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**AVO ATTRIBUTES AND INVERSION:
PRINCIPLES AND APPLICATIONS**

James J. Willis, Ph.D., P.G.

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ABOUT COURSE

This course provides an understanding of the evolving role of seismic petrophysics through the use of amplitude variations with offset or angle (AVO/AVA), attributes, and inversion techniques. Understanding rock physics and the behavior of the propagating seismic waves represents an integral part of the course, especially in the context of specific applications including enhanced seismic interpretation, rock and fluid characterization, including hydrocarbon identification and quantification, fracture identification, and stress/geomechanical analysis. Course concepts are enhanced by numerous practical exercises and case studies.

COURSE OBJECTIVE

- The fundamentals of seismic wave propagation and specific attributes of seismic measurements toward enhanced interpretation and petrophysics.
- The benefits and cons of various attributes in various facets of investigation, including stratigraphy/sedimentology, structural geology and geomechanics, and seismic petrophysics.
- How to determine elastic properties from AVO/AVA analysis for fluid and lithologic discrimination.
- How to integrate well data through seismic inversion techniques.
- The role of seismic attribute analysis and related techniques in understanding risk elements from exploration, drilling and completion, and development stages.

WHO SHOULD ATTEND

Geologists, Geophysicists, Petrophysicists, Reservoir Engineers, and Exploration/Production Managers

COURSE CONTENT

- **INTRODUCTORY EXERCISES**
- **INTERPRETATION EXERCISES**
- **REVIEW OF THE SEISMIC PROCESS**
- **REVIEW OF SEISMIC FUNDAMENTALS, INCLUDING ROCK PHYSICS AND ASPECTS OF PROPAGATING SEISMIC WAVES**
- **GENERAL SEISMIC INTERPRETATION**
- **REVIEW OF SEISMIC INTERPRETATION TECHNIQUES**
- **SEISMIC ATTRIBUTES**
- **SEISMIC ATTRIBUTE ANALYSIS, INCLUDING DISCUSSION OF VARIOUS ATTRIBUTE TYPES AND MULTI-ATTRIBUTE ANALYSIS**
- **AVO ANALYSIS**

- AN IN-DEPTH INVESTIGATION INTO AMPLITUDE VERSUS OFFSET (ANGLE) ANALYSIS, INCLUDING FUNDAMENTAL PRINCIPLES, APPLICATIONS, AND PITFALLS
- BOREHOLE SEISMOLOGY
- BOREHOLE SEISMIC MEASUREMENTS AND TECHNIQUES, AND INTEGRATION INTO THE SEISMIC PETROPHYSICAL INVESTIGATIONS
- SEISMIC INVERSION
- EXAMINATION OF TECHNIQUES AND BENEFITS OF SEISMIC INVERSION, INCLUDING PRESTACK (ELASTIC) VERSUS POSTSTACK INVERSION, DETERMINISTIC VERSUS STOCHASTIC (PROBABILISTIC) INVERSION, AND RESULTANT PRODUCTS, INCLUDING EXTRACTION OF PHYSICAL ROCK AND FLUID PROPERTIES
- ENHANCED SEDIMENTOLOGIC/STRATIGRAPHIC
- INTERPRETATION FROM SEISMIC ATTRIBUTES
- EXTRACTING MORE INFORMATION OF THE SEDIMENTOLOGIC/STRATIGRAPHIC SYSTEM, INCLUDING WAVELET VERSUS LAYERS, SEISMIC GEOMORPHOLOGY, INTRAFORMATIONAL VARIATIONS AND FACIES ANALYSIS, AND 3D WHEELER DIAGRAMS
- ENHANCED FAULT INTERPRETATION FROM SEISMIC ATTRIBUTES
- EXTRACTING MORE FAULT INFORMATION FROM SEISMIC DATA BY UNDERSTANDING AND UTILIZING SPECIFIC ATTRIBUTES FOR ENHANCING STRUCTURAL INTERPRETATIONS, FROM REGIONAL STUDIES TO ROLE IN RESERVOIR CHARACTERIZATION, INCLUDING TIMING AND GEOMETRY, SEAL CHARACTERISTICS, ETC
- SEISMIC ANISOTROPY ANALYSIS
- FRACTURE ID—SEISMIC ANISOTROPY ANALYSIS AND FRACTURE MAPPING FROM SEISMIC DATA, AND INTEGRATION WITH OTHER DATASETS, SUCH AS IMAGE LOG AND CORE DATA
- STRESS ANALYSIS FROM SEISMIC DATA—EXTRACTION OF STRESS DATA FOR PROSPECT SEAL RISKING, WELLBORE STABILITY INVESTIGATIONS, AND RESERVOIR BEHAVIOR DURING PRODUCTION
- RESERVOIR CHARACTERIZATION AND UNDERSTANDING RISK
- SUMMARY DISCUSSION OF THE ROLE OF SEISMIC DATA AND ANALYSIS IN INTEGRATIVE STUDIES (WELL, CORE, OTHER DATASETS) TO UNDERSTAND BETTER THE RESERVOIR PROPERTIES AND BEHAVIOR AND RISK UNCERTAINTIES FROM EXPLORATION AND PROSPECT GENERATION, THROUGH DRILLING AND COMPLETION, TO FIELD DEVELOPMENT AND ENHANCED RECOVERY

CASE STUDIES

- Case study 1: Reservoir continuity or not, Gulf of México.
- Case study 2: Sand probability, north Malay basin.

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- Case study 3: Fluid/lithology discrimination, Gingin west field, Perth basin, Australia.
- Case study 4: Fractured basement, Muara Bulian field, Indonesia.
- Case study 5: Structural/stratigraphic interpretation, badger basin field, U.S. Rocky Mountains.
- Case study 6: Porosity prediction from seismic data.
- Case study 7: Attribute analysis, deepwater Gulf of México

EXERCISES

Numerous hands-on exercises throughout the course to enhance understanding of key concepts and topics.

LECTURES

James J. Willis, Ph.D., P.G. Career Goal: To enhance the exploitation of hydrocarbons and other minerals through prospect and field development and evaluation, consulting, research, and/or educating others toward that purpose. Primary areas of expertise include structural geology and its stratigraphic interaction, log analysis and petrophysics, qualitative and quantitative geoscience, and geophysical interpretation. Education: 1991-1993 Doctor of Philosophy in Geology, Baylor University, Waco, Texas. GPA: 4.0. 1989 - 1990 Master of Science in Geology, University of Southwestern Louisiana, Lafayette, Louisiana. GPA: 4.0. 1989 Advanced Geologic Field Course, Iowa State University of Science and Technology, Ames, Iowa. GPA: 4.0. 1985-1989 Bachelor of Science in Geology summa cum laude, University of Southwestern Louisiana, Lafayette, Louisiana. Top ranking student of graduating class. GPA: 4.0. Publications & Presentations: Authored or co-authored about 60 scientific papers and abstracts, including in the American Association of Petroleum Geologists Bulletin, Journal of Geophysical Research, University of Arizona Space Science Series, Geophysical Research Letters, Icarus, and Gulf Coast Association of Geological Societies Transactions.