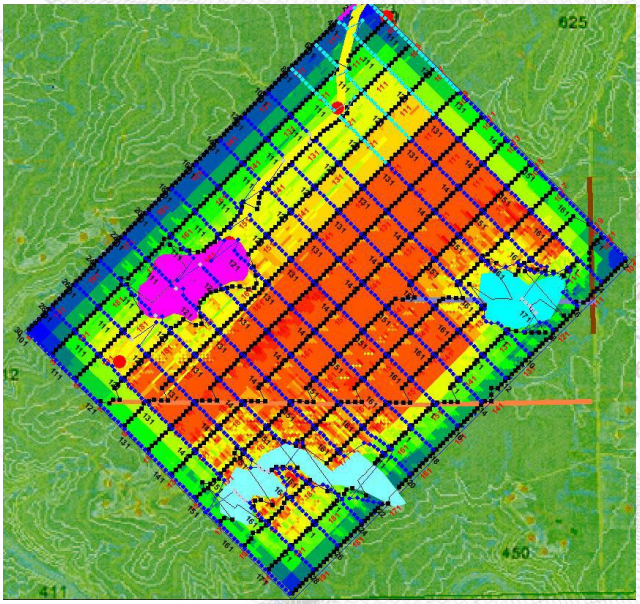
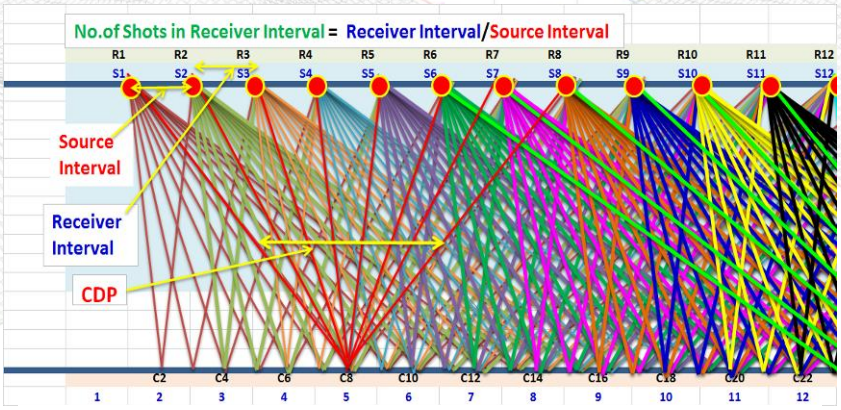
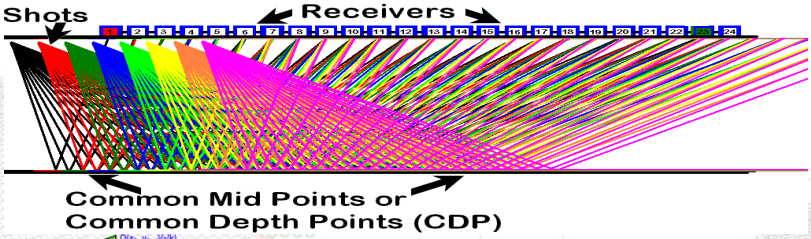
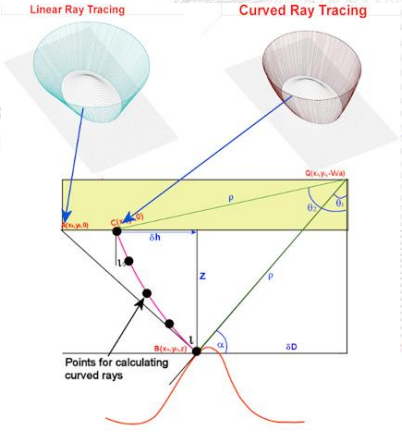
Principles of 2-D & 3-D Interpretation

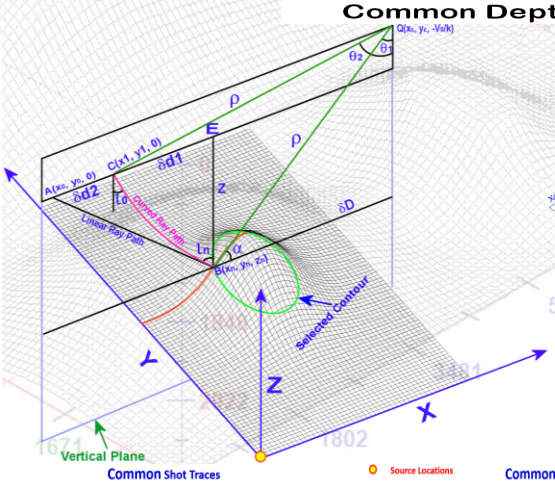
By: Dr. Mangat R. Thapar
President, IGC Inc.

