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Modification of fluids in subduction channel: Evidence from barium isotopes of western Alps whiteschis

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Subduction channel is critical for fluid migration from subducting slab to the overlying mantle wedge. Although the fluids are traditionally called upon to explain the geochemical compositions of arc magmas, it is still not clear whether such fluid compositions reflect dehydration from the source or modification during fluid-rock interactions through the channel. Ba isotopes may serve as a novel indicator for fluid modification in subduction channel because Ba isotopes can be significantly fractionated in the fluid-involved processes [1]. Here we investigate the Ba isotope compositions of the whiteschist and metagranite from the Dora-Maira Massif in western Alps to evaluate the role of fluid-rock interaction in modifying fluid geochemistry in the channel. The whiteschists are ultrahigh pressure metamorphic rocks which resulted from strong infiltration of the metagranites by fluids released from serpentinite [2].

The metagranites have a relatively small variation of $\delta^{138/134}$Ba (-0.25‰ to 0.26‰), while the $\delta^{138/134}$Ba of whiteschists dramatically increase from -0.99‰ to 0.48‰ with progressive loss of Ba. Such fractionation is not induced by weathering, retrograde metamorphism, or kinetic effects, but reflects fluid-rock interaction in the subduction channel. We applied a box model to simulate Ba isotope fractionation in metamorphic fluids and rocks as the compositions of the whiteschists change with fluid flux. The $\delta^{138/134}$Ba of the fluids decrease and then increase drastically with Ba concentrations declining, showing the controlling of fluid-rock interaction. Thus, the subduction channel is not only a mass transporting pathway but also the critical fluid-rock interaction zone where fluid compositions are strongly altered. The fluid modification in the subduction channel will affect the recycling of fluid-mobile elements in subduction zones and change the geochemical compositions of arc lavas.

[1] Wu, F., et al., (2020), *Geology* 48, 1053–1057.

[2] Chen, Y.X., et al., (2016), *Earth Planet. Sci. Lett.* 456, 157-167.