Expanding Conventional Seismic Stratigraphy into the Multicomponent Seismic Domain

DE-FG26-04NT42131

Goal
The objectives of this research are to create examples that illustrate that different stratal surfaces are imaged by different elastic wave modes, and to demonstrate how this new seismic imaging technology should be applied to improve geologic understanding of oil and gas systems. The technology developed in this research will provide the oil and gas industry a subsurface interpretation technology that may revolutionize the way geophysicists interpret and map subsurface strata. The intent of the research is to replace conventional P-wave seismic stratigraphy with the broader discipline of elastic-wavefield seismic stratigraphy.

Performers
Prairie View A&M University
Prairie View, TX

Bureau of Economic Geology
University of Texas
Austin, TX

Results
This project is intended to expand the science of seismic stratigraphy into a new seismic interpretation technology that could influence worldwide seismic operations for a long time. With such technology, stratigraphers will realize that it is necessary to include all seismic modes into sequence and facies analyses to fully define depositional architecture across critical intervals.

Benefits
The study will lead to a development of a new seismic interpretation technology that will provide oil and gas industries a better comprehension of reservoir and seal architecture and the distributions of baffles and barriers to hydrocarbon migration. The oil and gas industries will be able to under-stand that each of the basic elastic-wave modes (P and all S modes: SH, SV, and converted) image different stratal surfaces (in some stratigraphic intervals) and pro-vide different types of information regarding the nature of depositional sequences and facies across hydrocarbon prospects.

Background
Seismic stratigraphy was formalized as a science by researchers at Exxon Corp. in the early 1970s and made publicly available through AAPG Memoir 26 in 1977. Industry education on the concepts of seismic stratigraphy occurred in the late 1970s and early 1980s with the result that the interpretational principles of seismic stratigraphy are now the accepted methodology for interpreting seismic images of subsurface geology.

Seismic stratigraphy is well-structured and widely practiced throughout industry, government, and academia. However, use of the technology suffers from the fact that seismic stratigraphy concepts are applied only to conventional compressional (P-wave) seismic data. The research proposed here will expand seismic stratigraphy to the full-elastic seismic wavefield. A full-elastic wavefield contains all possible wave modes, with the reflected wavefield consisting of a P mode and three S modes: horizontal shear (SH), vertical shear (SV), and converted modes (P-SV and SV-P). A partial-elastic wavefield (either 3-C or 4-C data) will provide only the converted P-SV portion of the S wavefield. This study will demonstrate that each of these reflected wave modes has equal value for seismic stratigraphic analyses and that the seismic sequences and seismic facies associated with each mode provide rock and pore-fluid information not found in the other modes.

Summary
The project consists of:

- Selecting seismic data examples.
- Amassing geologic data.
- Interpreting seismic stratal surfaces.
- Constructing sequence models.
- Constructing facies models.
- Integrating seismic and geologic models.
- Summarizing technical findings.

Current Status (January 2006)
The project has reached a slow down. The last stages of the project are time consuming and the computer system that is currently being utilized for the project is outdated. A new system has been ordered. Work will continue when the system is received and installed. A No-Cost Extension has been granted to complete the work.

Funding
This project was selected in response to DOE's solicitation DE-PS26-04NT42031, November 12, 2003 (focus area: support of advanced fossil resources conversion and utilization research by historically black colleges and universities [HBCU] and other minority institutions [OMI]).

