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Authigenic Marine Sediment Sinks of K and Mg in the Abyssal Pacific Ocean

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Authigenic clays in marine sediments sometimes form via reverse weathering reactions where cations (e.g., Mg and K) are taken up into new clay minerals and bicarbonates are converted to CO2. If occurring at a significant scale, reverse weathering could play an important role in controlling climate. However, the mechanisms and magnitude of authigenic clay formation and the extent that it occurs via reverse weathering reactions are poorly constrained. In this presentation, I will focus on fingerprinting and constraining the sink of seawater Mg and K into authigenic clays, utilizing an approach that combines isotope ratios and multivariate statistical analyses of element concentrations.

First, element concentration data for over 2000 marine sediment samples from the Pacific Ocean are modeled using multivariate statistical models (Q-mode factor analysis and constrained least squares multiple linear regression). This allowed us to identify marine sediment “hot spots” that have the highest concentrations of K and Mg taken up from seawater into an authigenic phase in the open ocean. Second, we compare the multivariate models to isotope ratio analyses from two specific sites. Integrated Ocean Drilling Program (IODP) Site U1366 has patterns in the multivariate element concentrations and Mg isotope ratios that both support the uptake of Mg from seawater into an authigenic phase [1]. At Ocean Drilling Program (ODP) sites in the North Pacific, the K isotope ratios and multivariate model of element concentrations suggest seawater K uptake into an authigenic phase different than at Site U1366. Combining the multivariate and isotope approaches, we fingerprint a naturally-occurring authigenic end-members and help quantify the fluxes and impacts of authigenic phases on the Mg and K isotope systems.

[1] Dunlea et al. (2017) Nature Communications 8, 844. doi:10.1038/s41467-017-00853-5