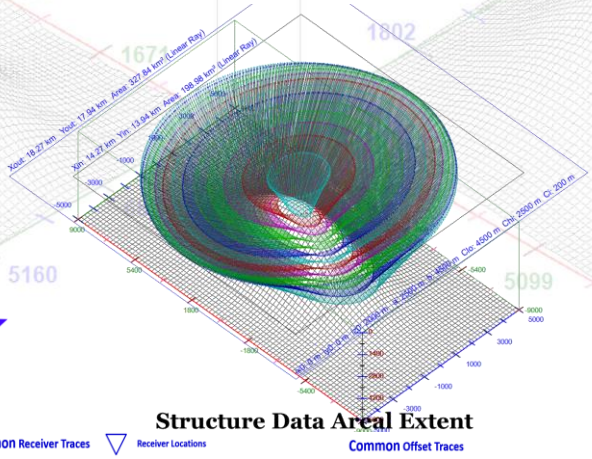


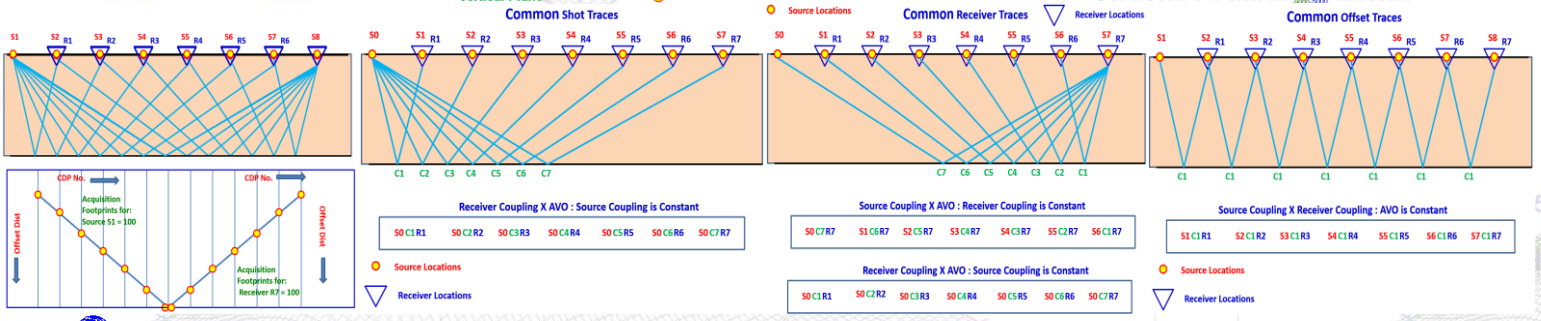








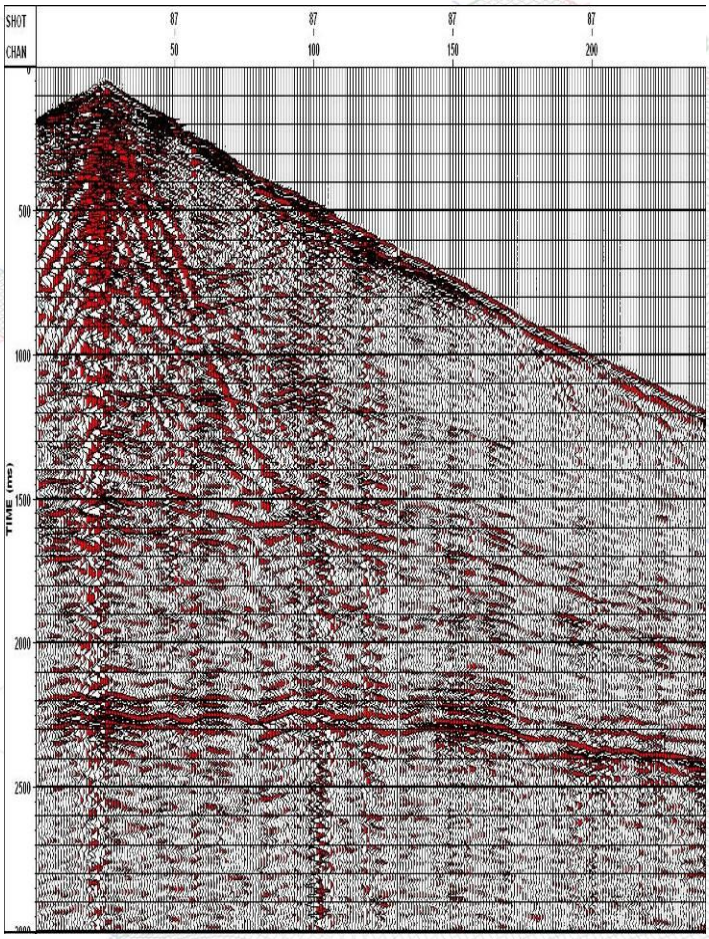


