Expanding Imaging Areas Using Transmitted Waves and Multiples in VSP Data

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The paper presents two new methods for imaging VSP data. For the first method, we demonstrate that mode-converted transmitted waves observed in VSP data can be used to image areas above horizontal wells which traditional VSP cannot due to lack of recorded reflections. We verify with real data examples that transmitted-wave migration coupled with the reduced-time theory can indeed image geologic horizons above a horizontal well in an offset VSP survey. As reflections can be used to image areas below geophones, transmissions can do the same for the areas above. Therefore, incorporation of mode-converted transmitted waves significantly expands the area illuminated by seismic data. For the second method, we will illustrate, with real and synthetic VSP data that multiples can be used to enlarge the imaged areas based on the newly developed interferometry theory.