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Bottom trawl fishing and dredging decrease marine CO_2 sequestration by reducing natural alkalinity generation

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The coastal seafloor plays an important role in regulating the global carbon cycle through burial of organic carbon, but also by generating alkalinity and thereby increasing the overlying seawater's capacity to buffer atmospheric CO_2. Antropogenic activities, such as frequent trawling and dredging, alter the sedimentary geochemical cycling and directly influence this natural carbon sink. While much attention has been given to anthropogenic alterations of the organic carbon cycling in marine sediments, the human impact on alkalinity generation remains unquantified. Here, we present model simulations of the impact of bottom trawling and dredging on sedimentary alkalinity generation. In an undisturbed sandy or muddy sediment, over half of the alkalinity is generated by dissolution of carbonate minerals, while the remainder is produced by pyrite precipitation. In muddy coastal sediments, both bottom trawling and dredging reduce the alkalinity efflux through reoxidation of pyrite. In contrast, bottom trawling stimulates pyrite precipitation and increases the natural alkalinity generation in muddy shelf sediments, while the impact of sediment disturbance on sandy and slope sediments is negligible. On a global scale, bottom trawling is estimated to reduce natural alkalinity generation by ~25 Geq. yr^{-1} and dredging by ~2.5 Geq. yr^{-1}. This is equivalent to a reduction of the natural coastal carbon sink by 1 Tg CO_2 yr^{-1}, which is 100 times the current carbon sequestration capacity of direct-air capture hubs. These results illustrate that the impact of trawling and dredging on sedimentary alkalinity generation is non-negligible and should be considered when performing carbon accounting in coastal systems.