photogeological interpretation, symbols for geological maps and a digitized model of the relief.

The exchange between the systems GEOBAZ and INFOKART is carried out through text

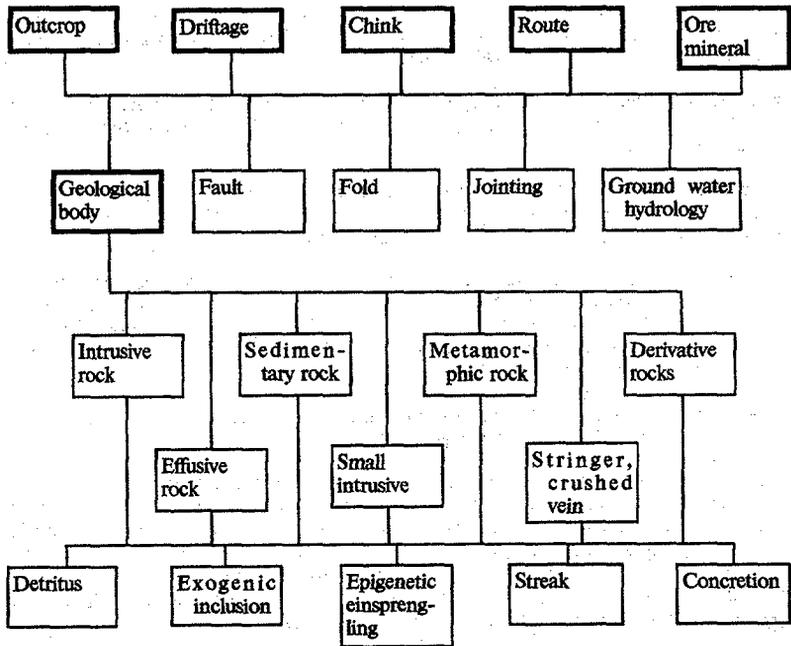


Figure 1: Field geological data systematization scheme

files. The software includes the following subsystems:

- input and output of topographic map and photogeological data;
- photogrammetric processing of the measurement results of photographs;
- interactive editing of the photogeological interpretation data of the field work material;
- the creation of symbols of geological maps;
- construction of profiles along directions marked with a cursor on the image of the map or the outline of the chinks;
- construction of marginal elements of a geological map.

The comprehensive block for analytical photogrammetric construction contains programmes of strip and block phototriangulation. Aerophototriangulation is widely used as a method of condensing, while analogical work with phototheodolite photograph isn't performed so often in spite of the fact that phototheodolite survey occupies an important place in geological survey and especially in detailed geological mapping [3].

A special programme for processing phototheodolite photographs has been developed. It realizes the bundle method which takes into consideration specific features of ground survey. Among these features are the following: one photostation can supply a number of

photographs from any type of surveying; as source data one may use geodetic coordinates of photostations and control points; the length of photographing bases, their directional angles, the height of the photostation locations, horizontal and vertical correcting directions, fixed angles of photographs slopes.

Since this geological map building is rather complicated and the participation of a geologist is absolutely necessary, the system provides for a dialogue mode through display image correction.

The graphic editing and interpretation block enables one to work with a full picture of a certain part of the map or to choose the main elements according to the subject (only geological boundaries or elements of bedding or isolines).

The layering of image has been taken into account according to the geological classifier corresponding to the symbols of the geological map. The system allows to perform simultaneous work with several types which appear in a respective window. The main window is assigned for editing, the low righthand window is the part of the map; the middle right one is for stereopair, the top right one for the symbol slides.

The parts of maps can be combined, superimposed or some part of the map can be separated, for instance the one corresponding to the stereopair.

The interpretation operation enables one to execute interactive verifying of geological boundaries on the basis of the field work material. The results of the photogeological interpretation are brought out on the display; other results on the display are the route line and points of geological observations. On choosing the point on the map image, in the right side of the display we obtain the window with the information about the current composition of rock and ellipse with respective symbols. The system contains the classifier of geological map symbols and the library of graphic slides.

The building of profiles along directions is marked with a cursor on the map image. The necessary signs may be placed on the profile.

The results of processing may be printed or plotted in a certain scale with a respective graphic presentation. Apart from automatization the system allows to:

- create and maintain the archives of the geological maps;
- create libraries of symbols and add new elements;
- go through the data of field work, produce a map of the actual material.

Conclusions The experimental work performed with real and model material yielded good results and supported the choice of this kind of work. Yet we are aware that much is still to be done as it is but a little step in the field of automatization of geological map production.

References

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