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Understanding the δ^{30}Si diversity of reactive silica pools in marine sediment

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Biogenic opal provides a reactive substrate for silica diagenesis in marine sediments. These diagenetic processes are postulated to have large-scale implications for ocean chemistry and the exogenic carbon cycle [1, 2]. They are also accompanied by silicon stable isotope fractionation that may be used to trace the balance of silicon fluxes resulting from diagenesis, including primary silicate weathering, biogenic silica dissolution, (de-)sorption to/from metal oxides, and the precipitation of marine authigenic clays [3, 4, 5].

Key in constraining this balance is an accurate identification of the pools of sedimentary reactive silica involved in diagenetic silica cycling. These pools are typically accessed by operationally defined chemical leaches [5, 6] that target authigenic oxide and silicate phases, biogenic silica, and lithogenic silica. The leaches indicate that marine sediment contains co-existing and co-mingled silica pools with very large differences in d^{30}Si, close to half the entire 10‰ range of natural terrestrial variability. However, the carriers of the mobilized Si pools have not been characterized in detail.

Here, we present complementary d^{30}Si and geochemical data from sequential leaches of marine sediments from two highly contrasting settings: muddy river-plume sediments of the shallow Louisiana shelf (~50 m water depth) and sediments of the abyssal equatorial Pacific (> 5000 m water depth). At both sites, the leaches mobilize Si pools that are very isotopically light (d^{30}Si between -2.0‰ and -2.5‰ at both sites) as well as those that are isotopically heavy (generally above +1.4‰ on the Louisiana shelf, and above +2.0‰ in the abyssal Pacific). We explore the similarity in leach isotopic compositions from these two sites in the context of their geochemistry, and present additional data from a soft leach that specifically targets metal oxides.

[1] Mackenzie and Garrels (1966), *AJS* 264, 507-525.
[2] Dunlea et al. (2017), *Nat. Commun.* 8, 844.
[3] Ehlert et al. (2016), *GCA* 191, 102-117.
[4] Ward et al. (2022), *GCA* 329, 206-230.
[5] Delstanche et al. (2009), *GCA* 73, 923-934
[6] Michalopoulos and Aller (2004), *GCA* 68, 1061-1085.
[7] Pickering et al. (2020), *GRL* 47, e2020GL087877.