WORKSHOP TOPIC
for the 29th May, 2008

„Mathematical problems of resource estimations: geological risk, economical risk, data management risk. How to quantify these, and how to connect them using mathematics."

Moderators:
Tomislav Malvic (INA & University of Zagreb)
György Bárdossy (Hungarian Academy of Sciences)

Prepared by: Tomislav Malvic

Resource estimation is evergreen topic for the majority of geological disciplines, especial for fields of petroleum industry, hydrogeology and mineral deposits evaluation. These types of estimations are often mixture of subjective personal attitude (expressed as "feeling") combined with objective parameters calculations using more or less simplified mathematical formulas.

Of course, objective estimation tends to be based on unique mathematical formulas that can be applied in each similar problem, without regarding the topic (hydrogeology, petroleum geology etc.), analyzed lithological unit or selected geological province. The most advanced formulas, or better approaches, allow to the estimator varies some equation's parameters in certain limits, but always supported with statistical "nature" of observed variable (like fluid flow, permeability, porosity, thickness etc.). Such types of estimations, based on relatively simple multiplication of geological categories, are the most popular approach for calculation of **deterministical geological risk**. Although, in the last decades stochastical approaches started to dominate for many reservoir and aquifer visualization tasks. There is the least one geological category that could be evaluated stochastically through a number of equiprobable realizations. Is there way to apply stochastic in evaluation of geological risk? How modified deterministical formula applied for evaluation of geological risk in potential hydrocarbon reservoir for using in describing mineral ore deposits like quarries, clay deposits etc.?

Economical risk is partially connected by geological risk, which is one of parameter included in calculation of economics of hydrocarbon prospect, play or even valuable aquifer of potable water as resource. Economic risk, in the most "geological" companies without regarding on their size, depends on exploration budget and company costs, geological probability, expected value and, of course, expected profit vs. risk. In petroleum industry, exploration and drilling feasibility studies are based on net present value (NPV) and expected value (EV) for potential discovery. Utility function is tool (developed several decades ago in economics) for evaluation of discover utility, regarding invested money and risk. Numerical result describes possible profit that could be reached regarding company's financial strength and financial obligations. Utility function, in general, represents attitude toward exploration

risk, derived from different approaches and possibilities that company applied through some period in the past. Different types of utility function, especially exponential, has been using through decades in different petroleum companies and expert teams. Are there other mathematical tools that could express different types of economical risks in geology?

Data management very hardly can be expressed "strictly" through mathematical equations. It is, more or less, the matter of the estimator feeling for the "right" way how to classify and categorize data or handle by extreme data like outliners. For example, the difference between conditional or unconditional simulations is matter of data management, which points us on the question of "cell sizes" in geological models. Moreover, the numbers of samples that can define the so called "representative" sample set are, obviously, different for different scales of study areas, but also differ for hydrogeological, petroleum geological or other problems. One very famous topic, scale problem concerning simultaneous use of well-log porosity and seismic attributes, can be observed also as data management problem based on different "strength" of data and the vertical resolution from two indirect sources. Maybe there are some other topics that can be considering as usual jobs that belong to data management procedures?