Kris Innanen*
k.innanen@ucalgary.ca

The importance of $V_P(f)$ in the near surface

...is difficult to overstate for FWI. It is difficult to be certain *a priori* which model to use, but leaving it as an unknown leads to an intractable inverse problem. So, direct measurement early in the processing flow is important. An approach using a walkaway VSP data set, specifically 20 traces with ray paths in the upper 75-120m, is discussed below. Results show good repeatability.
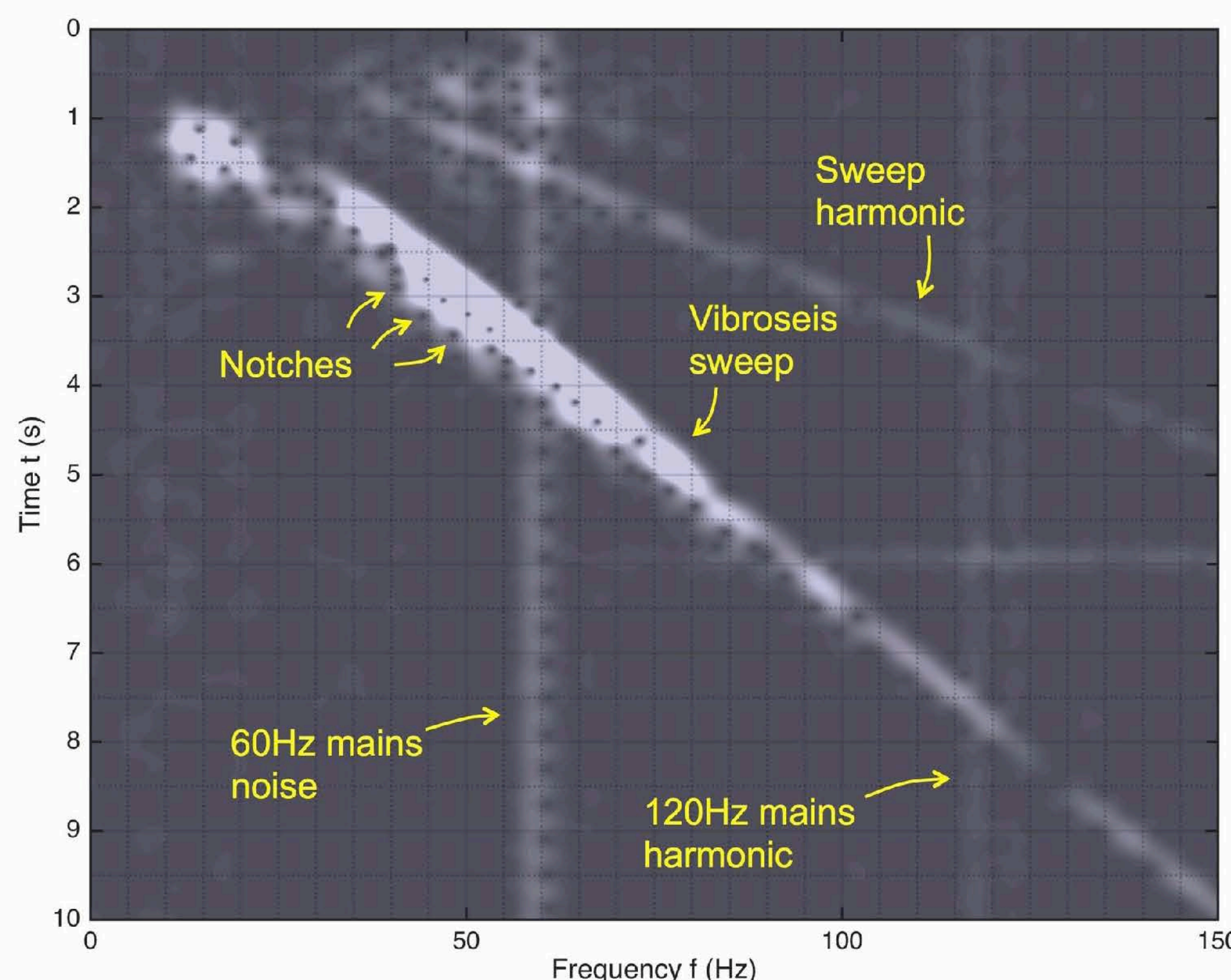

