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Shear and compressive wave data acquisition using multicomponent vibrating source and landstreamer

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In the vicinity of Ottawa, Ontario, Canada, we have recorded many multicomponent seismic data sets using an in-house multicomponent vibrator source named Microvibe and a landstreamer receiver array with 48 3-C 28-Hz geophones at 0.75-m intervals. The receiver spread length was 35.25 m, and the near-offset was 1.50 m. We used one, two or three source and three receiver orientations — vertical (V), inline-horizontal (H1), and transverse-horizontal (H2). We identified several reflection wave modes in the field records — PP, PS, SP, and SS, in addition to refracted waves, and Rayleigh-mode and Love-mode surface waves. We computed the semblance spectra of the selected shot records and ascertained the wave modes based on the semblance peaks. We then performed CMP stacking of each of the 9-C data sets using the PP and SS stacking velocities to compute PP and SS reflection profiles.

Despite the fact that any source type can generate any combination of wave modes — PP, PS, SP, and SS, partitioning of the source energy depends on the source orientation and VP/VS ratio. Our examples demonstrate that the most prominent PP reflection energy is recorded by the VV source-receiver orientation, whereas the most prominent SS reflection energy is recorded by the H2H2 source-receiver orientation with possibility to obtain decent shear wave near surface data in all other vibrating and receiving directions.

Pugin, Andre and Yilmaz, Öz, 2019. Optimum source-receiver orientations to capture PP, PS, SP, and SS reflected wave modes. The Leading Edge, vol. 38/1, p. 45-52. https://doi.org/10.1190/tle38010045.1