Non-First-Break Solution for Shallow Velocity Anomaly Problem

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Abstract

A method of compensation for the presence of discrete shallow velocity anomalies (SVAs) has been developed. When the first breaks approach fails for any reason (first breaks are hard to pick, there is a shallow low velocity layer, permafrost etc) the only seismic information available is deep reflections. Shallow velocity anomalies cause large lateral variations in stacking velocities increasing with depth. Dix's formula gives us interval velocities in 1-D media. In many cases, the 1D assumption does not work, especially when we have local velocity anomalies in the overburden. Not only do they reduce post-stack image quality, but also create large differences in stacking velocity behaviour for deep seismic reflectors with small dips. A non-fist-breaks technology provides us tools to determine shallow velocity structures and remove their influence on stacking velocities and imaging. This technology includes four main steps: (i) High-density automatic non-hyperbolic NMO picking, (ii) Analytical NMO inversion to estimate shallow velocity structure, (iii) Non-linear horizonbased traveltime tomography to improve depth velocity model and (iv) Time-dependent velocity replacement corrections for prestack data. Model and real data examples show the practical feasibility and robustness of the proposed approach if there are deep consistent reflections.