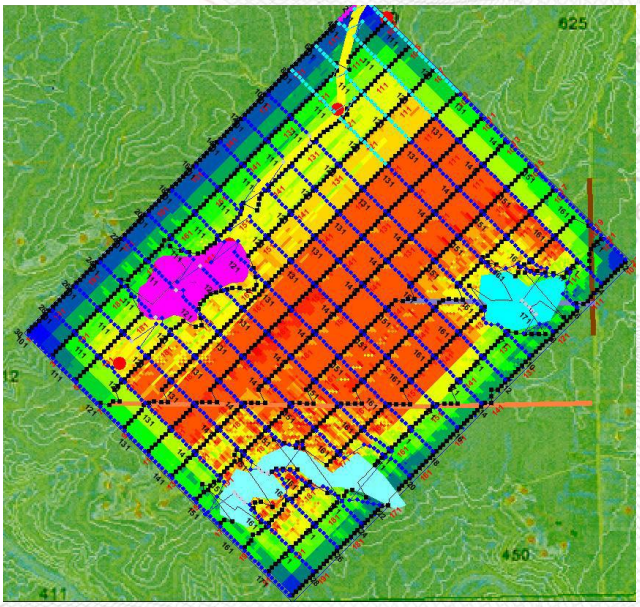
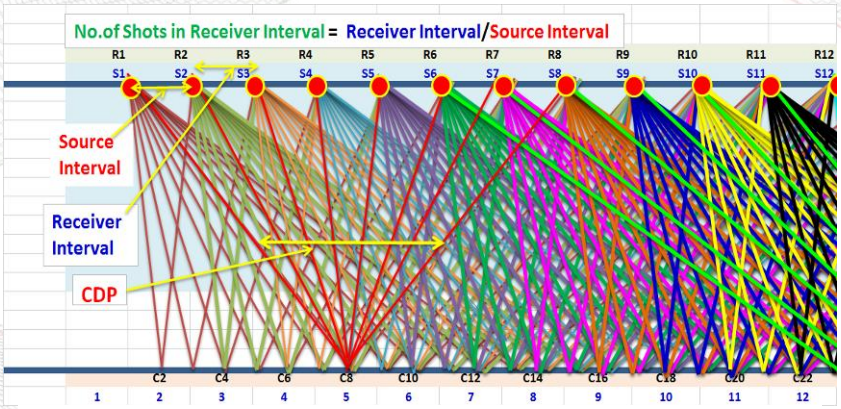
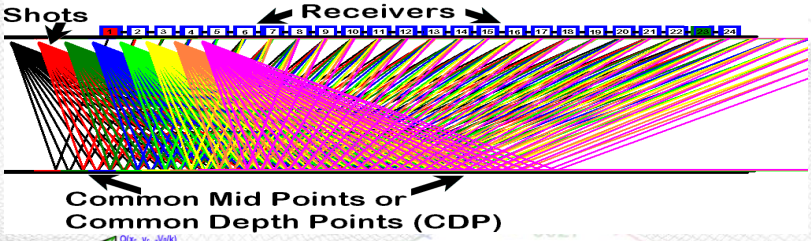
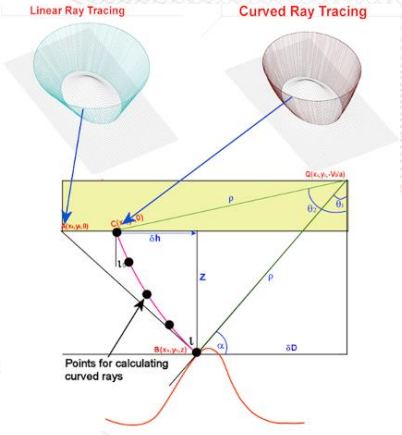
Seismic Survey Design & Acquisition

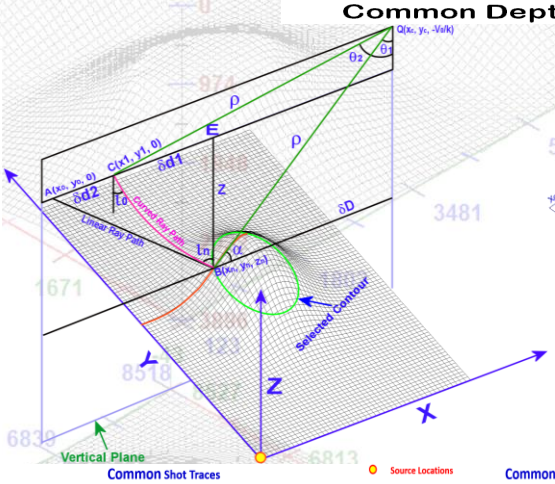
By: Dr. Mangat R. Thapar
President, IGC Inc.