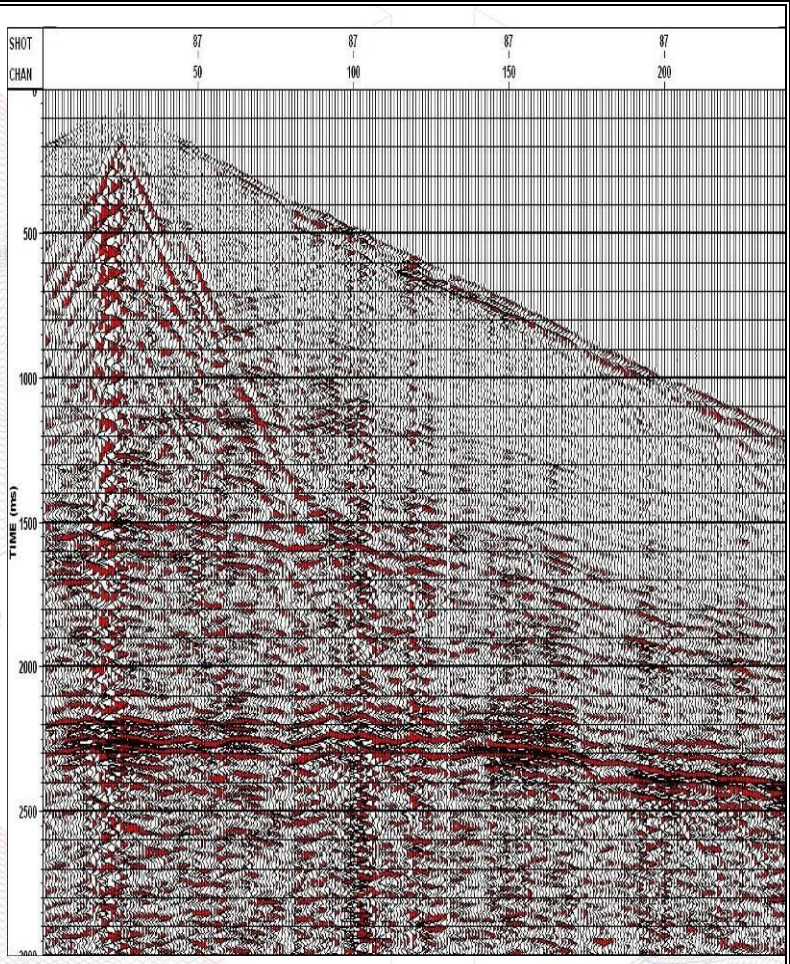


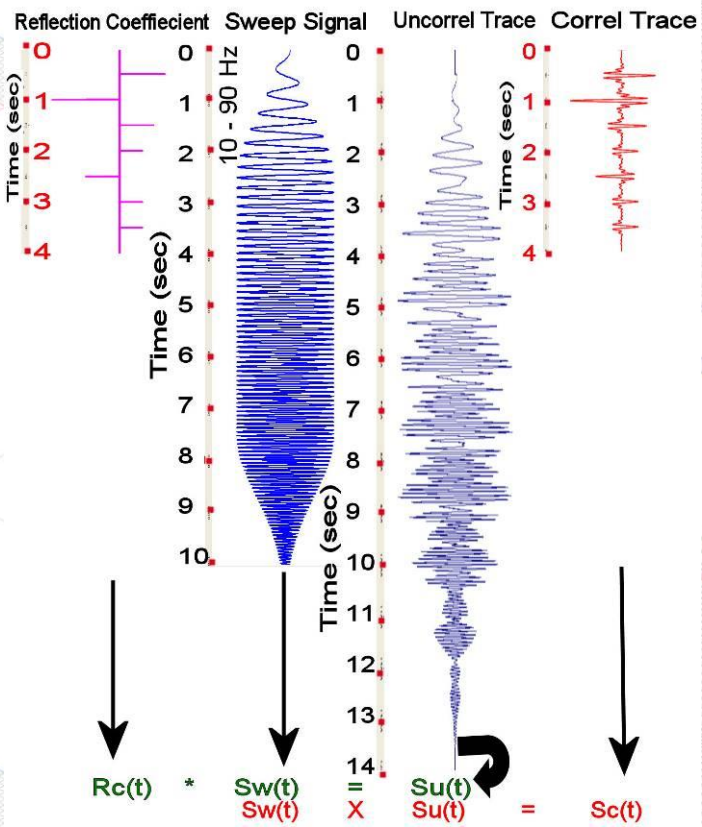
IGC Inc.

