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Qasim, D.; Raut, U.; Gimar, C.; Kammer, J.; Teolis, B.; Materese, C.; ... ; McClure, M.K.

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Interstellar Inheritance of Solar System Bodies: Laboratory, Modeling and JWST Observations

Danna Qasim[1] Ujjwal Raut[1] Caleb Gimar[1] Joshua Kammer[1] Ben Teolis[1] Christopher Materese[2] Hannah McLain[2] José Aponte[2] Daniel Glavin[2] Jason Dworkin[2] Melissa McClure[3]

[1]Southwest Research Institute, [2]NASA Goddard Space Flight Center, [3]Leiden University

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Our beautiful Solar System, the only one that we are aware of that hosts life, was birthed from an interstellar molecular cloud. Interstellar clouds are rich in the building blocks of life, such as amines and alcohols, and may even host amino acids, polymers and other complex species important to life's origins [1]. With the ongoing success of recent missions, such as the James Webb Space Telescope (JWST), interstellar astrochemistry has entered a 'Golden Age', allowing us to deeper examine the magnitude of interstellar inheritance in the chemistry across protoplanetary disks, planets and small bodies.

In this contribution, we overview the research conducted at Southwest Research Institute's (SwRI) rising astrochemistry program, which focuses on establishing the link between interstellar organics and the chemistry observed across Solar System bodies. Such research includes identifying the origin of Charon's red polar cap and gray cloak through experiments and exospheric modeling [2,3]. We also present experimental simulation results of a 'cosmic evolution', performed at NASA Goddard, which help decipher the role of interstellar cloud conditions in the distribution of amines and amino acids found in meteorites. Finally, we show some of the first results from the JWST Early Release Science Program, Ice Age. A notable finding is that we still only observe 1% of the sulfur budget in interstellar ices. 99% of the sulfur in dense molecular clouds is still unaccounted for, having implications for the incorporation of sulfur in protoplanetary disks, planets and small bodies. We demonstrate how we will investigate this missing sulfur problem at SwRI.

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