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Role of marine silicate weathering in cation turnover along continental marginals

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Marine silicate weathering is an essential process in producing porewater alkalinity and potentially impact bottom ocean chemistry. The process has been well identified by pioneers more than two decades ago through the documentation of porewater alkalinity that is 30 to 100 times higher than seawater alkalinity, a sign of cation released during silicate dissolution during weathering. There have been few progresses in understanding the controlling factors of marine silicate weathering rates and the types of silicates that are involved. In this contribution, we ask two fundamental questions: 1) where (geographically) does silicate weathering most often occur? 2) what cation(s) is primarily responsible for the elevated alkalinity derived from marine silicate weathering? We mined porewater data from scientific ocean drilling databases to locate drilling sites from specific continental margins with high porewater alkalinity. We expect that higher porewater alkalinity should be observed from locations with low water depth, i.e., more favourable conditions for silicate weathering are expected for shallow ocean than that in deep ocean due to higher supplies of organic matter and terrestrial-derived silicates. Nonetheless, we obtained ambiguous results. The correlation is either absent or only apparent when alkalinity is lower than ca. 56 meq/L (i.e., double of seawater sulphate concentration). By further examining porewater composition of these sites, we found that high alkalinity is a combined result of abundant ammonium, sodium, magnesium, and potassium in porewater. Especially, the high dissolved magnesium and potassium concentrations point towards the dissolution of mica-like silicates or even clay minerals that are likely sourced from adjacent land as a result of terrestrial weathering. We discuss the reasons behind the lack of clear correlation between porewater alkalinity and water depth as well as the implication of mica-like silicates dissolution being the main contributor of the observed high alkalinity in deep sea sediments.