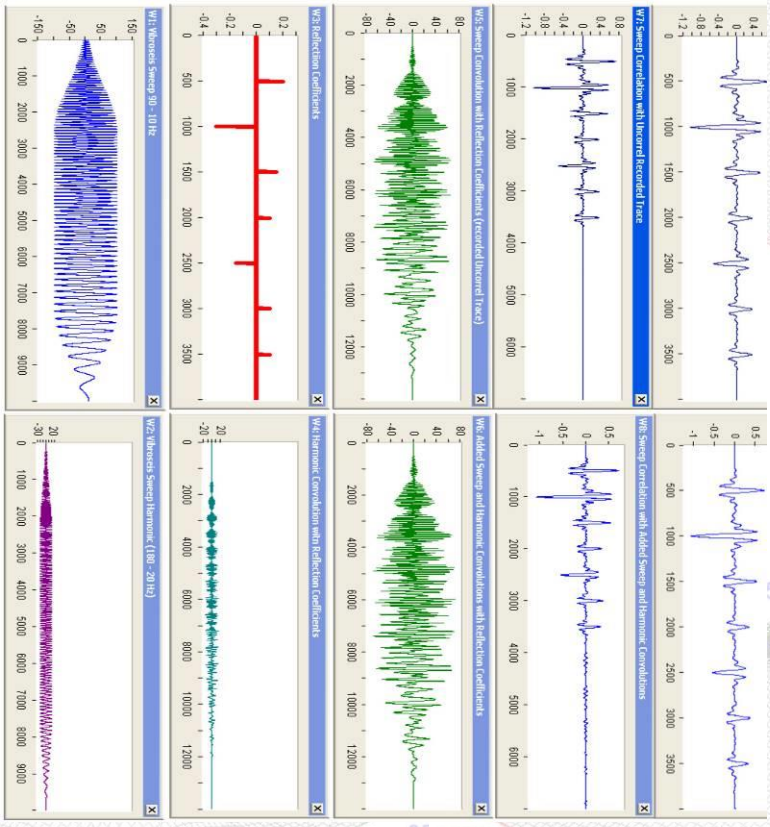
4325 E 51st Street, Suite 126, Tulsa, Oklahoma 74135

