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Relationship between plant colonization and desiccation features seen through 2D porewater chemistry in a superfast prograding saltmarsh

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Saltmarshes of the macrotidal Aiguillon Bay (French Atlantic coast) have prograded at very high rates, up to 14 m/yr since 1950 resulting in sedimentary accumulation rates up to 2.2 cm/yr (Amann et al., 2023). Such sedimentary dynamics make this environment a good laboratory to understand the interplay between sea-level rise and shoreline evolution, and also the capacity of temperate saltmarshes to mitigate atmospheric CO_2 through carbon burial. The present study aims to better understand the role of emersion time in the pioneer plant colonization of mudflats and how this affects remineralization processes including nutrient generation. Longer emersion time during summer generates important compaction of cohesive particles increasing mudflat resistance to erosive processes. It also generates desiccation features. As these cracks show mm to cm tri-dimensional organization, imaging techniques were applied to monitor seasonal evolution of early diagenetic processes in an unvegetated mudflat and to describe Spartina meadow development impact onto iron remobilization. During summer, very strong vertical chemical gradients and important lateral heterogeneity are observed in the sediment, especially for dissolved iron, nitrite and phosphate. During fall and winter, desiccation cracks are infilled by new iron-rich particles provided by nearby estuaries when riverine discharge increases. Progressively these iron oxides are reductively remobilized, inducing lateral heterogeneity fading. Spartina meadows develop during spring, taking advantage of light and temperature increase as well as benthic nutrient regeneration. Our hypothesis is that former cracks, that are softer sediments compared to well compacted sediments around, allows better development of plants root system. In this way, spartina colonization maintains and possibly increases lateral heterogeneity of porewater chemistry impacting nutrient regeneration and benthic efflux. A better understanding of the link between emersion time, plant colonization dynamics and mineralization processes would help to provide a better comprehension of the future evolution of such systems and their impact on biogeochemical cycles in a climate change context.