Fig. 1. An example Gabor spectrum calculated on an uncorrelated sweep, with noise and harmonics illustrated. The signature of non-negligible $V_P(f)$ is visible in the curvature of the direct arrival at 10-30Hz.
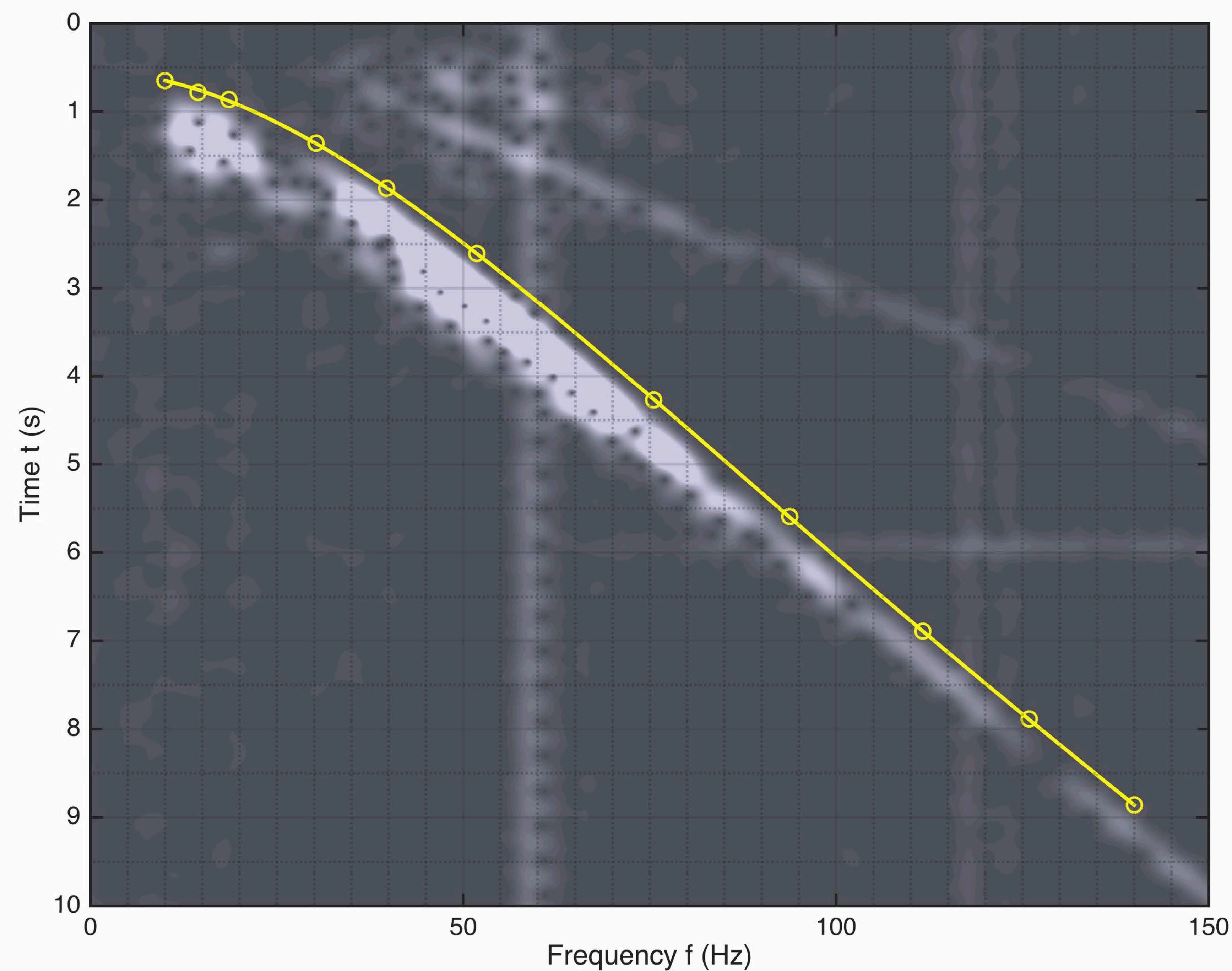

