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Triple oxygen isotope evidence forsubstantial slab-derived fluids in the Mariana forearc mantle

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Thermodynamic models predict that most water carried by cold subducting slabs is released at subarc depths or transported into the deep mantle, with only a minor fraction entering the forearc mantle wedge. However, enrichments of fluid-mobile elements in forearc peridotites suggest that fluid contents there may be substantially higher than these models imply, while the magnitude of this flux and its migration pathways remain poorly constrained. Here we apply temperature-insensitive triple oxygen isotopes ($\Delta'^{17}O$) to quantify fluid-rock interaction and fluid flux in the forearc mantle, where conventional $\delta^{18}O$ approaches are strongly temperature dependent. We analyze serpentinized peridotites exhumed from serpentinite mud volcanoes in the non-accretionary Mariana forearc, a representative cold intra-oceanic subduction system. $\Delta'^{17}O$-derived fluid-rock ratios average ~0.34, corresponding to a slab-derived fluid flux of ~7.92 x 10^7kg/yr/km, comparable to estimates from hot subduction zones. These results demonstrate that, despite its cold thermal regime, the Mariana forearc mantle hosts substantial slab-derived fluids. We suggest that fracture networks associated with interface seismicity may provide efficient pathways for fluid infiltration into the mantle wedge.