# ALIEN EARTHS

## Which Nearby Planetary Systems Are Likely to Host Habitable Planets and Life?

## MONTHLY NEWSLETTER

May 2026

# ALIEN EARTHS

Alien Earths is part of NASA's Nexus for Exoplanetary System Science program, which carries out coordinated research toward the goal of searching for and determining the frequency of habitable extrasolar planets with atmospheric biosignatures in the Solar neighborhood.

Our interdisciplinary teams include astrophysicists, planetary scientists, cosmochemists, material scientists, chemists, biologists, and physicists.

The Principal Investigator of Alien Earths is Daniel Apai (University of Arizona). The projects' lead institutions are The University of Arizona's Steward Observatory and Lunar and Planetary Laboratory.

For a complete list of publications, please visit the **AE Library** on the SAO/NASA Astrophysics Data System.

## Recent Publications

*A Chemical Mismatch between Young Stars and Their Inner Disks'*

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*TOI-1080 b: A Temperate, Rocky Planet Orbiting a Quiet M4V Host*

……

*Onset of Habitable Conditions on the Hadean Earth Set by Feedback between Tides and Greenhouse Forcing*

# A Chemical Mismatch between Young Stars and Their Inner Disks

Diogo Souto, Ilaria Pascucci, Katia Cunha, Shubham Kanodia

Astrophysical Journal Letters, Volume 1001, Number 2

We present the first stellar elemental abundance study for two very low-mass stars, similar in mass to TRAPPIST1, in the ~5–10 Myr old Upper Scorpius association. Their mid-infrared JWST/MIRI spectra, like those of many very low-mass stars, are hydrocarbon-rich, indicating C/O ratios greater than unity in the inner disk gas inside their snowlines. By fitting synthetic spectra to high-resolution Apache Point Observatory Galactic Evolution Experiment near-infrared stellar spectra, we show that, unlike their inner disks, both stars have solar C/O ratios. Their Fe, C, O, Mg, and Ca abundances are likewise consistent with solar values, placing them within the Galactic thin-disk population, as expected for nearby star-forming regions. This contrast between stellar and inner disk C/O ratios provides the first direct evidence that the inner disk's supersolar values are not inherited from the natal cloud but arise from disk processes. If these enhanced C/O ratios are primarily driven by inward drift of icy pebbles, there are major implications for disk evolution and planet formation, which we also discuss.

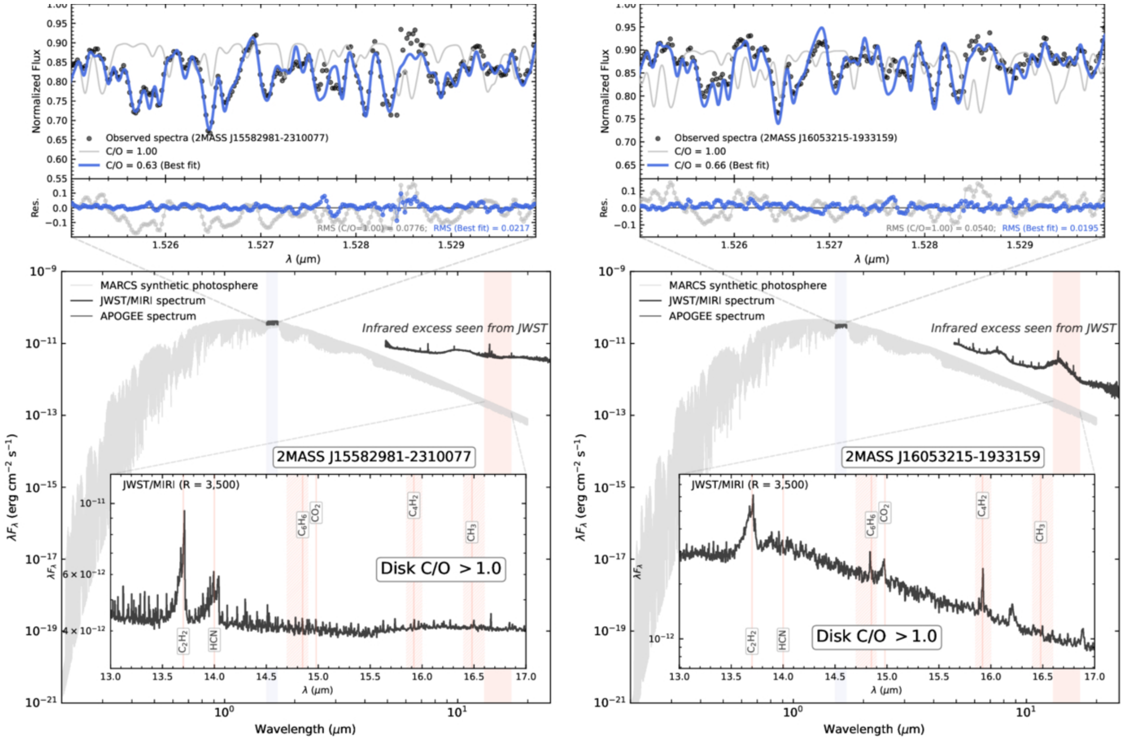

***Figure 1.*** *Left and right panels show the same figure layout for 2MASS J15582981-2310077 and 2MASS J16053215-1933159, respectively. The top panels show the high-resolution APOGEE spectra (black filled circles) and the best-fit synthetic spectra (in blue). Syntheses with C/O = 1 are also shown, as well as the residuals between syntheses and observed spectra. The bottom panels show the JWST/MIRI spectra together with the synthetic photospheric spectrum, while the lower inset highlights molecular features detected in the MIRI spectra.*