Fig. 2. A smooth travel time "pick" is generated with roughly 10 manual picks, followed by fitting with a low (4rth) order polynomial.
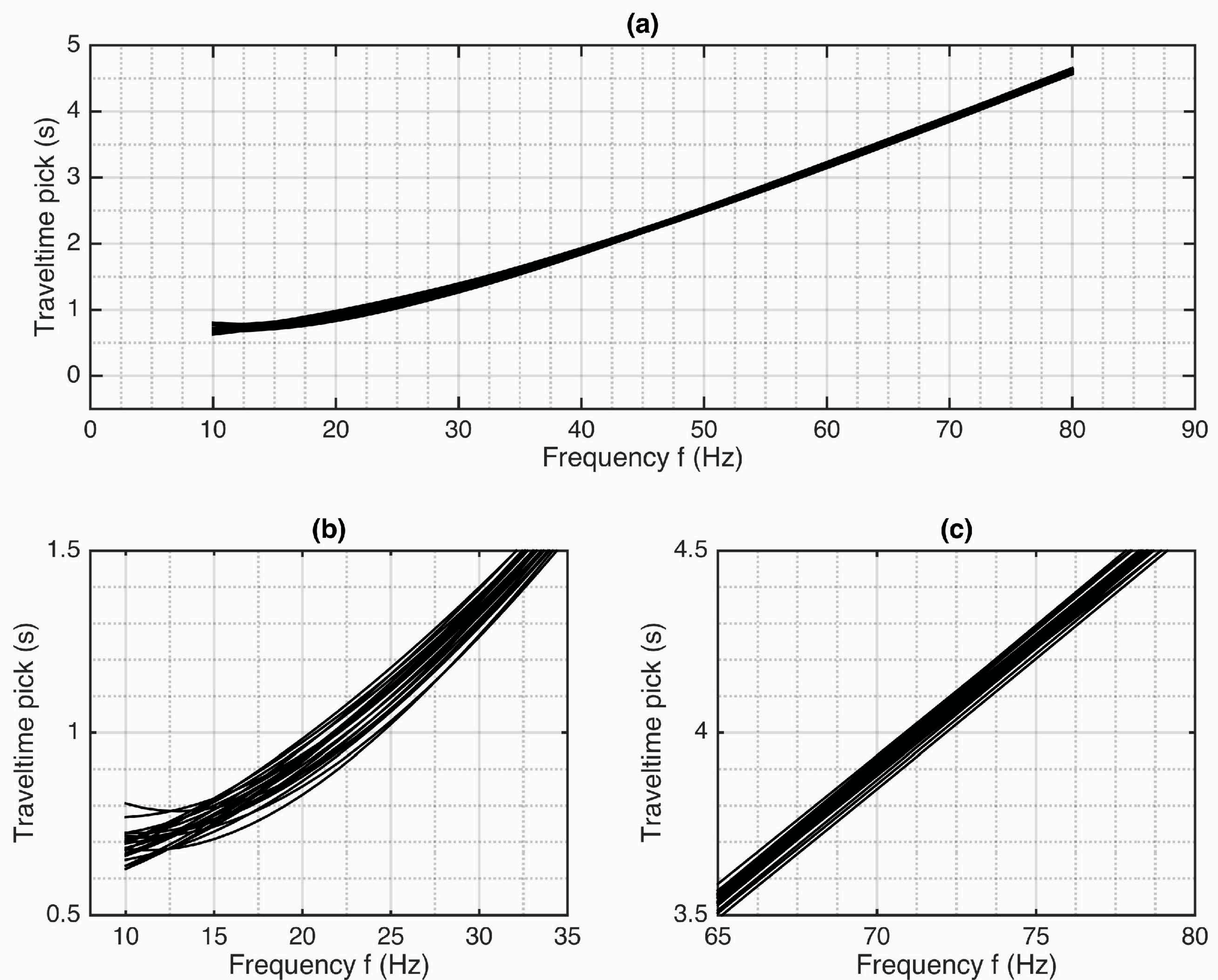

