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Exploring Volatiles in Chondritic Materials - *Earl Ingerson Lecture*

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The C-N-S-H_2O inventory of planets is a result of an intricate series of processes, starting from presolar dust, organics, and ice in a molecular cloud, collapse into a protoplanetary disk, formation of planetesimals and planetary embryos, and ending with planetary accretion. A major motivation for the research in my team at Arizona State University is to understand how processes ongoing in the small undifferentiated, chondritic bodies in the young protoplanetary disk phase influence the inventories of these life-essential volatiles found on Earth and other rocky planets. To accomplish this research, we explore the geochemistry of meteorites, micrometeorites, and samples brought back by the *Hayabusa* and *Hayabusa2* missions. In the talk, I will present the results from recent work (H_2O[1-2], C[3], and S[4]) on asteroid Itokawa samples, micrometeorite TAM19B-7 from Antarctica, and Ryugu particles. Because these extraterrestrial samples accreted at different locations in the disk and (likely) at variable times, the results can constrain the volatile inventories of early disk objects as a function of both space and time. Froh et al (2022) also reveal the nature of microenvironments and chemical cycling that occur in primitive water-rich asteroids. Finally, I will share ongoing plans for laboratory analyses of samples to be brought back from comets and the dwarf planet Ceres.

1. Jin Z. L., Bose M., Lichtenberg L., & Mulders G. D. (2021) New evidence for wet accretion of asteroids from recent meteorite falls Chelyabinsk and Benenitra. *The Planetary Science Journal* 2, 244-258.

2. Jin Z. & Bose M. (2019) New clues to ancient water on Itokawa. *Science Advances* 5, eaav8106.

3. Froh V., Bose M., Suttle M. D., Nava J., Folco L., Williams L. B., & Castillo-Rogez J. (2022) Water-rich C-type asteroids as early solar system carbonate factories. *Icarus* 391, 115300.

4. Bose M. & Root R. A. (2023) Ryugu particles contain sulfur in multiple oxidation states. *Lunar and Planetary Science Conference* 54, Abstract #2205.