Exploration Analysis

Chairman: Professor B. W. MACKENZIE
Rapporteur: Professor D. A. PRETORIUS

Papers:

Optimum spacing for soil sample traverses by W. A. Hodgson

Evaluation of geochemical data by C. J. Lenz

Research in oil exploration decision-making by J. W. Harbaugh and A. Prelat

A drill hole data bank by M. R. Anderton

Ore reserve estimation and depletion planning for a beach diamond deposit by M. M. Oosterveld

In opening the session, the Chairman indicated that the papers and discussions would revolve about quantitative methods of analysis and optimization of various aspects of exploration planning. The five papers would cover a wide range of topics within a general theme of exploration analysis, and it would be appropriate, therefore, to present the papers as representing a sequential information-gathering process, namely, (i) geological, geochemical and geophysical types of surveying for the location and identification of anomalous zones, (ii) trenching and drilling of the anomalous zones found, and (iii) further refinement of the data for ore reserve calculations and production planning.

The first paper, which was presented by Dr W. A. Hodgson, dealt with the optimum spacing between soil sample traverses conducted during geochemical prospecting. The theme of the paper was that the critical sampling interval should be based on the concept of element continuity, and that this interval could be determined by means of a correlogram. Ensuing discussion concerned the probability of the method, designed for areas where dispersion was high, working in localities where dispersion was either low or virtually non-existent. In the latter cases, specific orientation surveys for varying topographic, climatic and geological conditions would possibly be more useful than the preparation of correlograms. A further suggestion was made that cost *versus* risk should be taken into consideration when deciding upon the spacing between traverses. A balance could be struck by mathematical optimization. If the exploration budget was fixed, then the variance of risk could be minimized.

The second paper was a short contribution by Mr C. J. Lenz. Computer-based plotting and evaluation of geochemical prospecting results were carried out because the low cost of analysis in Rhodesia permitted very large volumes of data to be accumulated in mass-coverage operations. Anomalous areas were demarcated within different environments by selecting probability or population boundary values from frequency distributions. In the short discussion which took place it was debated whether the method should be used only in the early high-risk stages of geochemical exploration and whether the introduction of geological bias could influence the actual results of an exploration program.

Professor J. W. Harbaugh then delivered a paper on an aspect of research in oil exploration decision-making: estimation of wildcat well outcome probabilities. Petroleum geologists were generally reluctant to give outcome probabilities. A hindsight approach was normally employed, but, it was advocated in the paper, a foresight approach should be considered in stepping through the past, bearing in mind that the main use of geological data lay in improving the estimate of probabilities. The paper described a pilot study conducted in central Kansas, involving 6 000 holes drilled in an area of 24 × 24 miles. The results were looked at in five-year steps from 1935 onwards. Frequency distributions were obtained that involved pre-drilling interpretations and post-drilling outcomes. With time, the discovery frequencies changed steadily and the probabilities became stable and, therefore, usable as predictors. Discussion of the paper included the possibility of preparing a time series of probabilities and the possible nature of the follow-up to the pilot study. The follow-up could be only hypothetical because the area had been drilled out. However, the probability frequencies could be transferred to adjacent areas at earlier stages in their history.

The fourth paper, by Mr M. R. Anderton, dealt with the design of a drillhole data bank. The points emphasized were input coding, storage of the code, and retrieval of information. The development of a comprehensive drillhole data bank for geological information, using the coding method described, generalized storage methods, standardized retrieval language based on the input code and automated display systems could provide exploration geologists with a powerful tool. The paper put forward the proposition that there was a need for a language developed specifically for geologists and that a general data-banking system based upon a comprehensive code was a move in this direction. Several delegates wanted to know whether the data bank described was already in use. Input coding was being used, but the storage and retrieval components were not yet usable. The program could recover at present, but not unambiguously. Questioners asked whether the geological information was gathered in the field in a form suitable for putting on magnetic tape. The geologist employed a coded sheet in the core-yard, but much of the information recorded was highly qualitative.

In the final paper of the session, Mr M. M. Oosterveld dealt with ore reserve estimation with depletion planning for a beach diamond deposit. Geological and sampling information from a paleomarine environment had been digitized and stored in magnetic files. For the evaluation of the deposits, it was necessary to estimate both the diamond content and the size frequency of the diamonds occurring in it. The three most important characteristics needed for the evaluation were the size frequency of the diamonds, the number of diamonds per

unit area, and the price structure of the diamonds. The method described of calculating statistically more accurate ore blocks, combined with a linear programming technique for production planning, had greatly facilitated the more efficient control of mining production. Questions that were asked subsequently dealt with differences between diamonds coming from alluvial deposits and from kimberlite pipes, but no answers could be provided since such information was classified.

In closing the session, the Chairman said that mining companies were being confronted with increasingly competitive forces, among which were the depletion of high-grade mineral deposits and the fact that oil companies had entered the sphere of metal mining. The long-term survival of mining companies in this environment was very much dependent on the success of exploration ventures. This required the most effective utilization of exploration capital and skills. The papers that had been presented during the session indicated the considerable progress that had been made in the application of quantitative decision-making to exploration analysis.