

Name: Hannah L. McLain

Code: 691

Home Institution: Catholic University of America

Name of Task: Isotopic Enrichment of Meteoritic Organics

Role in Task/What do you do for CRESST: I am an Astrochemist in the Astrobiology Analytical Laboratory (AAL) at NASA Goddard Space Flight Center. My research involves organic analysis of meteorites, lunar samples, and sample return missions such as OSIRIS-REx and Hayabusa2. The focus of my research is to study the organic complexity of extraterrestrial samples and the pervasiveness of prebiotic molecules necessary for the origins of life. The AAL utilizes liquid chromatography mass spectrometry (LC-MS) and gas chromatography liquid chromatography (GC-MS) instruments to examine pristine samples from the near-Earth space environment and simulated chemical environments similar to the early Earth.



What is your background: I was born in the mountains of North Carolina and obtained my bachelor's degree in chemistry in 2006 with a minor in physics from Warren Wilson College in Asheville, NC. After undergrad I went on to get my master's degree in chemistry from the Georgia Institute of Technology where I used LC-MS to study the formation of nucleobases from formamide mixtures to simulate the formation of nucleobases on early earth. I started my current position analyzing small organic compounds in extraterrestrial samples in the AAL in October 2013.

Favorite part of being a CRESST Scientist: The people that I work with and the precious samples we get to work with. It is always wonderful to be able to touch a sample that was in outer space less than a couple months before we get to analyze it.

Highlight of research as a CRESST Scientist: There are so many wonderful projects to work on in the AAL. One of the biggest projects is the analysis of samples from asteroid return missions, such as Hayabusa2 and OSIRIS-REx.

Hayabusa2 is an asteroid sample return mission from the Japan Aerospace Exploration Agency (JAXA) which returned 5 g of samples from the carbonaceous asteroid Ryugu in 2021. I was able to collaborate with Dr. Hiroshi Naraoka and the soluble organic matter (SOM) group to come up with a method to conduct serial extractions to obtain the best data for these very small precious samples. The AAL is a part of a group of collaborators around the world that specialize in different compound classes and methods that were sent samples of Ryugu to analyze as part of the JAXA initial analysis.

OSIRIS-REx is an asteroid sample return mission from NASA which expects to have >60g sample from carbonaceous asteroid Bennu returned in 2023. I worked with the team that analyzed multiple contamination control witness plates through the building of the OSIRIS-REx spacecraft to make sure that it was clean before launch. We also analyzed a variety of samples for contamination knowledge including rocket fuel and other items that came into contact with the sample collection device to make sure that what we see in the return sample is not being contaminated by the spacecraft itself. In preparation for this return the AAL is working on a streamlined method to obtain the most results from this very precious extraterrestrial sample using a variety of very specialized small organic compound methods.

Selected list of recent publications:

Regberg, A. B., C. L. Castro, H. C. Connolly, R. E. Davis, J. P. Dworkin, D. S. Lauretta, S. R. Messenger, [H. L. McLain](#), F. M. McCubbin, J. L. Moore, K. Richter, S. Stahl-Rommel, and S. L. Castro-Wallace. 2020. "**Prokaryotic and Fungal Characterization of the Facilities Used to Assemble, Test, and Launch the OSIRIS-REx Spacecraft.**" *Frontiers in Microbiology*. 11: [Full Text (Link)] [10.3389/fmicb.2020.530661]

Glavin, D. P., [H. L. McLain](#), J. P. Dworkin, E. T. Parker, J. E. Elsila, J. C. Aponte, D. N. Simkus, C. I. Pozarycki, H. V. Graham, L. R. Nittler, and C. M. Alexander. 2020. "**Abundant extraterrestrial amino acids in the primitive CM carbonaceous chondrite Asuka 12236.**" *Meteoritics & Planetary Science*. maps.13560 [Full Text (Link)] [10.1111/maps.13560]

Vinogradoff, V., L. Remusat, [H. L. McLain](#), J. C. Aponte, S. Bernard, G. Danger, J. P. Dworkin, J. E. Elsila, and M. Jaber. 2020. "**Impact of Phyllosilicates on Amino Acid Formation under Asteroidal Conditions.**" *ACS Earth and Space Chemistry*. 4 (8): 1398-1407 [Full Text (Link)] [10.1021/acsearthspacechem.0c00137]

Aponte, J. C., [H. L. McLain](#), D. N. Simkus, J. E. Elsila, D. P. Glavin, E. T. Parker, J. P. Dworkin, D. H. Hill, H. C. Connolly, and D. S. Lauretta. 2020. "**Extraterrestrial organic compounds and cyanide in the CM2 carbonaceous chondrites Aguas Zarcas and Murchison.**" *Meteoritics & Planetary Science*. 55 (7): 1509-1524 [Full Text (Link)] [10.1111/maps.13531]

Glavin, D. P., J. E. Elsila, [H. L. McLain](#), J. C. Aponte, E. T. Parker, J. P. Dworkin, D. H. Hill, H. C. Connolly, and D. S. Lauretta. 2020. "**Extraterrestrial amino acids and L-enantiomeric excesses in the CM2 carbonaceous chondrites Aguas Zarcas and Murchison.**" *Meteoritics & Planetary Science*. [Full Text (Link)] [10.1111/maps.13451]

Simkus, D. N., J. C. Aponte, J. E. Elsila, R. W. Hiltz, [H. L. McLain](#), and C. D. Herd. 2019. "**New insights into the heterogeneity of the Tagish Lake meteorite: Soluble organic compositions of variously altered specimens.**" *Meteoritics & Planetary Science*. 54: 1283-1302 [10.1111/maps.13276]

Dworkin, J. P., H. L. McLain, et. al. 2018. "**OSIRIS-REx Contamination Control Strategy and Implementation.**" *Space Science Reviews*. 214 (1): 19 [Full Text (Link)] [10.1007/s11214-017-0439-4]

Friedrich, J. M., [H. L. McLain](#), J. P. Dworkin, et al. 2018. "**Effect of polychromatic X-ray microtomography imaging on the amino acid content of the Murchison CM chondrite.**" *Meteoritics & Planetary Science*. 54 (1): 220–228 [Full Text (Link)] [10.1111/maps.13188]

Awards:

2022: Space Foundation John L. "Jack" Swigert Jr. Award for Space Exploration, OSIRIS-REx Team

2020: American Astronautical Society Space Technology Award, OSIRIS-REx Team

2019: NASA Goddard Code 690 Special Thanks and Recognition (STAR) Award

2017: NASA Group Achievement Award, OSIRIS-REx Team

2017: Asteroid discovered at Mount Lemmon was renamed 117614 Hannahmclain

2017: NASA Group Achievement Award, MSL Extended Mission-1 Science and Operations Team

2015: NASA Group Achievement Award, MSL Prime Mission Science and Operations Team

2014: NASA Goddard Code 690 Special Act Award

To contact Hannah to learn more about her work or to collaborate, you can reach her at:

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