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Interlayered metasediments and peridotite lenses in continental lower crust

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Metasediments interlayered with lenses of metaperidotite are commonly observed in exposed sections of middle and lower continental crust (> 0.7 GPa). These mixed assemblages are unlikely to have been transported deep into the crust via burial. Mixed metasediment and peridotite lenses are common in forearc accretionary prisms, and thus the lower crustal examples were probably “relaminated” (as defined by Hacker et al. EPSL 2011): via (1) thrusting of forearc material into or just below arc crust, or via buoyancy-driven ascent of subducted material (2) in a subduction channel or (3) as diapirs (review in Kelemen et al. Treatise on Geochem 2025, K25). Well documented examples of such interlayered assemblages recording middle and lower crustal depths are within the Ivrea Zone (e.g., Quick et al. Geology 1995), and in the continental US: the North Cascades crystalline core (e.g., Haugerud & Taber 2009), the Orocopia schist (e.g., Haxel et al. Int Geol Rev 2014), the Condrey Mtn schist (Tewkesbury-Christie et al. Tectonics 2024), and even the Teton gneisses (reviews in Swapp et al. and Frost et al. Geosphere 2018). The current proportion of such assemblages at depth is difficult to discern from geophysical data, since peridotite lenses are commonly hydrated, and/or smaller than the length scale of seismic observation, and the geophysical properties of metasediments overlap those of a broad range of igneous rocks. Where peridotites are less hydrated, small-scale mixtures of peridotite with high seismic P-wave speeds (Vp) plus felsic rocks with low Vp have higher SiO_2 contents, at a given seismically observed, intermediate Vp, compared to large volumes of homogeneous rocks (K25, Figure 6B). Similarly, peraluminous metasediments have higher SiO_2 contents at a given Vp compared to most igneous rocks. These factors potentially lead to an underestimate of mid- and lower-crustal SiO_2 in some regions.

To further quantify these observations, we present new data on the proportion, length scale and composition of newly collected samples of interlayered metaperidotites and metasediments in the Napeequa schist (0.6 to 1.2 GPa) of the North Cascades, as well as a review of literature data.