



UvA-DARE (Digital Academic Repository)

Probing solid compositions in planetary core formation zones

McClure, M.; Dominik, C.; Kama, M.

Publication date

2021

Document Version

Final published version

Published in

Bulletin - American Astronomical Society

License

CC BY

[Link to publication](#)

Citation for published version (APA):

McClure, M., Dominik, C., & Kama, M. (2021). Probing solid compositions in planetary core formation zones. *Bulletin - American Astronomical Society*, 53(3), [1137].
<https://baas.aas.org/pub/2021n3i1137/release/1>

General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

Bulletin of the AAS • Vol. 53, Issue 3 (AASTCS8 Habitable Worlds 2021 Abstracts)

Probing solid compositions in planetary core formation zones

M. McClure¹, C. Dominik², M. Kama³

¹Leiden Observatory, Leiden University, Leiden, Netherlands,

²Anton Pannekoek Institute, University of Amsterdam, Amsterdam, Netherlands,

³University College London, London, United Kingdom

Published on: Mar 17, 2021

License: [Creative Commons Attribution 4.0 International License \(CC-BY 4.0\)](https://creativecommons.org/licenses/by/4.0/)

The bulk elemental ratios of planetary cores and atmospheres are a critical factor in determining a planet's habitability. Upcoming missions like JWST and Ariel will enable spectroscopic surveys of molecules and atoms in exoplanet atmospheres, allowing us to determine bulk atomic ratios in the outermost atmospheric layers. Radius and mass measurements from TESS and ground-based RV follow-up can determine the bulk density of exoplanets, allowing us to infer their core compositions, with significant degeneracies. In principle, the observed bulk elemental abundances of a given exoplanet should be traced back to its radial birth location in a protoplanetary disk, indirectly probing the process of planet formation. However, planets may form their cores first and then migrate, accreting their envelopes at different locations and times relative to their cores. Furthermore, with current observational methods, we can only measure the radial gas phase composition of disks (e.g. with ALMA); we are blind to the finer details of the solid composition, e.g. iron, refractory carbon, or ice content at the disk midplane. To connect observed exoplanet compositions with the planet formation processes, we need techniques to probe the solid composition at locations where planets might form in disks.

We present a new technique to assess the composition of solids retained in protoplanetary disks during their lifetimes. Using near-infrared spectroscopy of the famous TW Hya disk, we take a snapshot of the gas phase abundances of several key elements (e.g. C, O, Si, Fe) inside the dust sublimation radius of this disk. These elements are all depleted from the gas phase, suggesting that they are trapped in solid dust grains at the inner edges of TW Hya's known millimeter rings. We identify one refractory-rich dust trap in the terrestrial planet forming region and one trap in the outer rings that is enhanced in nitrogen relative to Solar System bodies. These results highlight how bodies forming in this disk could have compositions both similar to, and different than, our own solar system. Applying this technique to more disks with a broad range of ages will give us insight into the composition of planetary cores formed at different disk radii and times.