Phone: 918-492-0850 Email: info@IGC-OK.com





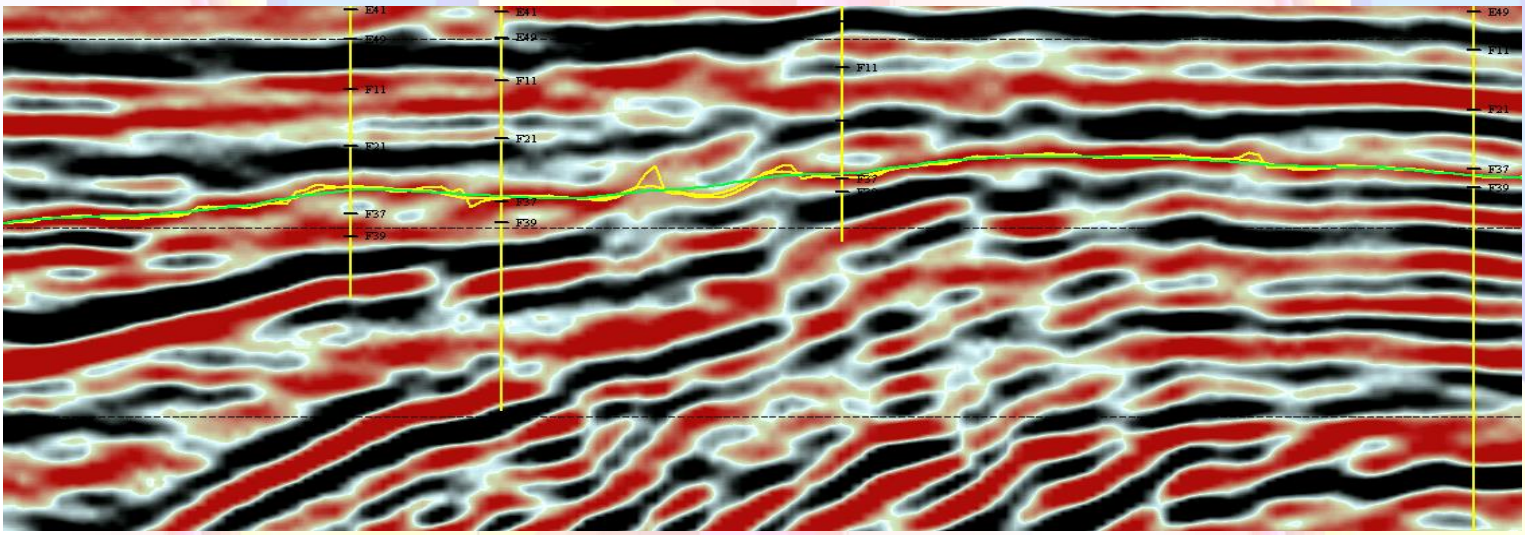


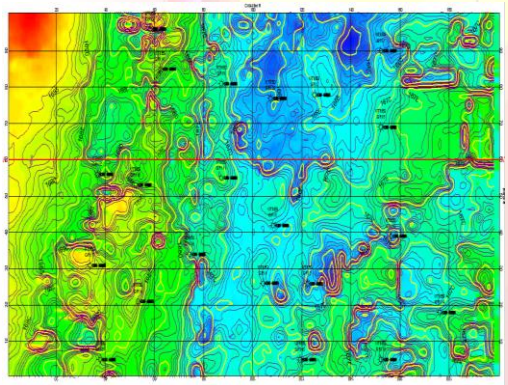


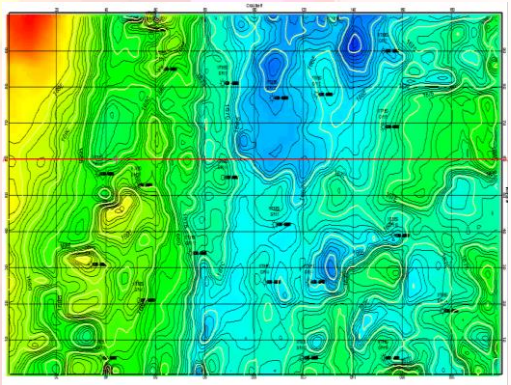
IGC Inc.
4325 E 51st Street, Suite 126, Tulsa, Oklahoma 74135
Phone: 918-492-0850 Email: info@IGC-OK.com

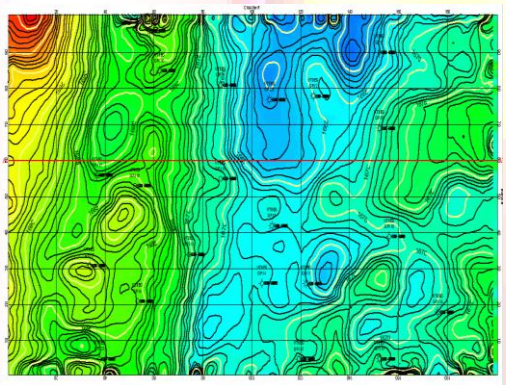
2-D & 3-D Interpretation

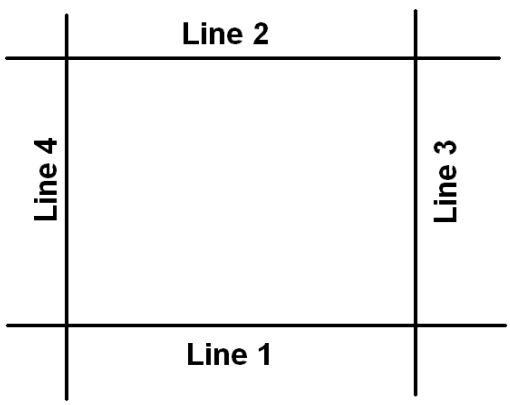
By: Dr. Mangat R. Thapar
President, IGC Inc.

