SAMPLING OF MINERAL DEPOSITS

(2 days)

Who should attend : Exploration and grade control geologists worried about the quality of their sampling results.

Summary : About 30 years ago, Pierre Gy was presenting for the first time his theory on the sampling of broken ore and the accompanying "sampling formula" which can be found, in one form or another, in almost all textbooks dealing with sampling of natural materials. At about the same time, Georges Matheron was putting together his theory of "regionalized variables" which also touches on sampling, but this time of in-situ material. In both cases, the objective was to develop tools allowing to quantify the quality of a sampling program and to answer very practical questions like : *Do we have enough samples?, Are they big enough?, Where should we collect them?. How should we process them?.*

The goal of this two-day seminar is to present tools to help answer those questions. It concentrates on the sampling of broken material i.e. the framework of Gy's theory. Sampling of in-situ material is covered in another seminar on geostatistics for exploration and grade control.

Seminar is split in three parts. First, we summarily review the various sample types and sampling equipment, the sample processing methods and type of analyses in the lab and typical QC/QA protocols followed in sampling programs (frequency and types of standards, blanks and duplicates). Second, we present the statistical techniques to process QC data, determine the presence of a significant bias between two sets of samples and experimentally assess the so-called "sampling variance". Third, we show how the proposed "sampling theories" (starting from that by P. Gy) can help devise an efficient sample preparation program

For course schedule and pricing please contact Geostat Systems International Inc. at:

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Course outline :

DAY 1 = Practical aspects and statistical processing

Introduction : objectives of a sampling program
Similarities with poll surveys. Terminology : population, sampled fraction, representativity, accuracy and precision, error, confidence level.

Practical aspects. Types of samples : core/percussion holes, channel/chip/muck samples, bulk samples, sources of errors in sample collection. **Processing of samples** : crushing and pulverizing, mass reduction, sampling towers and pilot plants, standard preparation protocols, sources of errors in sample preparation. **Analysis of samples** : (brief) review of analytical methods, sources of errors in analysis of samples. **QC/QA protocols** : nature, size and frequency of standards, blanks and duplicates

Statistics of QC sampling data. Brief statistics reminder : histograms, cumulative frequency and correlation diagrams, parameters (mean, variance, standard deviation and coefficient of variation), distribution models (normal and lognormal), variance of the mean and precision of estimates. **Testing for bias** : ordinary T-test, T and sign tests for paired data. **Correcting biased data** : linear and log-linear regression. Smoothing problems. Monte-Carlo simulations. **Experimental determination of sampling variances** : from results of simple or nested programs and from duplicates

DAY 2 = Models to predict sampling variances.
Definition of the fundamental sampling error. Simple models in the case of complete liberation of the element of interest : binomial and Poisson models. The various forms of Gy's formula. Practical implementation of Gy's formula with nomograms. Critics and extensions of Gy's formula. Work by Ingamells, Visman and François-Bongarçon. Links with geostatistics : sampling error and nugget effect of variograms.

Instructor

This seminar is run by Michel Dagbert, who has been associated with Geostat Systems International Inc. since the beginning of operations in Golden (1980) and Montreal (1981). As a senior consultant for Geostat, Michel Dagbert has been responsible for a large number of ore reserve estimation projects for exploration and mining companies throughout the world, most of them involving geostatistics.

Michel Dagbert has taught geostatistics at the Colorado School of Mines, Ecole Polytechnique and UQAC as well as at seminars in Canada, Australia, Colombia, Ivory Coast, Congo, India and China. He inaugurated this sampling seminar at Cambior in March 1999. He is a graduate of the School of Mines in Paris and McGill University. He is also a member of IAMG, CIM and AIME as well as a Professional Engineer in the Province of Quebec.