Mustagh Resources Ltd.

VIBROSEIS THEORY AND PARAMETER DESIGN
COURSE OUTLINE

- **Introduction**
- **The Fundamental Seismic Principle**
  - Average velocity
  - Modes of acoustic energy propagation
    - Compressional wave, Shear wave
    - Raleigh wave, Others
  - Rock properties
    - Interval velocity
    - Density
    - Poisson's ratio
  - Propagation of a P-wave
  - A simple seismic experiment
  - A basic reflection model
    - Effect of wavelet length
    - Effect of signal to noise ratio
- **Basic Signal Theory**
  - Properties of the cosine wave
  - Fourier decomposition
  - The effect of phase
  - The effect of amplitude
  - Principles of filtering
- **Resolution and Bandwith**
  - Simple wedge model – variable bandwith
  - Simple wedge model – variable phase
  - Simple wedge model – variable signal/noise ratio
  - Bandwith
- **Energy Loss Mechanisms**
  - Reflection coefficients and transmission losses
  - Mode conversion and energy partition
  - Spherical divergence
  - Absorption
- **The Energy Source**
  - Desired source qualities
  - Dynamite vs Vibroseis
  - Vibroseis – Structural aspects
  - Vibroseis – Hydraulic aspects
  - Vibroseis – Electrical aspects
  - Vibroseis – Signal theory
- **Correlation and Vibroseis**
  - Overview of correlation
  - Sweep length and noise
  - Noise suppression tools
    - Sweep length
    - Number of sweeps
    - Noise edit algorithms
    - Number of vibrators
    - Array effect
  - Types of noise
  - Balancing sweep effort with production time
    - Sweep effort
    - Pad time
    - Sweep length vs number of sweeps
    - Number of sweeps vs daily production
    - Sweeps vs vibrators
  - Tapers
    - Effect on sidelobes
    - Effect on signal energy and bandwith
    - Tapers as filters
    - Effect on machinery
  - Non-Linear sweeps
    - Linear vs +3 dB/oct Hi-Dwell non-linear sweep
    - +3 dB/oct with tapers
    - +6 dB/oct with tapers
    - -3 dB/oct with tapers
    - Comparison of linear, +3dB/oct & +6 dB/oct sweeps
    - Linear vs Non-linear sweeps –Effect on tapers
    - Linear, +3dB/oct, +6dB/oct and star tapers
    - Linear, +3dB/oct, +6dB/oct and sweep rate
    - Linear, +3dB/oct, +6dB/oct vs –3dB/oct
  - Vari-Sweep
  - Coupling
    - Upsweep vs downsweep
    - Effect of coupling
  - Time delay to onset a distortion
  - Harmonic distortion
  - Benefits of sweep length
  - SerQC plots
- **Evaluation of Noise**
  - Analysis of coherent noise
  - Array Design
    - Simple linear array design
    - Optimizing a two sub-array system
    - Optimizing a three sub-array system
    - Spatial convolution and sub-arrays
- **Trapped Mode and Guided Waves, A common noise problem**
- **Dual Source Vibroseis**
  - Plus-Minus method
  - Up-Down method
  - Vari-Sweep
  - Dual sourcing (Ping-Pong)
  - Slip sweep
- **Sei-Fi Technology**
  - Introduction
  - Data Acquisition: Techniques and equipment
  - Data Processing: Separation and Inversion
  - Pre-stacked and stacked data examples
  - summary