

Insights into the Adhesion Forces behind environmental DNA Taphonomy

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DNA-mineral interactions emerge as an essential parameter for preserving and transporting DNA across timescales and environments¹. Unravelling the mechanisms that control the DNA-mineral interaction can allow us to better understand preservation and adsorption dynamics of environmental sedimentary DNA^{2, 3}. Additionally, understanding the DNA-mineral interface can help improve extraction protocols, optimize the amount of eDNA recovered and understand biases in the extracted DNA³.

Sedimentary minerals have a broad range of surface properties stemming from the crystalline structure, elemental composition of the mineral, and the aqueous environment in contact with it³. Mineral chemistry and surface structure determine the number of sites per mineral area that can react with other molecules in the environment (active sites)⁴. The fraction of these sites protonated or deprotonated varies with solution chemistry and considerably influences both the capability of a mineral surface to retain DNA molecules and the strength of the interaction³.

In our work, we used Chemical Force Microscopy to obtain insight into the adhesion forces between DNA and mineral samples as a function of solution chemistry. We functionalized Atomic Force Microscopy probes with 100 bp DNA molecules and measured the interaction forces between the DNA and minerals. The resulting force–distance curves show that mineral surface composition and solution chemistry significantly impacts the adhesion forces between DNA and mineral surfaces. Specifically, we see that DNA adhesion differs between minerals with exposure to environmentally relevant solutions at different pHs. Our observations are important to our understanding of eDNA taphonomy and indicate how eDNA extraction protocols may be improved to increase yield and target specificity.

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