Selective Attachment of Ribose onto Goethite with Mg^{2+} and Ca^{2+}. Charlene F. Estrada[1,2] and Robert M. Hazen[1], [1]Geophysical Laboratory, Carnegie Institution of Washington, 5251 Broad Branch Rd NW, Washington, D.C. 20015, [2]School of Earth and Space Exploration, Arizona State University, 781 E Terrace Mall, Tempe, AZ 85287, Charlene.Estrada@asu.edu

The chemical evolution of RNA required the concentration and self-organization of ribose and nucleobases above other potential organic species on early Earth. This process may have been facilitated by the selective adsorption of biomolecules at the mineral-water interface [1]. Furthermore, divalent cations that characterize most aqueous environments, such as Mg^{2+} and Ca^{2+}, form bridges between the mineral surface and biomolecules that may substantially enhance adsorption [2,3].

We investigated the attachment of the pentose sugars ribose, xylose, and lyxose and the hexose sugars glucose and mannose onto goethite [α-FeOOH] with batch adsorption experiments. Either 50 or 100 µM of an individual sugar or a 1:1 equimolar mixture of sugars were added to a 10 $g{\bullet}L^{-1}$ suspension of goethite in water, 3 mM $CaCl_2$, or 3 mM $MgCl_2$. In all these experiments, we observed that ribose adsorbed up to three times more onto goethite than any other sugar. Following ribose, lyxose and xylose attached onto goethite in greater amounts than glucose and mannose. The presence of Ca^{2+} almost doubled the total amount of sugar adsorption at pH 11, whereas Mg^{2+} decreased adsorption between pH 5 and 11 by almost half.

The interaction between the sugars and goethite is likely electrostatic and may involve one or more hydroxyl groups as points of attachment onto the surface [4,5]. Therefore, the selective adsorption of ribose from a mixture of pentose and hexose sugars may result from the increased availabily of *–cis* hydroxyl groups present in its preferred aqueous orientation, β-D-ribopyranose [6]. The greater amount of pentose sugar adsorption onto goethite could also indicate that the hydroxymethyl group in the cyclic orientation of hexose sugars sterically inhibits surface attachment.

The results of this study indicate that the goethite-water interface may selectively concentrate ribose apart from less biologically-relevant sugars in an aqueous setting. The selectivity of the mineral-water interface may provide a pathway toward the emergence of molecular self-organization within the framework of a geochemical environment.

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