Summary

As a means of introduction, this report begins with the presentation slides that were used to propose the M-OSRP program to the university community and to the petroleum industry. They describe the philosophy, objectives and strategy that define, motivate and guide this program – that is, to serve the aligned interests of prioritized fundamental seismic science, the petroleum industry, and the core educational responsibility of the university.

The industry response to our invitation to participate and sponsor our new program was overwhelmingly positive. A list of our petroleum industry sponsors, and their Advisory Board members, and associate sponsors is included. This is followed by a list of our students and faculty. The high level of support, participation and collaboration is both encouraging and gratifying.

Our technical strategy and plan are then described followed by a list of our Ph.D. students and their research projects. The section that follows describes the math-physics tools that form the foundation for the methods we develop, test and apply. These methods are specifically designed to improve our ability to unravel seismic data. They allow us to separate the information about the portion of the wavefield's history that we are interested in from the myriad of factors that have influenced its character. The flexibility of the method used to describe how data experienced the Earth determines how flexible and cooperative the data will be to reveal its history when using that method in an inverse sense as a processing tool.

The methods we seek are multidimensional and heterogeneous and allow the maximum number of channels and realism for the data while requiring only realistic achievable levels of a priori information. The inverse scattering series is the maximally flexible deterministic tool available today for relating reflection data to subsurface properties. As these methods reduce the unrealistic assumptions about the subsurface, they place a greater burden, demand and responsibility on the definition and completeness of the seismic experiment. The wavefield prediction, extrapolation, wavelet estimation, and deghosting projects are our response to that challenge and derive from direct inversion, indirect inversion or various forms of the Extinction Theorem. In addition, statistical methods are sought to accommodate the uncertainties inherent between reality and deterministic methods. When combined with new acquisition (e.g., point wavefield measurements), this trend from unrealistic assumptions about the subsurface to greater expectations about the definition and completeness of the seismic experiment, represents an empowerment where those interested in spending more have the opportunity of achieving more. M-OSRP and this report are aligned with this objective.

In this document, the objectives and status of individual projects are described by reports, notes, expanded abstracts and manuscripts. The five current projects are: wavefield and wavelet estimation, data reconstruction and near source interpolation in shallow water, imaging at depth without the precise velocity, inversion of complex large contrast targets, and velocity analysis. There are fundamental studies and reports that support and guide these projects. Since we are committed to working on relevant high prioritized outstanding technical challenges, we anticipate that significant attention at the embryonic stages of projects would be paid to problem definition, solution concept development, and analytic and numerical data tests. The projects in M-OSRP represent a portfolio of different risk and timetables for deliverables. The expectation is that the Extinction Theorem derived wavefield prediction, wavelet estimation and deghosting algorithms will be the first to be tested for added value on field data followed by data reconstruction, and near source extrapolation. The demonstrated cooperation between successive terms in the imaging at depth (without the velocity) subseries and the numerical testing results for 1-D normal incidence models are encouraging. Further analysis and testing are planned.

The program will maintain the current balance between seeking new enabling capability for locating and identifying targets and new processing techniques (when combined with advances in acquisition) that meet the heightened demands (prerequisites) on completeness and definition of the seismic experiment.

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