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Controls on Lower Arc Crust $\delta^{98/95}$Mo: Insights from the Exhumed Kohistan Paleo-Island Arc

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The Mo isotope system serves as a powerful tracer for crustal recycling [e.g., 1,2,3]. However, accurately characterizing recycled crustal components in the mantle requires well-constrained Mo isotopic compositions ($\delta^{98/95}$Mo) and concentrations across the full range of crustal materials that may be returned to the mantle. Lower arc crust is particularly important, as its foundering and erosion likely represent important mass transfers to the Earth's mantle [e.g., 4]. Yet, no published constraints exist on the $\delta^{98/95}$Mo values and Mo content of this reservoir. To fill this gap, we measured a series of lower crustal cumulates from the obducted Kohistan paleo-island arc. These rocks, spanning compositions from ol-pyroxenite to trondhjemite, record the deep (7-8 kbar) calc-alkaline differentiation of hydrous picrites (> 5 wt.% H_2O) [e.g., 5].

Our results reveal substantial $\delta^{98/95}$Mo variability, ranging from +0.36 to -0.51 ‰ (relative to NIST SRM 3134), and very low Mo concentrations (5 to 34 ppb). Among the ultramafic cumulates, $\delta^{98/95}$Mo correlates with TiO_2, which, combined with mineral chemical data, suggests that $\delta^{98/95}$Mo variations stem from differences in isotope fractionation factors ($\Delta^{98/95}Mo_{mineral\text{-}melt}$) among phases controlling the Mo budget. Hornblende appears to exhibit the largest $\Delta^{98/95}Mo_{mineral\text{-}melt}$ among the primary minerals, driving the $\delta^{98/95}$Mo of ultramafic cumulates toward values that are much lighter than the depleted MORB mantle. This suggests that the $\delta^{98/95}$Mo of recycled ultramafic lower arc units depends not only on the primitive arc magma $\delta^{98/95}$Mo but also on the extent to which hornblende governs their Mo budget. Further analyses should refine these interpretations.

[1] Bezard *et al* (2016) *EPSL* 453, 171-181. [2] Ahmad *et al* (2022) *GPL* 23, 43-48. [3] Willbold & Elliott *EPSL* 621, 118399. [4] Jagoutz & Schmidt (2013) *EPSL* 371-372, 177-190. [5] Bouilhol *et al* (2015) *J. Petrol* 56, 1309-1342.