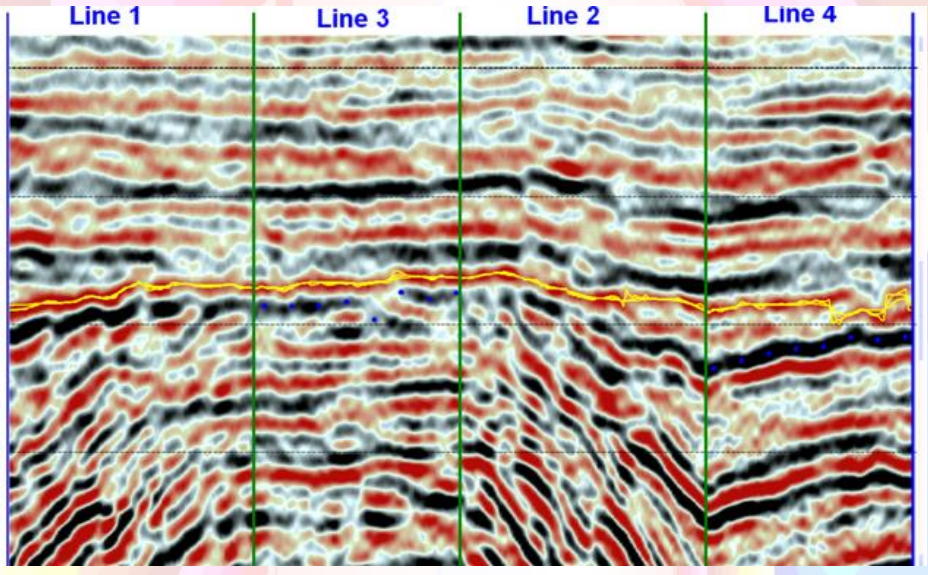




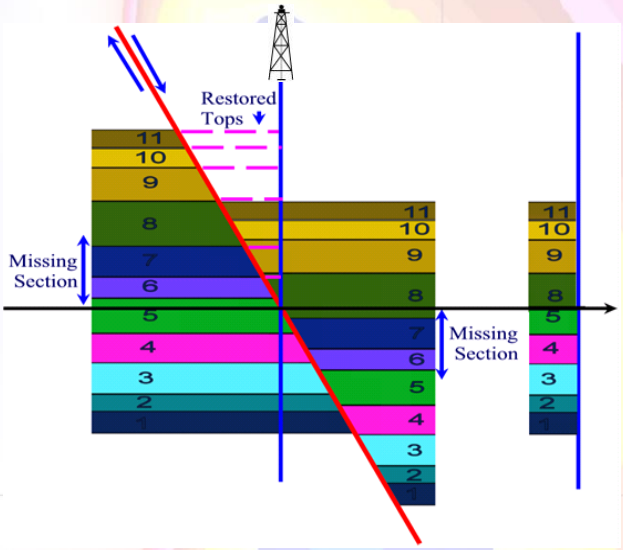


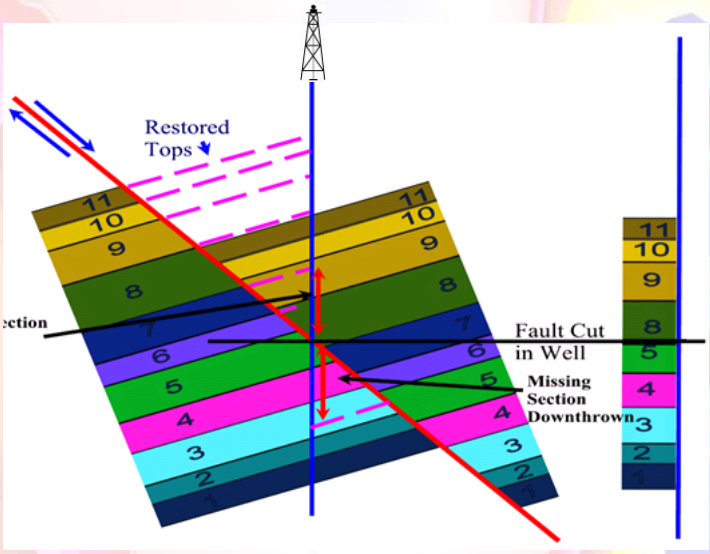


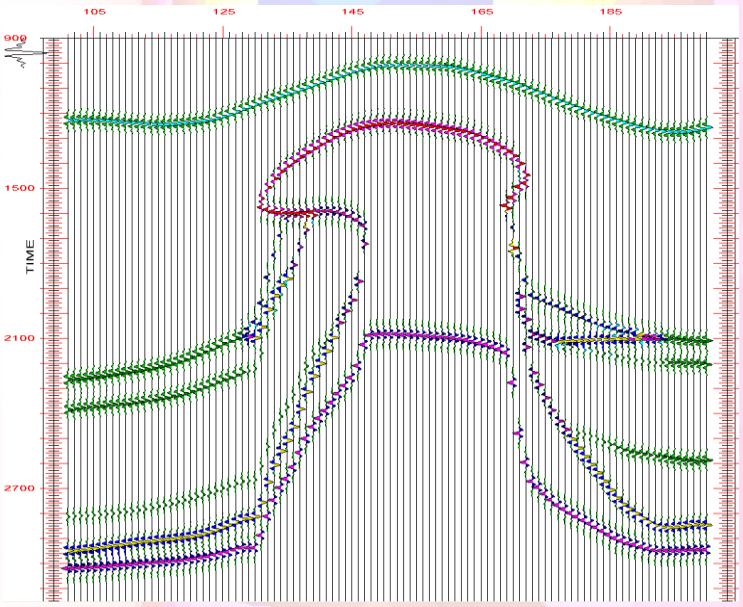


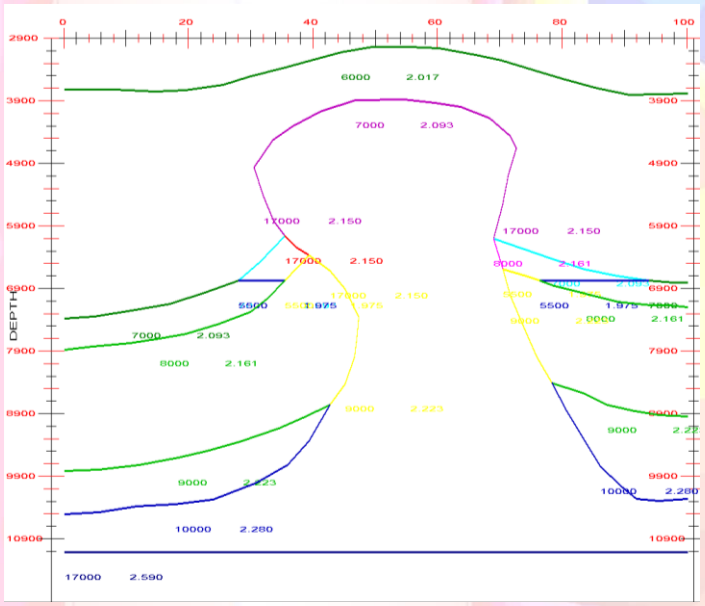


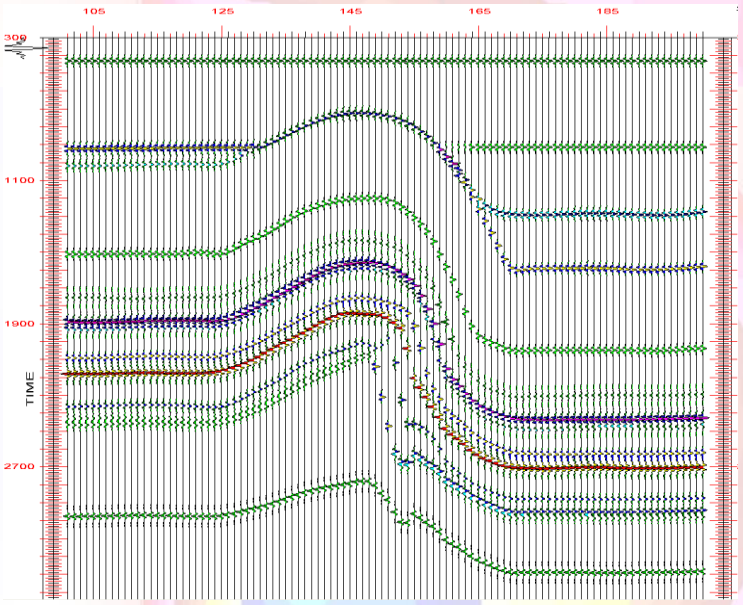
IGC Inc.
4325 E 51st Street, Suite 126, Tulsa, Oklahoma 74135
Phone: 918-492-0850 Email: info@IGC-OK.com

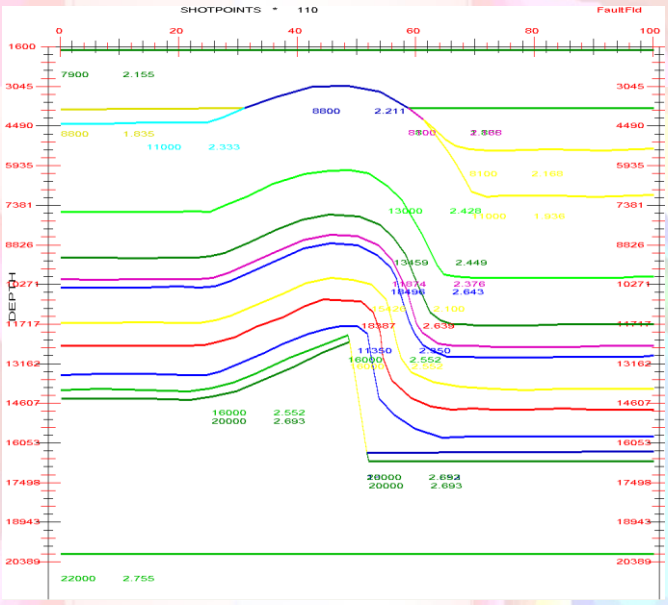












IGC Inc.
4325 E 51st Street, Suite 126, Tulsa, Oklahoma 74135
Phone: 918-492-0850 Email: info@IGC-OK.com

(4) Principles & Interpretation of 2-D and 3-D Seismic Interpretation

Instructor: Dr. Mangat R. Thapar
Course Length: 5 Days
Course CEUs: 4.0

Course Description:

The basic principles and technology associated with 2-D seismic data interpretation provide the interpreter with the solid foundation necessary for 3-D interpretation. It is important to grasp the concepts of 2-D and 3-D seismic data and associated processing techniques. One can only quality control 2-D or 3-D data by learning and understanding the survey design and the data processing flow. For 3-D survey, it is important to know or determine that the survey template design meets all fundamental principles required in a good design. In processing, it is important to know how to QC pre and post migration techniques. To realize the full potential benefits from seismic data, it is important to have full knowledge of the available technologies, e.g. VSP, Seismic Attributes, P and S wave multi-component data, Anisotropy, and Time Lapse (4-D) applications. Other valuable applications are the use of amplitude and frequencies to estimate thickness of thin beds. For an effective and a sound interpretation of seismic data in time and depth, it is necessary to fully learn and utilize available tools for modeling in 1-D, 2-D and 3-D. All interpretations of 2-D and 3-D data lead to a variety of maps. Therefore, it is very important to have a good understanding of Geostatistical Kriging and variogram modeling. Typically costing