EARTH SCIENCE FRONTIERS
Volume 14, Issue 5, September 2007
Online English edition of the Chinese language journal

Available online at www.sciencedirect.com
ScienceDirect

Cite this article as: Earth Science Frontiers, 2007, 14(5): 54–62.

RESEARCH PAPER

A 3-D Prediction Method for Blind Orebody Based on 3-D Visualization Model and Its Application

CHEN Jianping[1,2,*], LU Peng[1,2,3], WU Wen[1,2], ZHAO Jie[1,2], HU Qing[1,2]

1 The Institute of Land Resources and High Techniques, China University of Geosciences, Beijing 10083, China

2 The Land Resources Information Development and Research Laboratory of Beijing, China University of Geosciences, Beijing 100083, China

3 International Cooperation Office, China University of Geosciences, Beijing 100083, China

Abstract: Based on the study of existing orebody predicting theories and using commercial 3-D geological modeling software, we established an integrated 3-D quantitative method and procedure for locating blind orebodies, based on 3-D visualization model. In this paper, we discuss the procedure of the 3-D visualization method, such as data preprocessing, 3-D geological modeling, process and 3-D quantitative prediction. Using the 3-D visualization method, we established favorable prospective targets, calculated the ore containing probability of perspective blocks and estimated the resources in a test project zone using the Gejiu tin deposit in Yunnan, China. This application shows that the 3-D visualization method is effective in 3-D orebody prediction for determining quantity, position and probability.

Key Words: 3-D; large scale; blind ore body; ore-forming prediction; 3-D visualization method

1 Introduction

With the decrease of the number of surface mines, shallow mines, and easily identifiable mines, there is an increase in the difficulty with regard to prospecting and a decrease in the exploration effect. Since the 1980s, the prospecting of blind mines and deep mines has become the main targets in many countries. The effects of prediction of large-scale (generally greater than 1 : 10000) deposit has become more prominent[1]. Traditional deposit predictions are mostly on the ground surface, the 3-D prediction technique of large-scale deposit is rare. At present, 3-D techniques and theories with respect to deep mine prediction are important subjects in current academic frontiers, which include obtaining 3-D prospecting information, 3-D prediction method for deposits, and 3-D visualization technologies.

Over the past decade, with the rapid development of 3-D computer technology, many researchers began to carry out large-scale prediction of the blind deposits using 3-D technology, for example, 3-D orebody visualization and calculation of orebody reserves[2–4], 3-D geological mapping[5], 3-D geological data acquisition and visualization[6,7]. The 3-D visualization technology can help us visually detecting subsurface geological body, and finding the distribution features which indicate the relationship between different orebodies.

This article presents a prediction method for blind orebody based on real 3-D geological model. Using large amounts of data collected during the course of prospecting and mining in the study area, we establish 3-D models of strata, magma rock, structure, drill, and orebody; interpolat the contents of elements of geological cube units; establish the cube-prediction model of the study area; and carry out the quantitative predictions to determine resource, position, and found probability of the deep blind orebodies.

2 The procedure of 3-D visualization method

The 3-D visualization prediction method summarizes the rules of ore-controlling geological conditions and prospecting

Received date: 2007-03-20; **Accepted date:** 2007-09-05.
*** Corresponding author.** E-mail: 3s@cugb.edu.cn
Foundation item: Supported by the National Science and Technology Support Project of the 11th "Five-Year Plan"(2006BAB01A08); the Project Co-building Plan of Beijing Municipal Education Commission (JD104910556).

signs, especially in the deep mines; analyzes various quantitative information of the prospecting evaluation of the deep orebody; establishes 3-D geological prospecting model; and then establishes the 3-D entitative models including the strata, structure, rocks, orebody, and element anomalies. On this basis, the 3-D visualization method built the 3-D cube model of the study area. Quantitative information will be given to each cube prediction unit. Finally, using the appropriate method of prospecting information processing, the 3-D visualization method carries out the 3-D prediction for the quantitative determination, positioning, and found probability of the deep orebody. The procedure of the 3-D visualization prediction method is as follows:

(1) Collect and collate the preliminary geological research data and the production data with respect to digging: Summarize the geological background and the nature of genesis of the orebodies, according to the known geological works and related researches. Determine ore-deposit types in the formation of the geological environments. Build the geological structure, geophysical, geochemical, and drill database of the study area, especially collect geological section maps, interpret plan maps and drill sample data.

