Figure S1: Summary statistics for $V_p$ from combined HMC chains, Pacific centered view. A) Mean B) Standard Deviation C) Power in each harmonic degree (Black line shows the median and grey bars show the 95% credible interval).
Figure S2: Summary statistics for $V_p$ from combined HMC chains for an inversion restricted to $l' = 6$. A) Mean B) Standard Deviation C) Power in each harmonic degree (Black line shows the median and grey bars show the 95% credible interval).
Figure S3: Summary statistics for $V_p$ from combined HMC chains for an inversion restricted to $l' = 6$, Pacific centered view. A) Mean B) Standard Deviation C) Power in each harmonic degree (Black line shows the median and grey bars show the 95% credible interval).
Figure S4: Unfiltered binary synthetic model used for the geometric synthetic test.
Figure S5: Summary statistics for $V_p$ from combined HMC chains for the synthetic test on the DETOX-P3 model, including power per degree, Pacific centered view. A) Synthetic Model B) Mean Recovered Model C) Standard Deviation D) Power in each harmonic degree (Black line shows the median and grey bars show the 95% credible interval, red dots show power of the input model).
Figure S6: Travel time residuals for the 2 datasets used in this study using the DETOX-P3 as a synthetic input model and 0.2s applied Gaussian noise. Black histograms show the initial distribution of residuals, and purple / orange histograms show the quantiles of remaining residual distributions after inversion with maximum $l' = 15$. 
Figure S7: Posterior distributions of scale variables $\sigma_{d\tau}$, $\sigma_{PcP-P}$ and $\sigma_{PKPab-PKPbc}$ for maximum $l'=15$ using the DETOX-P3 as a synthetic input model and 0.2s applied Gaussian noise. Prior distributions were half-normal for all 3 scale variables, with prior standard deviation $\nu_1 = 5$ for $\sigma_{d\tau}$ and $\nu_2 = 2$ for $\sigma_{PcP-P}$ and $\sigma_{PKPab-PKPbc}$. 