WIDE-ANGLE DIFFRACTED MULTIPLE REFLECTIONS

A DISSERTATION

SUBMITTED TO THE DEPARTMENT OF GEOPHYSICS

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

By

Raul Estevez

May, 1977

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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(Principal Adviser)

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Approved for the University Committee
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Raul Estevez, Ph.D.
Stanford University, 1977

Theory and observation show that multiple reflections migrate differently than primaries. An effective scheme of multiple suppression must correctly model their migration. D. C. Riley (1976) showed how the two-dimensional wave equation can be used to model diffracted multiple reflections and he developed a method of reflector imaging and multiple removal for the case of data with small shot-to-geophone offset (vertical plane-wave stacks). In this thesis, his theory has been extended to slanted plane-wave stacks. As a consequence, seismograms with larger offset, as well as variations of depth and reflection coefficients within the multiple paths, are correctly handled. For example, synthetic seismograms show that travel times of peg-legs of a given order (1) are equal in horizontal layer models, (2) can be somewhat different because of migration effects, and (3) can have large differences because of the combination of topography and offset. Like Riley's theory, the present wide offset diffracted multiple theory is exactly invertible, thereby, in principle, providing a means of processing field data.

Studies with marine data and synthetic data have shown that routine application will require accurate shot waveform estimation. The same imaging algorithms used in the general theory, and especially Riley's Noah deconvolution, indicate the possibility of estimating the signature directly from the data. Optimization techniques, based on the minimization of the recorded seismogram's power, allow further improvement of the initial estimates.

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