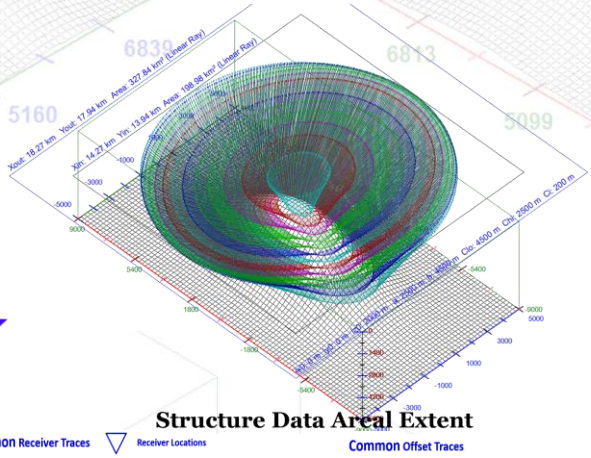


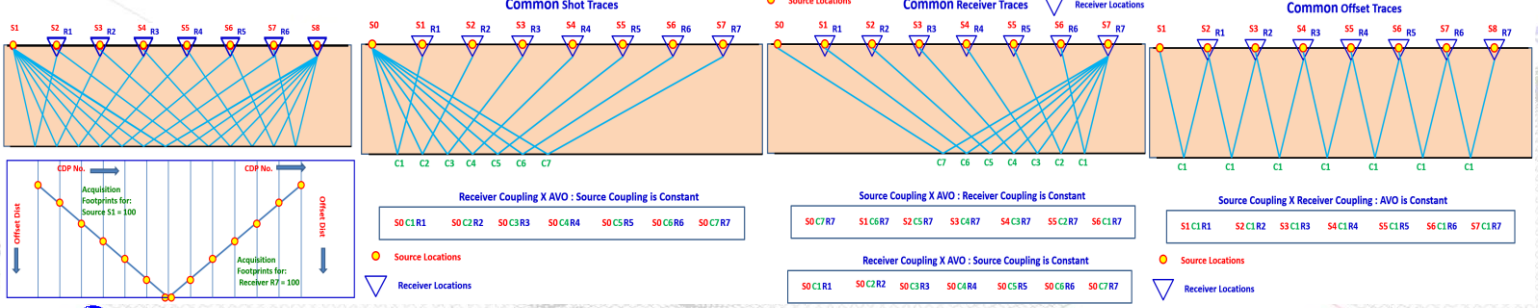




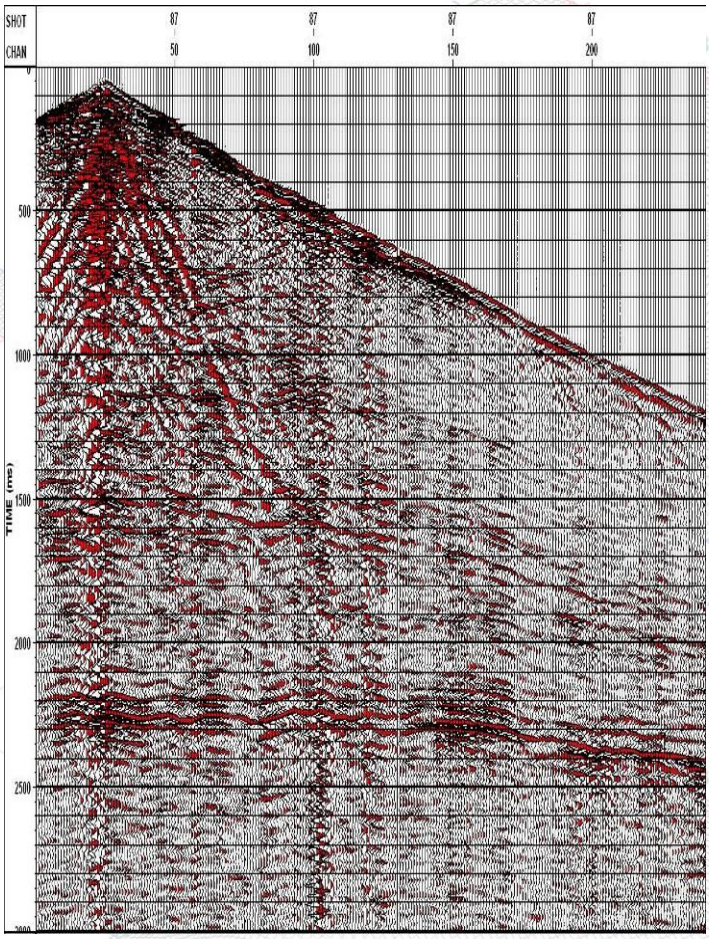