less than a few pennies per barrel of oil, 3-D seismic data not only reduces the risk involved in drilling exploration and development wells, but also can dramatically increase production from existing fields. The success of any exploration or development program utilizing 3-D seismic data is dependent upon accurate, three-dimensionally viable structural and stratigraphic interpretations of the seismic data. The successful interpretation of a 3-D seismic survey depends on proper survey design, acquisition, and processing, guarding against pitfalls, and optimal utilization of available 3-D technologies. The basic principles of 2-D seismic data interpretation provide the interpreter with the solid foundation necessary for 3-D interpretation. Not knowing or simply ignoring the well established principles of 2-D interpretation such as picking faults and horizons, and loop tying seismic lines are fundamental to all seismic interpretation. These principles are demonstrated with hands-on 2-D and 3-D seismic exercises involving picking faults and horizons in time and converting to depth, making time and depth maps for horizons and fault surfaces, and performing volumetric calculations. Typically costing less than a few pennies per barrel of oil, 3-D seismic data not only reduces the risk involved in drilling exploration and development wells, but also can dramatically increase production from existing fields. The success of any exploration or development program utilizing 3-D seismic data is dependent upon accurate, three-dimensionally viable structural and stratigraphic interpretations of the seismic data. The successful interpretation of a 3-D seismic survey depends on proper survey design, acquisition, and processing, guarding against pitfalls, and optimal utilization of available 3-D technologies. Detailed steps for information and data gathering for 2-D interpretation, Recommended steps in 2-D seismic interpretation, Guide lines for seismic interpretation, picking horizons, and picking faults