Fig. 4 (a) Arrival time picks derived for 20 traces whose ray paths occupy top 70-110m. (b) Zoom in on frequency range 10-35Hz; (c) frequency range 65-80Hz. The primary signal is at the low end, which is in agreement with standard NCQ dispersion models.
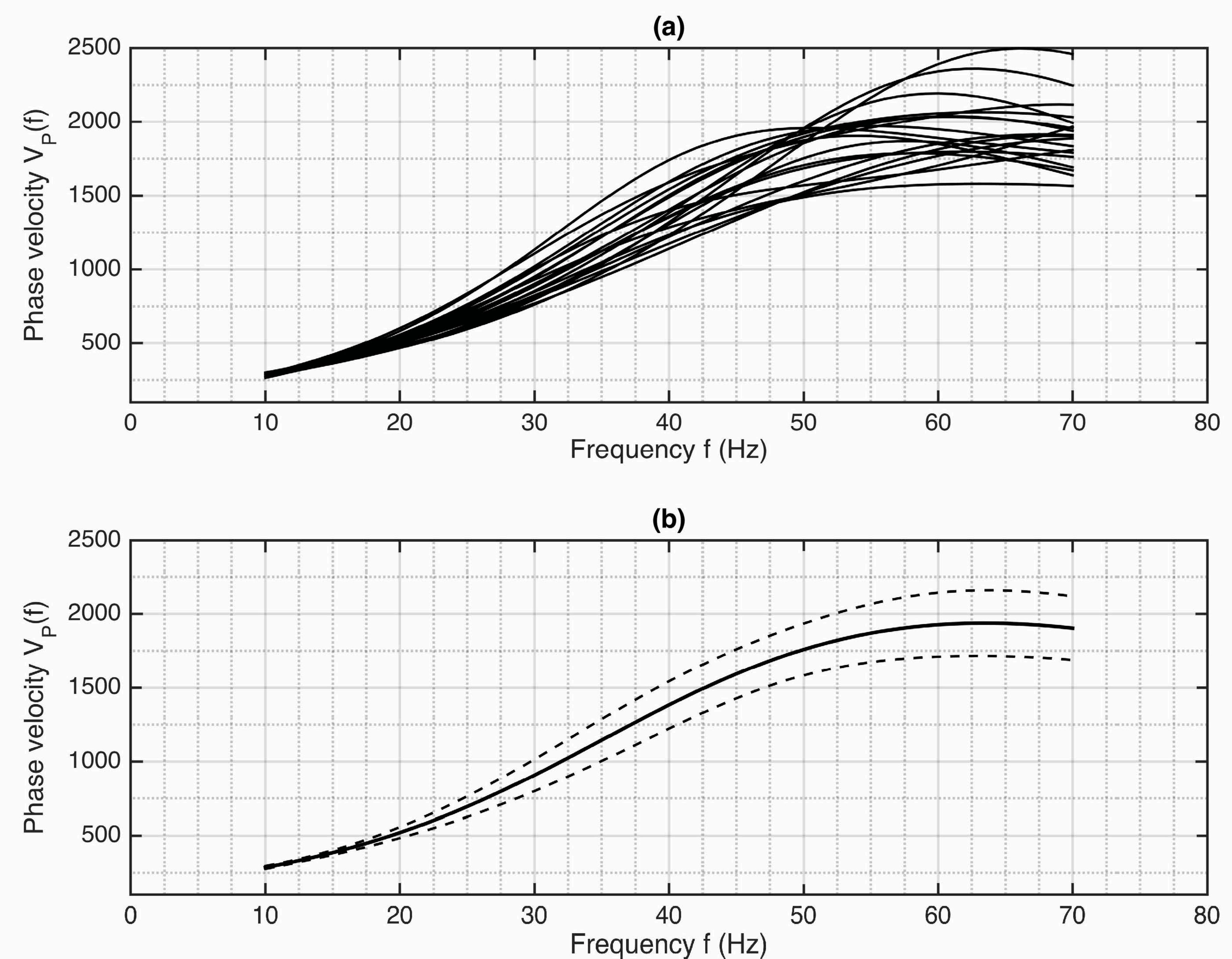

Fig. 5. Phase velocity estimates based on ratios of travel path lengths to $\Delta\tau = \tau_a - \tau_d$, where τ_a = time of arrival of the wave at frequency f, and τ_d = the time of departure. (a) $V_P(f)$ curve for each of 20 traces; (b) average (solid black) with +/- one standard deviation (dashed black). Negative curvature at low f does not match with standard NCQ models.

Full development, citations, and acknowledgments, are available in the CREWES report.

1