Subsurface Data Analysis, Geomodeling and Geostatistics

Discipline: **Geostatistics/Geomodeling**

Length: **5 days**

Instructor

David Garner has more than 30 years of technical experience in industry with over 20 years in applied geostatistical studies in petroleum and mining. He has published and presented over 25 papers, many of which were peer-reviewed. Currently, he is a consulting geomodeling advisor and trainer and an associate of Geovariances in Fontainebleau, France. Previously Mr. Garner held positions in Halliburton as a Chief Scientist in R&D, as a Specialist in Statoil's Heavy Oil Technology Centre-Unconventionals R&D, as Senior Advisor Geologic Modeling for Chevron Canada Resources, and Reservoir Characterization Specialist at ConocoPhillips Canada. He was president of TerraMod Consulting for 6 years applying geostatistics and geomodeling techniques mainly for large international reservoir studies and mining resources. As a volunteer, Mr. Garner currently serves as a co-chair for the CSPG Geomodeling Technical Division committee and is chair for the upcoming Gussow conference, Closing the Gap III Advances in Geomodeling for Petroleum Reservoirs to be held in October, 2018. He was general chair for the CSPG 2011 and 2014 Gussow conferences., co-editor of the special edition December 2015 BCPG on Geomodeling Advances and the 2013 **CSPG Memoir 20**. Other courses taught are Fundamentals of Geostatistics, All You Need to Know about Geostatistics, Deconvolution Theory, and Introduction to Geophysics

COURSE DESCRIPTION

The course subjects cover a broad scope of subsurface practices applicable to offshore, onshore mature, unconventional and heavy oil reservoirs. The course intent is to provide grounding in geomodeling thought process, and to place high level topics into their basic integrated context. By the end of the course, each topic will have been defined and discussed and related to general workflows with examples. Additional reading material will be listed in the notes.

Geomodeling today is integral to a successful business strategy in many hydrocarbon reservoirs. The sub-surface exploration to development team uses the Geomodel to render the geologic interpretation into a digital format suitable for resource assessments, volumetrics, input to reservoir simulation software, well planning, uncertainty analysis, and a variety of decision making processes. A key goal in the Geomodeling practice is to deliver through diverse data and geological concepts an image of reservoir heterogeneities critical to better understanding the physical hydrocarbon extraction processes

and resource. Geomodels help reveal the impact of the various reservoir multi-scale features on dynamic behavior.

Geostatistics is the mathematical engine of spatial data analysis and geomodeling. Spatial data used by subsurface teams in the hydrocarbon industry is information with a location, i.e., data with coordinates. Dominant uses of geostatistics in the industry are exploratory data analysis mapping, integrating diverse variables, building geomodels, and resource evaluation. Uncertainty is a fundamental topic because the applications are stochastic and the data provide a sparse or imprecise sampling of reservoirs. Geostatistical basic theory and best practices are explained along with a variety of practical tips. Uses of probabilistic results are discussed. Context for the subsurface team is given to improve communication across disciplines. Exercises are designed to reinforce the theory and lecture through the hands-on learning. The Isatis Geostatistics toolkit is used for exercises since basic techniques are transferable.

Learning outcomes

To provide grounding in subsurface geomodeling thought process, and to place high level topics into their basic integrated context. By the end of the course, each topic will have been defined and discussed and related to general workflows with examples. Improved understanding of best practices and important workflows. An introductory grounding in basic geostatistical theory and best practices, tools of the trade for those who will carry on using geomodeling or mapping, understanding the application of geostatistics in the context of the hydrocarbon industry, and subject knowledge to improve team communication. Improved understanding of the uses and limitations of geostatistics and geomodeling.

COURSE CONTENT

Topics to be defined and discussed:

- Geologic Concepts: heterogeneities, stratigraphic architecture, geometries
- Exploratory Data Analysis – cleaning and checking data
- Geomodeling Cases
- Multi-scale data and rescaling topics
- Multi-variate Data analysis (for seismic and wells)
- Trends in data and how to handle them
- Geostatistical Depth conversion introduction
- Properties in Models: discrete and continuous variables
- Topics around Facies and petrophysics preparation
- Modeling Uncertainty: The importance and introduction to approaches
- Post-processing Geomodels: practical use of multiple realizations with objectives

Outline -Modeling process has many important steps and choices:

- An overview of geostatistics.
- Context, terminology and essential statistics for a foundation
- Estimation, kriging, and stochastic simulation methods as grounding in techniques
- Generalized subsurface workflows and practice
    - Compiling and checking the input databases, data types, e.g. well markers, logs, seismic.

- Defining the stratigraphic framework
- Defining and Modeling Facies, Petrophysics (porosity, saturation), Permeability, Geomechanics
- Post-processing for summarizing uncertainty and connectivity; well placement
- Volumetric assessments with constraints
- Re-scaling for the simulator
- Linking static to dynamic behavior
- Direct forecasting (proxies and type curves)

Customization of the course content is possible.

Who should attend: technical and decision makers working on subsurface hydrocarbon reservoirs in multi-disciplinary teams using or considering using geomodeling. This includes technicians, geologists, geophysicists, petrophysicists, reservoir engineers, technical managers, new hires, and geomodelers.

Computer requirements: Windows based laptop. The Isatis Geostatistics Toolkit Software from Geovariances will be provided for the course exercises and will be installed on attendees' laptops at the start of the course.

Course setting: Clients' offices or mutually agreed outside venue

Exercises: Several on each main topic with an integrated probabilistic volumetric study. Exercises are intended to reinforce concepts and practical application. Client customization with data is possible with appropriate preparation time or on an ad hoc basis during or after the course time.

Prerequisites: None, but general practical experience with integrated subsurface teams planning to use or using geomodeling would be helpful. Openness to seeing basic mathematical theory which is shown in places. Concepts are explained.