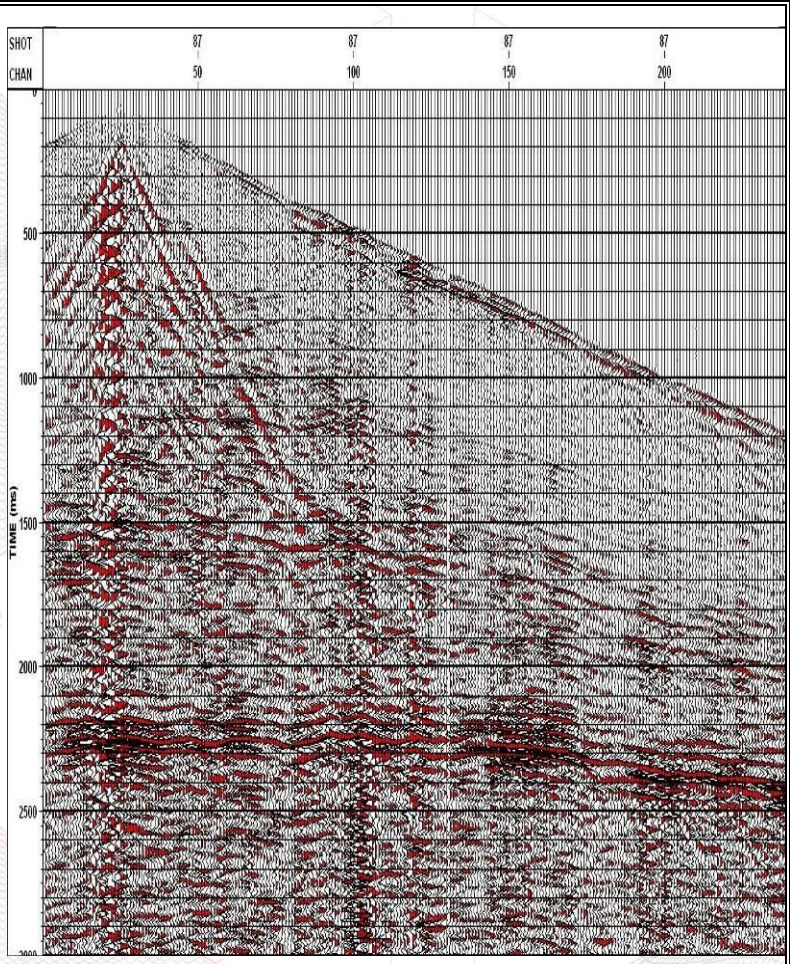


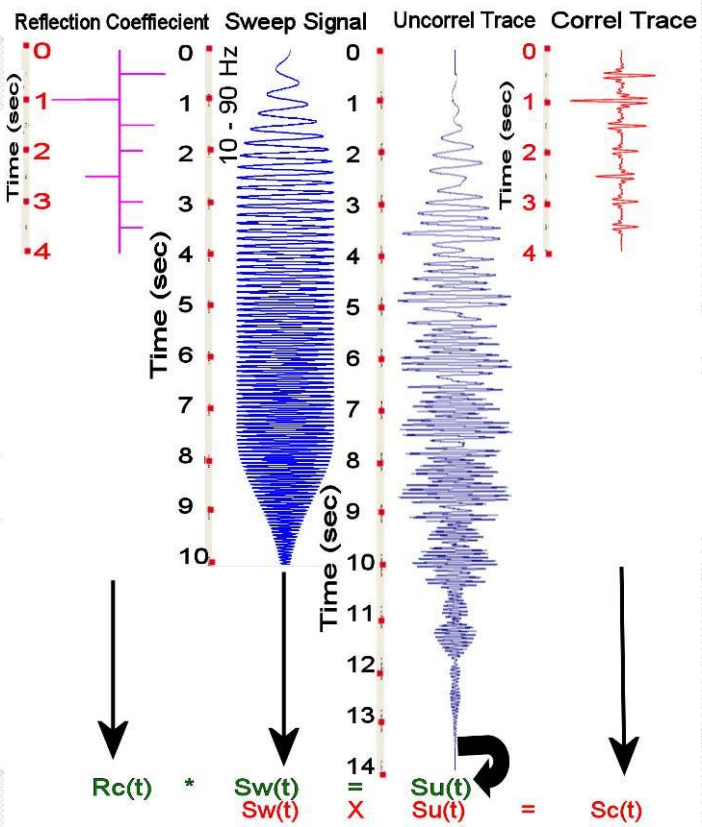


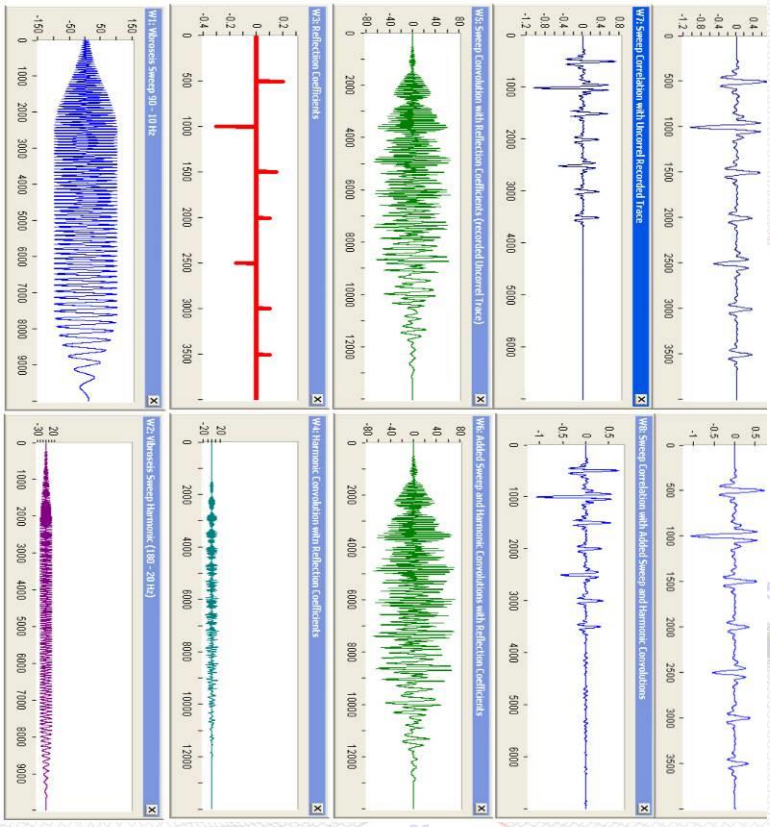


IGC Inc.
4325 E 51st Street, Suite 126, Tulsa, Oklahoma 74135
Phone: 918-492-0850 Email: info@IGC-OK.com





