

# **GEOP 315**

## **Seismic Exploration I**

### **Course Outline**

#### **1. Seismic Waves**

- Theory of elasticity
  - Stress
  - Strain
  - Hooke's law
  - Elastic constants
- The wave equation
- General aspects of waves
  - Huygen's principle
  - Fermat's principle
- Body waves
  - P-wave
  - S-wave
- Surface waves
  - Rayleigh wave
  - Tube wave
- Anisotropy
- Medium effects on waves
  - Geometrical spreading
  - Absorption
  - Dispersion
- Interface-related effects
  - Reflection
  - Refraction
  - Diffraction
- Amplitude partitioning at an interface

#### **2. Time-Distance Curves**

- Reflection in a homogeneous medium
  - NMO
  - DMO
- Reflection in a vertically heterogeneous medium

#### **3. Seismic Velocity**

- Introduction
  - Model of a sedimentary rock
    - Porosity
    - Porosity relations
  - Velocity types
    - Average

- RMS
- Stacking
- NMO
- Interval
- Dix
- Methods of velocity determination
  - Time-distance methods
    - $X^2-T^2$
    - T- $\Delta$ T
    - Best-fit
      - Velocity spectrum
      - Constant velocity stacks
  - Borehole methods
    - Check-shot
    - VSP
    - Acoustic logging

#### 4. Seismic Signal and Noise

- Primary reflections
- Events other than primary reflections
  - Direct wave
  - Ground roll
  - Head wave
  - Diffraction
  - Multiple
    - Short-path
      - Peg-leg
      - Ghost
      - Water reverberation
    - Long-path
- Shape of seismic wavelet
- Noise
- Resolution
  - Vertical
  - Horizontal

#### 5. Seismic Equipment

- Determining location
  - Land
  - Marine
- Seismic energy sources
  - Land
    - Impulsive
      - Explosive
      - Nonexplosive

- Nonimpulsive
    - Vibroseis
- Marine
  - Air gun
- Seismic energy detectors
  - Land
    - Geophone
  - Marine
    - Hydrophone
- Recording

## 6. Field Procedures

- Spread types
  - Split
    - Split-dip
    - Deviated
    - Gapped
  - End-on
  - Broadside
  - Cross
- Common-midpoint (CMP) method
- Arrays
- Weathering layer
- Marine and transition-zone methods
- Selection of field parameters

## 7. 3-D Seismic Exploration

- What is 3-D seismic?
- Why 3-D seismic?
- Terminology
- 3-D land survey design
  - Swath
  - Non-swath
- Factors controlling 3-D survey design
- Swath shooting method
- Marine surveys