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Assessing the Abundances of Sugar Molecules on Comet Nuclei

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Introduction: Recent detections of the biologically relevant compounds glycolaldehyde (GLA) and ethylene glycol (EG) on comets [e.g., 1,2] warrants investigations as to how abundant they are on the comet nuclei and how these molecules may survive impact onto a habitable planet or moon. The presence and availability of these molecules in hospitable pre-biotic environments may be important for understanding the origin of life as we know it.

Previous experiments have assessed the survivability and production of these sugar molecules under impact conditions [3]. The results, together with published values of observed production rates of water, GLA, and EG [e.g., 1] on a few Oort-Cloud comets (e.g., C/1995 O1 Hale-Bopp, C/2012 F6 Lemmon, C/2013 R1 Lovejoy 2013, and C/2014 Lovejoy 2014) have allowed us to estimate the amounts of GLA and EG that could have been delivered via cometary impact. Even with a high degree of uncertainty in comet diameters and volumes, we have determined that extremely large amounts of these molecules could have survived the impact of a single comet.

Compiled cometary data [4] have been used to estimate total amounts of delivered GLA and impact-produced EG that may have been available on habitable planets or moons, especially during the era of late heavy bombardment (~4.2 to ~3.7 billion years ago; 5,6,7) when life may have been developing on Earth [e.g., 8,9].

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