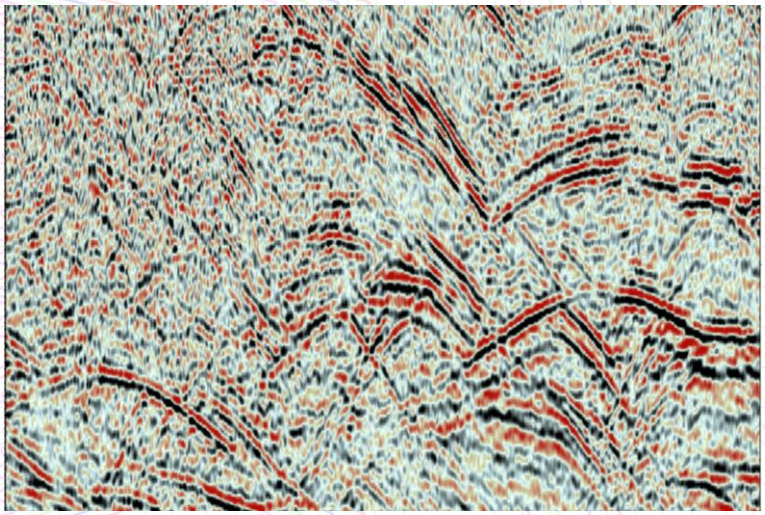


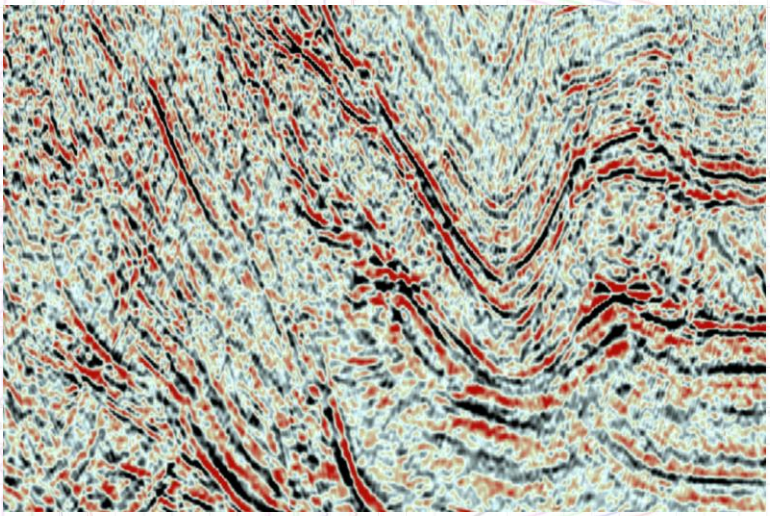


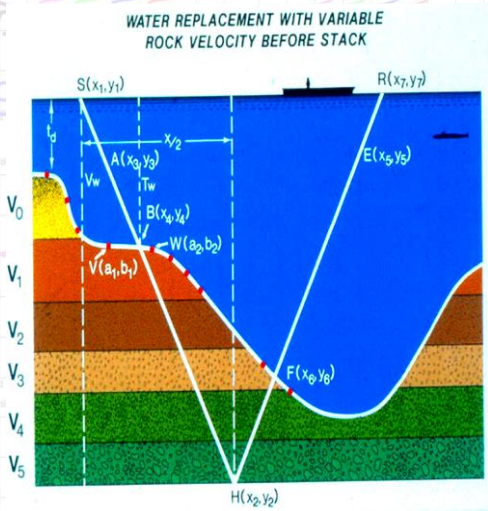
IGC Inc.
4325 E 51st Street, Suite 126, Tulsa, Oklahoma 74135
Phone: 918-492-0850 Email: info@IGC-OK.com

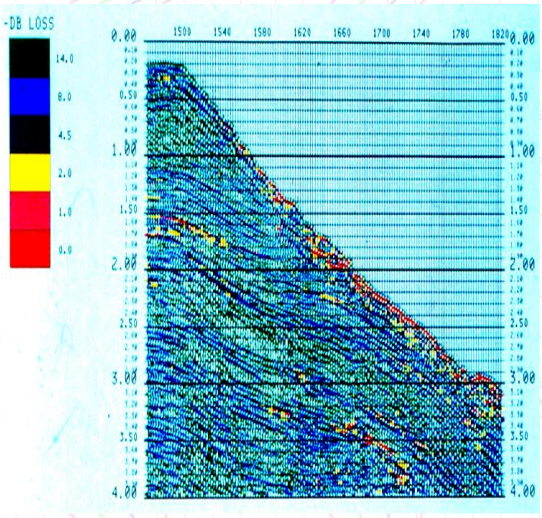
Seismic Data Processing

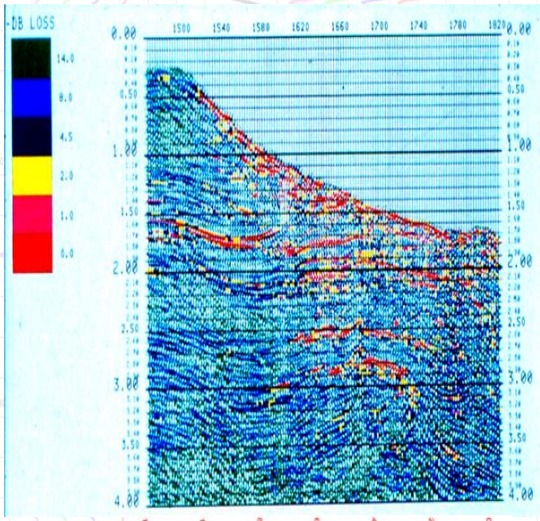
By: Dr. Mangat R. Thapar
President, IGC Inc.

