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Lithostatic-Load Effects in Geologically Constrained Model Building for Foothills Anisotropic Seismic Imaging

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Abstract

In complex-structure land settings, like a continental rift in Central Africa or a thrust belt in the Andes, seismic data is often affected by low signal-to-noise ratios and subsurface complexity. Under these conditions, the seismic data is far too underconstrained for data-driven seismic methods, so we need as many geologic constraints as possible to constrain the seismic velocity model.

Subsurface rock velocity is a function of lithology, geologic age, and compression due to lithostatic load. Our goal is to isolate the compression effect so that we may focus on the interpretation of the geologic structures and the rock types within the fault blocks. Ideally, our velocity model would be parameterized such that the same lithology of the same age would have the same velocity regardless of the depth of burial, and then, prior to depth migration, we can include a compression factor into the velocity model to account for the lithostatic load that results from depth of burial.

We tested a few parameterization schemes, including weighted averages and multiplicative scalars, and we have examples from a variety of structural-geology settings where different methods apply with varying degrees of success. Generally, we find that parameterizing the compression function as a multiplicative scalar is the most effective method for incorporating compressive effects into a geologic velocity model. Data examples include the foothills of the Rockies, Andes, and Zagros mountains.