

***In situ* marine silicate weathering as a source of Fe to the oxic ocean**

JIANGHUI DU^{1*}, BRIAN HALEY¹, ALAN MIX¹

¹College of Earth, Ocean and Atmospheric Sciences, Oregon State University, Corvallis, OR, 97331, USA.

(*correspondence: dujia@oregonstate.edu)

The number of measurements of marine trace elements and their isotopes (TEIs) has increased dramatically in recent years, and strong evidence has emerged indicating that marine silicate minerals undergo weathering *in situ*. Being a key source function for marine TEIs, it is critical to recognize that low temperature silicate weathering happens outside terrestrial environments. We revisit *in situ* marine silicate weathering with special focus on how it may provide novel mechanistic insight into the sedimentary sources that are increasingly seen as key sources of marine TEIs.

High concentrations of dissolved iron (dFe) in oxic seawater emanating from continental margins and extending far into the ocean interior, even exceeding that in the Oxygen Minimum Zones (OMZs)[1-3], is a surprising discovery in recent years. Such high dFe cannot be explained by diffusive benthic flux from reducing sediments as in OMZs. Instead, it is linked to high concentrations of suspended lithogenic sediments[4,5], suggesting *in situ* Fe release due to silicate weathering. To demonstrate this, we perform thermodynamic and kinetic calculations on silicate mineral-seawater interactions. We show that primary ferrous silicates are highly undersaturated in oxic seawater and therefore are favorable for *in situ* weathering. In a model including weathering, complexation with organic ligands and scavenging, we further show that *in situ* silicate weathering can kinetically provide the source of Fe to support the observed high dFe. In the model the key parameters controlling dFe are the abundance and reactivity of primary silicate minerals. Thus, we predict that silicate minerals delivered from active margins can support higher dFe upon *in situ* weathering compared to their counterparts from passive margins, as the loss of mineral reactivity and reactive minerals in the continental weathering cycle is much weaker because of shorter transport timescales.

[1] Resing et al. *Nature* 523, 200–203 (2015). [2] Conway & John. *Nature* 511, 212–215 (2014). [3] Nishioka & Obata. *Limnol. Oceanogr.* 62, 2004–2022 (2017). [4] Lam et al. *Deep Sea Res. Part II Top. Stud. Oceanogr.* 116, 303–320 (2015). [5] Lam et al. *Mar. Chem.* (2017)