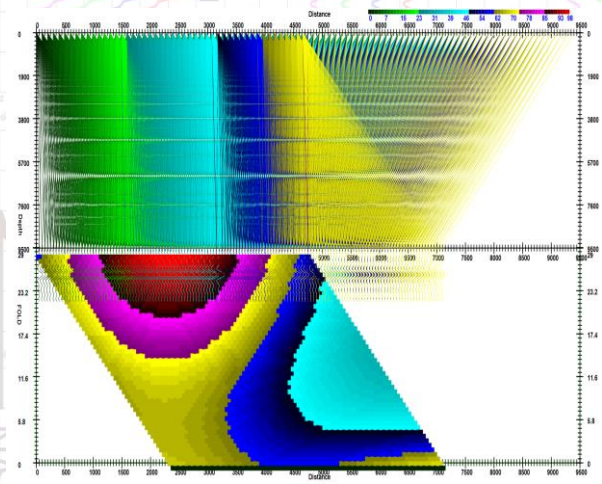


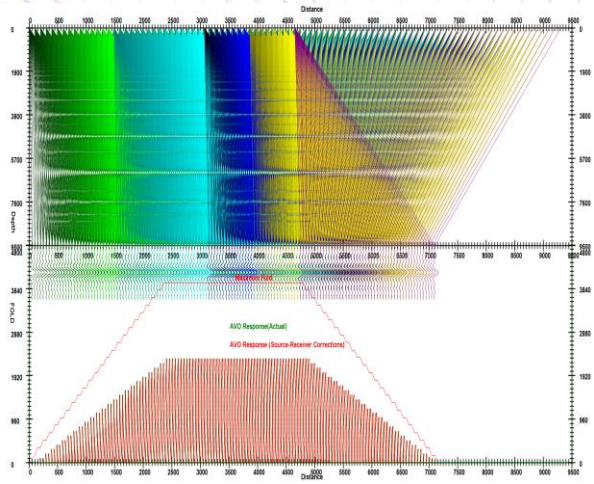


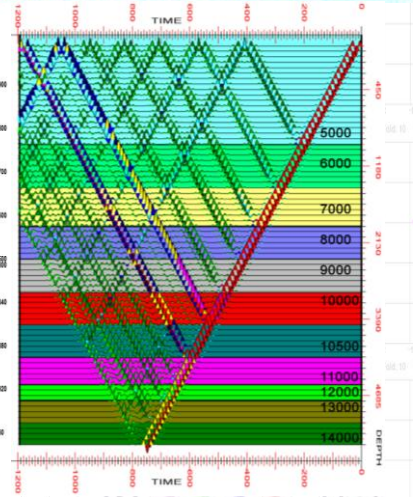




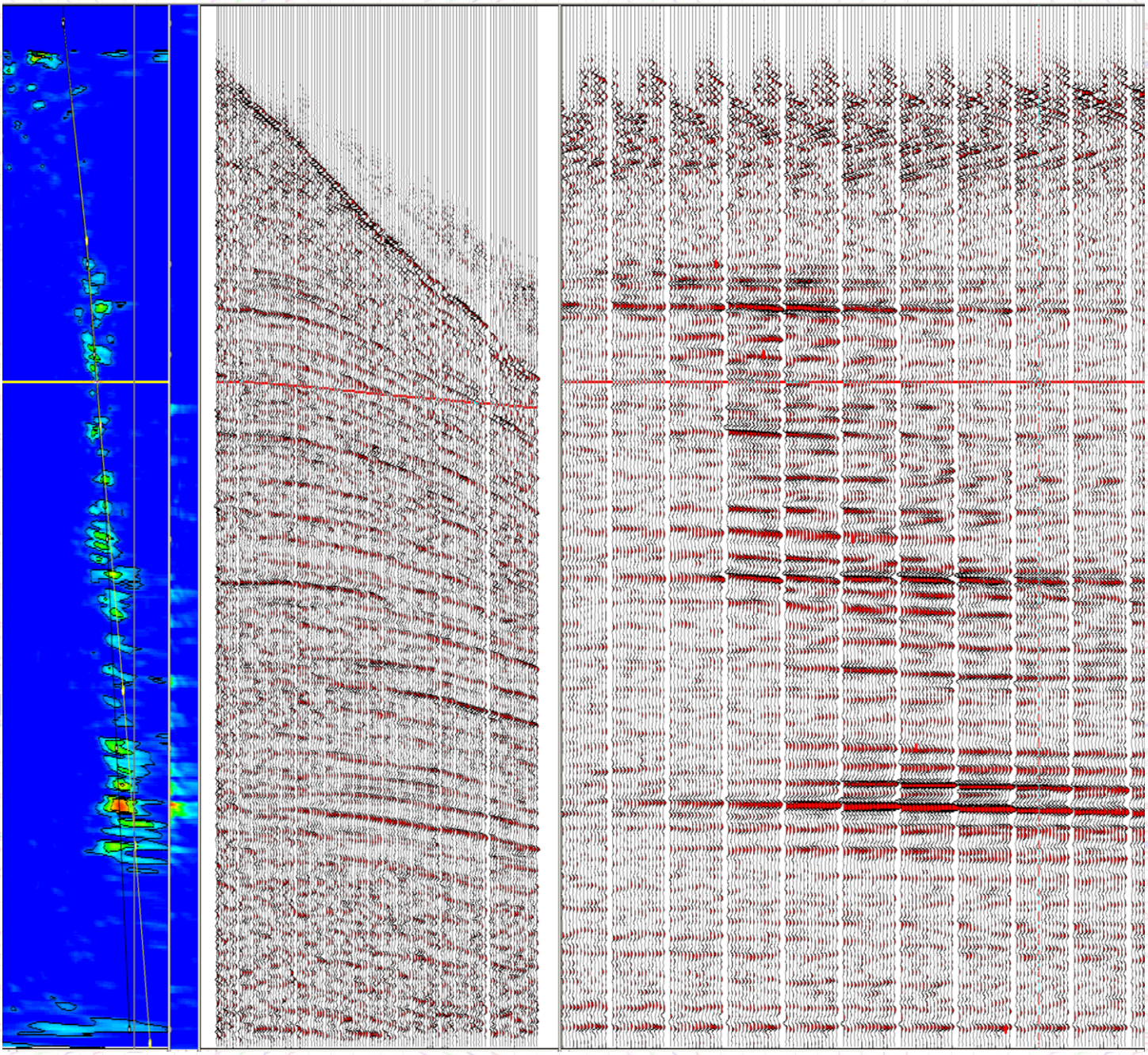


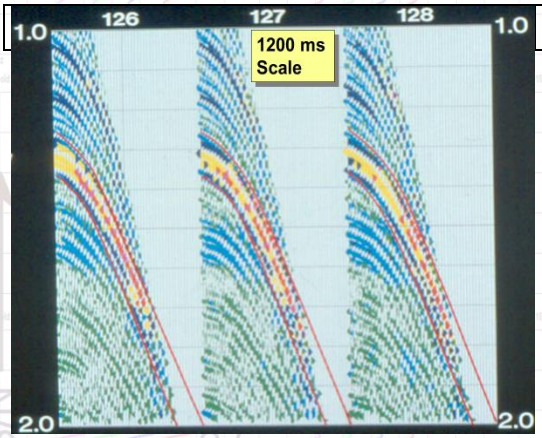


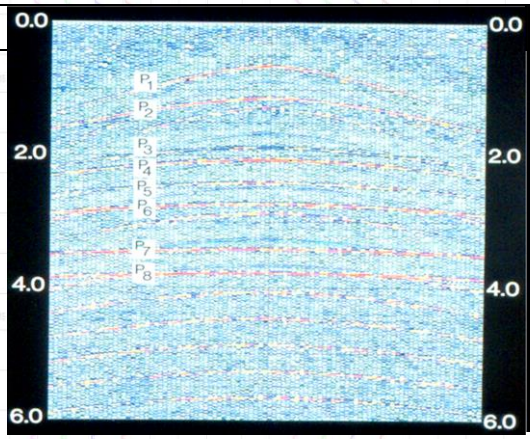


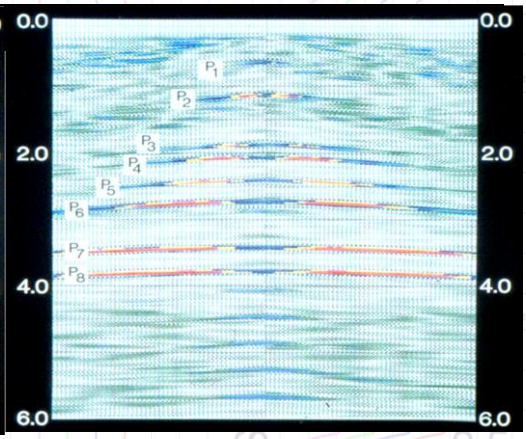


IGC Inc.
4325 E 51st Street, Suite 126, Tulsa, Oklahoma 74135
Phone: 918-492-0850 Email: info@IGC-OK.com









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

(2) Seismic Survey Design, Data Acquisition & Processing

Instructor: Dr. Mangat R. Thapar

Course Length: **5 Days**

Course CEUs: 4.0

Course Description:

The appropriate design and acquisition of 3-D seismic survey is vital to the success of any oil and gas exploration or development program. This course emphasizes the importance of proper design and acquisition for producing a 3-D seismic survey that will effectively impact drilling success. Exercises and case histories are utilized to teach fundamental principles and explain limitations and pitfalls. Live demonstrations of design using OMNI, and acquisition using Cirrus Board I/O Sensors (wherever possible) are included to help participants grasp the subject matter in survey design and seismic data acquisition. By the end of the course, participants will be able to contribute to the effective planning, execution, and quality control of survey design and seismic data acquisition. The appropriate processing of 3-D seismic survey is equally important to the success of any oil and gas exploration or development program. This course emphasizes the equal importance of proper acquisition and processing parameters to producing a 3-D seismic survey that will effectively impact drilling success. Exercises and processing flows are utilized to teach fundamental principles and explain limitations and pitfalls. Live demonstrations of processing using VISTA are included to help participants grasp the subject matter in seismic data processing. By the end of the course, participants will be able to contribute to the effective quality control of seismic data processing

