

Imaging of sub-basalt sediments using waveform inversion of wide-angle seismic data

Kalachand Sain[#], Fuchun Gao^{*}, Gerhard R. Pratt[@] and Colin A. Zelt^{*}

[#] National Geophysical Research Institute, Uppal Road, Hyderabad, A.P. India

^{*} Department of Earth Science, Rice University, Houston, Texas, USA

[@] Department of Geological Sciences, Queen's University, Kingston, Ontario, Canada

The oil industry is interested in imaging the fine structures of sedimentary formations masked below high-velocity basalt flows for commercial exploration of hydrocarbons. But standard seismic reflection profiling very often fails to explore the subbasalt sediments due to contamination of near-vertical primaries with multiples, converted and scattering waves generated by interbeds, breccia and vesicles within the basalt. The effect of this noise becomes less prominent as the source-receiver offset increases, and the primaries carrying sub-surface information stand out at the wide-angle range. Though traveltimes tomography of first arrival seismic data provides little information about the underlying low-velocity sediments, traveltime inversion of wide-angle seismic data including both first arrivals and identifiable wide-angle reflected phases has been able to delineate the large-scale velocity structure of basalt-covered sedimentary formations but lacks in small-scale velocity details.

Here we apply 2-D full-waveform inversion to synthetic data for a realistic earth model, with a view to extracting the small-scale stratigraphic features of sedimentary formations. Waveform inversion has the potential to delineate thin sedimentary layers hidden below thick basalt cover, and may thus serve as a powerful tool to image sedimentary basins in various parts of the world, where the sediments are covered by high-velocity materials like basalts, salts, carbonates, etc.