(2) Establish the prospecting models: Establish the models elaborating large-scale mineralization-controlling conditions; list the prospecting signs extracted from geological, geophysical, geochemical, and remote sensing data, to provide the basis for selection of the prospecting variables for the 3-D prediction.

(3) Establish 3-D geological models of the study area using appropriate 3-D geological modeling software: using geological profile section maps, interpret geological maps and drill data, establish 3-D entitative models of strata (Fig. 2), structure (Fig. 7), type of rocks (Fig. 2), known orebodies (Fig. 9), and drills (Fig. 12).

(4) Establish the 3-D visualization prediction models (Fig. 4): Extract the 3-D cube prediction units using related functional modules of modeling software; evaluate quantitative prospecting information as attributes of the unit cube, including strata (Fig. 3), structure buffer (Fig. 6), rock buffer, geochemical anomalies, and known orebodies (Fig. 8). Table 1 lists certain attributes of cube, where (1), (3), and (5) represent the unit's *x*, *y*, and *z* coordinates, respectively; (2), (4), and (6) represent the length, width, and height of the cube, respectively; (7), (8), (9), (10), and (11) are lithology codes, Sn content, 150-m fault buffer signs, 150-m rock buffer signs, and Pb content data, respectively.

Table 1 Some blocks' attributes in the cube-predicting model

1 East	2 _East	3 North	4 _North	5 RL	6 _RL	7 Lith	8 Sn	9 Fault_150	10 Rock_150	11 Pb
125044.96	20	582086.25	20	1801	20	2	0.62003	1	–	2.33363
125064.96	20	582106.25	20	1801	20	–	0.68797	1	–	2.52997
125064.96	20	582086.25	20	1801	20	2	0.58612	1	–	2.70723
125079.96	10	582111.25	10	1806	10	–	0.67538	1	–	2.86711
125089.96	10	582111.25	10	1806	10	–	0.67538	1	–	2.86711
125089.96	10	582111.25	10	1796	10	–	0.67538	1	–	2.86711
125079.96	10	582101.25	10	1796	10	–	0.67538	1	–	2.86711
125079.96	10	582111.25	10	1796	10	–	0.67538	1	–	2.86711
125089.96	10	582101.25	10	1806	10	–	0.67538	1	–	2.86711
125089.96	10	582101.25	10	1796	10	–	0.67538	1	–	2.86711
125079.96	10	582101.25	10	1806	10	–	0.67538	1	–	2.86711
125089.96	10	582121.25	10	1806	10	–	0.75448	1	–	2.89099
125089.96	10	582121.25	10	1796	10	–	0.75448	1	–	2.89099
125079.96	10	582121.25	10	1796	10	–	0.75448	1	–	2.89099
125079.96	10	582121.25	10	1806	10	–	0.75448	1	–	2.89099
125079.96	10	582091.25	10	1806	10	–	0.61587	1	–	3.20647
125079.96	10	582121.25	10	1826	10	–	0.66096	1	–	3.82517
125089.96	10	582121.25	10	1826	10	–	0.66096	1	–	3.82517
125079.96	10	582121.25	10	1816	10	–	0.66096	1	–	3.82517

(5) The 3-D prospecting information statistics and prediction: According to the quantitative 3-D visualization model, we statistically analyze the data contained in cube unit; using statistical methods, calculate a value named prospecting beneficial degree to indicate probability of finding deposit; and according to beneficial degree, determine the prospecting target zones and beneficial ore-forming zones.

3 The 3-D visualization model's application in Gejiu tin deposit field

In this article, we use Kantan 3D — a software of