- Description of fundamentals of P, S, and R waves with intuitive illustrations.
- Understand aliasing in time and 2-D, and its effect on seismic data.
- Important steps and parameters in data acquisition in the field.
- Thorough discussion of vibroseis and dynamite as energy sources, and ground positioning methods for source/receiver stations.
- Estimation of SNR and its importance.
- Important steps in designing and setting parameters for marine data acquisition, including discussion of airgun arrays, and positioning methods for source/receiver locations.
- A systematic, step by step procedure is presented for designing a 2-D or 3-D survey including most of the available templates and array designs.

- Basics of correct recording geometry; shot, receiver, and CDP gather are explained.
- How to apply proper amplitude scaling, and select the correct deconvolution and bandpass filter.
- How to conduct, monitor or QC velocity analysis. Detailed discussion of the relationship between NMO and velocity.
- Discussion of static corrections to seismic data.
- How to improve SNR with stacking, the relationship between fold and SNR, and migration (pre-stack, post-stack, DMO) of seismic data.
- Discussion of basic seismic attributes, step by step VSP processing, and the effect of deep water on data acquisition and processing.

Exercises:

Exercises designed to further the understanding of basic principles in survey design and data acquisition, and processing include:

- How to relate useable offsets, fold, and critical angle for major horizons?
- Design Vibroseis sweep and calculate related parameters to avoid harmonics interference with data.
- Measure ground roll velocity and frequency from field records to design array patterns and filters?
- Calculate Aliasing frequency due to sampling and due to dip.
- Calculate Migration aperture for dipping horizons.
- Design 2-D crossing lines over a structure and calculate all required parameters.
- Design a 3-D survey over a prospect, and calculate template parameters related to the sources and receivers.

- Calculation of absorption effects of P and S waves.
- How to apply relative amplitude scaling using tn, and how to obtain the value of n from seismic data?
- Calculate and relate critical angle, incidence angle, offset, and fold for major horizons.

- How to quality control velocity analysis using RMS and Interval velocities?
- How to Interpret and Identify water bottom and peg-leg multiples, and primaries on the records?
- A group exercise for participants to compare, QC, and select the best seismic section of the same line processed by different seismic data processing companies.
- A group exercise for participants to compare, QC, and select the best seismic section of a line processed by a single processing company but with different processing flows and parameters.
- As a group, participants examine, analyze, and modify an existing acquisition parameter and processing flow to make it suitable for AVO and seismic attribute analysis.

Learning Outcomes:

- Understanding of sources in seismic data acquisition, shot arrays, vibroseis sweep generation and its parameters, and airgun arrays
- Array patterns for sources and receivers
- Design 2-D and 3-D surveys for land and marine.
- Quality control of acquisition.
- Selection of acquisition and processing parameters for AVO and seismic attributes.
- Overcome limitations and pitfalls in acquisition.
- Understand the principles and application of relative amplitude scaling and AGC.

- Learn the basic principles, methods and pitfalls in velocity analysis.
- A good understanding of how to relate SNR with the stacking process.
- Concepts of pre and post stack migrations
- Optimize seismic processing flows
- Process data for AVO and attributes
- Processing flow for VSP data
- Overcome limitations and pitfalls in processing.

Who Should Attend?

Geologists, geophysicists, engineers, supervisors, executives and managers involved in the design, execution and monitoring of seismic data acquisition and processing

Prerequisites:

- Fundamentals of P, S, and R waves
- Acoustic impedance, reflectivity, amplitudes, and diffractions
- Data acquisition field work, operations and survey
- Source and receiver array patterns
- Marine sources and Vibroseis sweeps
- 3-D survey design formulae, patterns

- Recording geometry, CMP method NMO velocity and stacking, aliasing
- Recording geometry, CMP method NMO velocity and stacking, aliasing
- Proper use of amplitude scaling and deconvolution for AVO and attributes
- Improving data with static and dynamic corrections
- Correlation, convolution, deconvolution, filtering, and frequency spectra
- Time and depth migration, DMO/VSP processing
- Seismic attributes, VSP, and Tau-P
- Seismic survey design and processing flow for AVO or attribute analysis

Participants should have taken a *Basic Geophysics or Introduction to Gephysics course* prior to attending.

Course Content

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