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The impact of cations on dsRNA adsorption and stability at goethite surfaces

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RNA is ubiquitous in environmental systems where its stability plays an important role in biogeochemical cycling and diverse emerging technologies including wastewater-based epidemiology, RNA interference pesticides and transcriptomics. While RNA is generally considered to degrade rapidly in the environment due to its propensity towards hydrolysis, in aqueous conditions the degradation of double stranded (ds)RNA by abiotic processes is hindered relative to that of single stranded RNA. This increased stability may lead to prolonged persistence of dsRNA released into the environment from sources including viruses and RNA-based pesticides. However, in contrast to DNA that is well established to benefit from adsorptive protection at mineral surfaces - including against enzymatic hydrolysis - adsorption of dsRNA to certain minerals such as iron oxides, has been shown to enhance dsRNA hydrolysis [1], potentially limiting its persistence in a range of soils and aquatic environments. As such, it is likely that the environmental fate of dsRNA is strongly influenced by a range of geochemical conditions including mineralogy and solution chemistry, however, these remain poorly constrained. In this work, we investigate the adsorption of dsRNA to goethite and its resulting stability in the presence of various cations at a range of pHs. We find that the presence of cations strongly influences dsRNA adsorption at all pH values tested. While degradation of dsRNA adsorbed at the goethite surface was observed in all systems, the extent of degradation was heavily dependent on both pH and cation presence. These data have implications for the stability of dsRNA in environmental systems, including those thought to facilitate rapid hydrolysis.

References

1. Zhang, K., et al., *RNA Hydrolysis at Mineral–Water Interfaces.* Environmental Science & Technology, 2023. **57**(22): p. 8280-8288.