Project Start: September 1, 2004
Project End: August 31, 2007

Anticipated DOE Contribution: $200,000
Performer Contribution: $0

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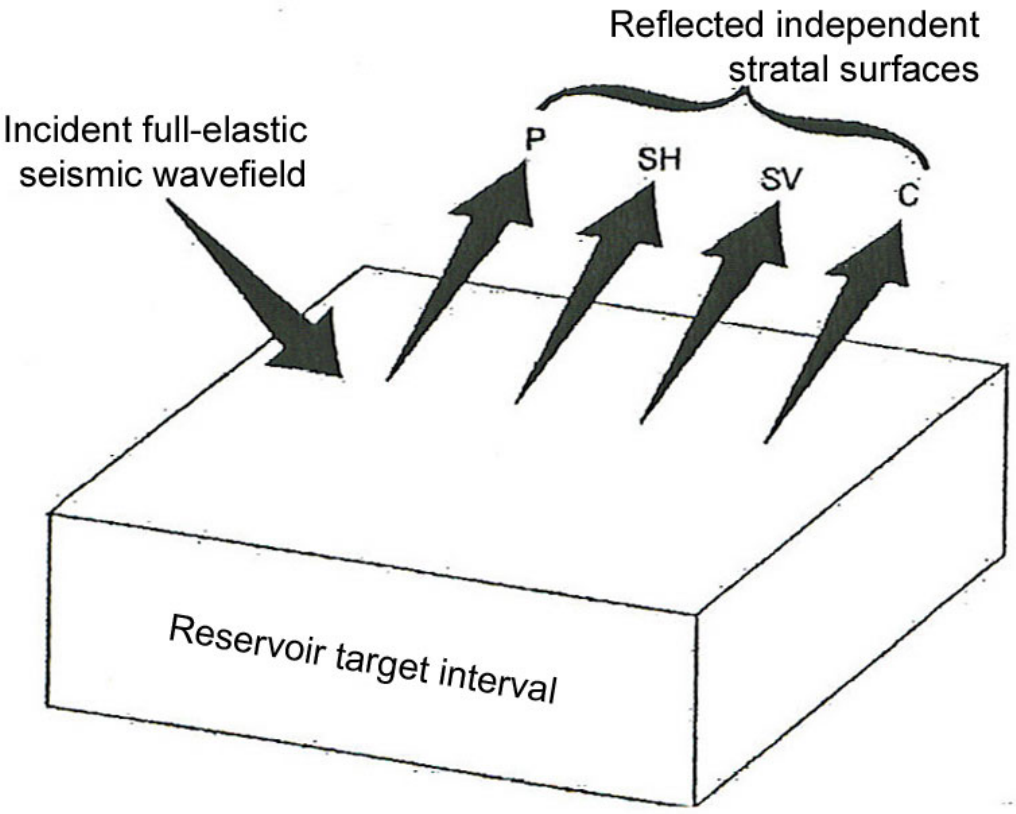
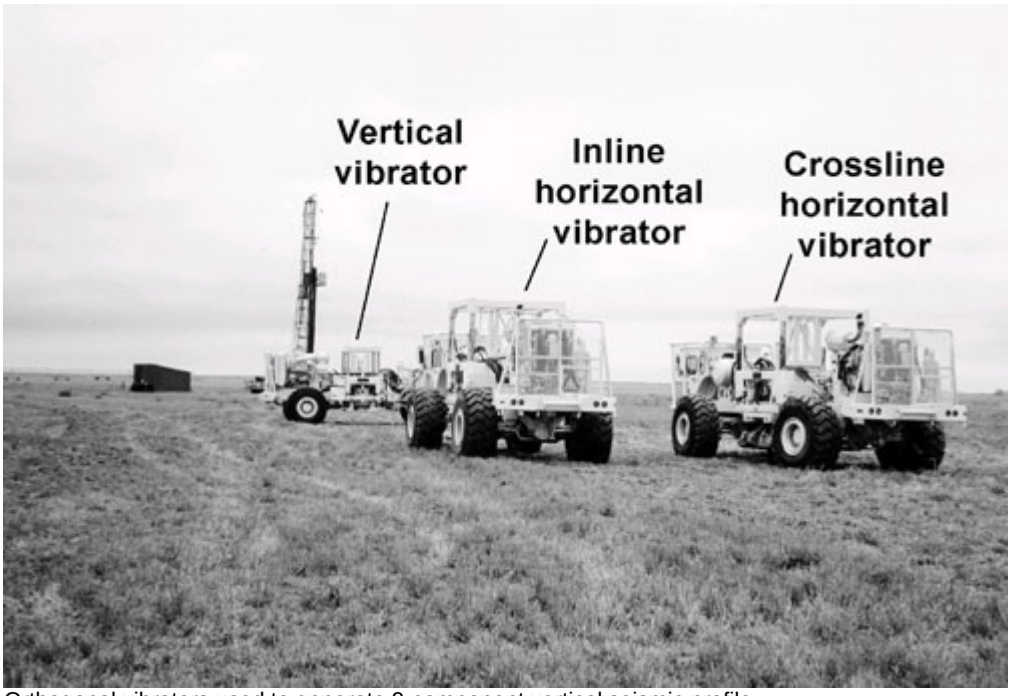


Comparison of conventional seismic stratigraphy and elastic-wavefield seismic stratigraphy. Conventional seismic stratigraphy utilizes only P-wave mode. Elastic-wavefield seismic stratigraphy utilizes all elastic modes, P, SH, SV, and C.



Orthogonal vibrators used to generate 9-component vertical seismic profile.