- Detailed step by step discussion of how to design a 3-D survey along with crucial processing steps and related pitfalls.
- Discussion of the application of VSP, methodology for mapping channels, Geostatistical Krigging for thickness interpolation, time lapse 3-D (4-D), principles of P & S wave (multi-component) anisotropy analysis and interpretation, component rotation, and S-wave splitting into slow and fast due to fractures and saturation.
- In-depth explanation of thin bed thickness estimation using properly processed and modeled amplitudes and frequencies, and related pitfalls
- How to utilize of seismic attributes including coherency and variance.
- How to apply seismic modeling in 3-D analysis and to convert stacking into interval velocities for dipping layers.
- How to loop tie horizon picks and determine mis-ties
- Procedure for correlating logs to locate a fault, missing section, and repeat section
- Recognizing interpretation pitfalls due to dip, velocity, velocity gradient, and migration effects
- Use of ray tracing and modeling to comprehend the effects of dip, velocity, and migration

- Step by step procedure for structural interpretation is presented for picking faults, picking horizons, marking fault polygon, and loop tying horizon picks. QC and smoothing or filtering fault surface picks and horizon picks.
- Procedure for converting time picks to depth, and generating time and depth maps, structure and thickness maps, dip and coherency maps.
- Volumetric calculations
- Discussion of constant time slices and their application to generate a structure map independent of the horizon picks
- Workflow chart for 3-D interpretation
- Procedures for stratigraphic interpretation are presented with examples and exercises.
- Application of constant time slices and horizons slices for channels and other stratigraphic features
- Defining reservoir compartments using time slices
- Application of 3-D in Reservoir management, reservoir compartmentalization, and targeted drilling, and reservoir characterization
- How to conduct the risk analysis of 4-D seismic, reviewing more than 20 case histories from many parts of the world.

Exercises:

- Calculating aliasing relating to sampling/Re-sampling of seismic data
- Calculating migration aperture
- Calculating Fresnel Zone parameters
- Design 3-D Survey Template and calculated related source/receiver parameters
- P and S wave attenuation for a thick gas/oil reservoir
- Calculating and mapping thin bed thickness from modeling and amplitudes.

- Picking faults and horizons
- Creating time and depth structure maps; integrating fault surfaces (maps) with structure maps
- Calculating volumetrics
- The 2-D exercises are extended to 3-D to generate structure maps from time slices and calculate volumetrics to compare with calculations in 2-D exercise.

Learning Outcomes:

- Utilize essential procedures in structural and stratigraphic interpretation
- Apply fundamental principles of structural and stratigraphic interpretation
- Use Geostatistical Kriging
- Use S-waves in fractured reservoir interpretation
- Conduct risk analysis of 4-D data

- Utilize essential procedures and technology in structural and stratigraphic interpretation for 2-D and 3-D interpretation
- Apply fundamental principles of structural and stratigraphic interpretation
- Make use of reservoir characterization and compartmentalization tools
- Conduct risk analysis of 4-D data

Who Should Attend?

Interpreters who need an understanding of 3-D seismic fundamentals, geophysicists, geologists, technical support personnel, seismic processors, exploration and data processing managers, and data acquisition managers; any geoscience professionals who uses 3-D seismic data.

Prerequisites:

It is recommended that participants take Seismic Survey Design, Acquisition and Processing; and AVO and Seismic Attributes or equivalent courses.

Course Content

- Overview of 3-D data acquisition and processing
- Principles of 3-D migration
- Horizontal and horizon slices
- 3-D modeling
- 3-D seismic technologies
- Geostistical Kriging and variogram
- Anisotropy, 3-D, 3-C, S-waves
- Application of seismic attributes
- Thickness estimation using amplitude modeling, and frequency

- Principles of structural & stratigraphic Interpretation
- Reduced risk using 4-D
- Successful applications of 3-D in E&P
- Application of seismic attributes
- Reservoir management using 3-D

Participants are encouraged to bring data examples related to this course.