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Adsorption characteristics of ssDNA and dsDNA onto mineral surfaces: implications for DNA preservation in sedimentary archives

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Sedimentary ancient DNA (sedaDNA) can provide valuable information on past biodiversity. Adsorption of DNA molecules onto mineral surfaces is vital for its long-term survival, and the mineral surface charge and the environmental conditions are key factors controlling the DNA-mineral interactions. Adsorption of double stranded (ds) DNA can occur directly onto the surfaces of positively charged minerals through its phosphate backbone (negatively charged in most environments). Alternatively, dsDNA can bind to negatively charged sites through cationic bridges. With reference to single stranded DNA (ssDNA), its adsorption characteristics are less clear due to the presence of both negatively (phosphate backbone) and positively (amines) charged groups.

This study presents on the dependence of ssDNA and dsDNA adsorption and conformation on solution composition and mineral characteristics (surface morphology and charge). Using atomic force microscopy (AFM) we visualize the adsorption of ssDNA and dsDNA on positively (calcite, hematite) and negatively (mica) charged mineral surfaces. We further assess the sensitivity of each DNA-mineral system to the composition and ionic strength of the background electrolytes ($MgCl_2$, NaCl, seawater), and their possible role in bridging the mineral surface and the DNA. We finally highlight the important implications of the different scenarios for the preservation of sedaDNA in the sedimentary archives.