# TOI-1080 b: A Temperate, Rocky Planet Orbiting a Quiet M4V Host

Y. Gómez Maqueo Chew, G. Dransfield, K. Barkaoui, C. Cadieux, E. Ducrot, B. V. Rackham, M. Timmermans, A. J. Burgasser, A. Segura, K. G. Stassun, C. Ziegler, A. Soubkiou, J. M. Almenara, B.O. Demory, M. Gillon, J. M. Jenkins, E. Jofré, A. Khandelwal, S. Páez, R. Petrucci, L. Parc, M. Pichardo Marcano, I. Plauchu-Frayn, U. Schroffenegger, R. Schwarz, T.G. Tan, A. H. M. J. Triaud, Z. Benkhaldoun, X. Bonfils, F. Bouchy, K. A. Collins, F. Davoudi, R. Doyon, M. Gachaoui, M. J. Hooton, E. Jehin, F. J. Pozuelos, M. G. Scott, S. Yalçınkaya, F. Zong Lang, S. Zúñiga-Fernández, J. R. De Medeiros, J. I. González-Hernández, N. C. Santos

➔ **Astro-ph: arXiv:2603.00385**

We present the detection and validation of a small, temperate transiting exoplanet orbiting TOI-1080 every $3.9652482^{+0.0000014}_{-0.0000015}$ days. The host is a quiet M4V star at 25.6 pc. The planet signal was first detected by TESS and validated using TESS and ground-based observations. By fitting the available light curves, the planet radius is measured to be $1.200\pm0.058 R_\oplus$ and its equilibrium temperature of $368^{+12}_{-10}$ K. With NIRPS radial velocities, we are able to place a 3-$\sigma$ upper limit on the mass of TOI-1080 b of 10.7 $M_\oplus$. Our injection-recovery tests enable us to discard additional transiting planets in the TOI-1080 system with radii down to 0.9 $R_\oplus$ and periods between 0.5 and 7.7 days, and planets with radii larger than 1.4 $R_\oplus$ for periods up to 19 days. We demonstrate that it is highly amenable to characterisation of its mass and putative atmosphere. In particular, we find that TOI-1080 b is an exceptional target for the ongoing JWST+HST Rocky Worlds DDT programme, having a priority score that is higher than four out of nine targets currently being investigated by the programme. TOI-1080 b can be added to the sample of nearby benchmark planets accessible for detailed study with JWST.

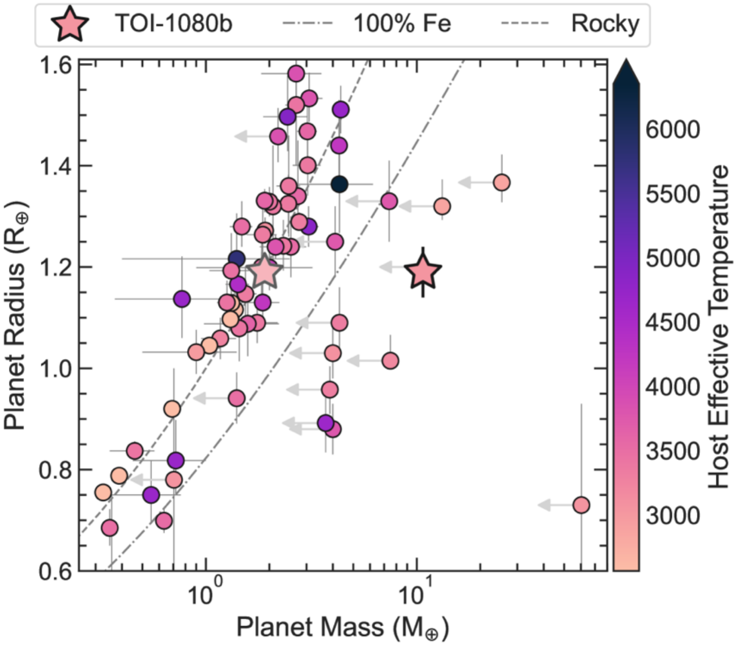

***Figure 10**:Planets within 50 parsecs with $R_p < 1.6R_\oplus$ from the NASA Exoplanet Archive. Points are coloured according to host star effective temperature and upper limits on masses are indicated with grey arrows. Composition curves for 'rocky' and '100% Fe' are taken from* Zeng *et al.* (2019). *TOI-1080 b is indicted as a star; the mass value plotted is the upper limit we derive in Section* 6*; we show as a fainter star the mass derived from the mass-radius relations of* Chen and Kipping (2017) *using* FORECASTER.

# *Onset of Habitable Conditions on the Hadean Earth Set by Feedback between Tides and Greenhouse Forcing*

Marijn R. van Dijk, Harrison Nicholls, Tim Lichtenberg

➔ The Planetary Science Journal, Volume 7, Number 4

In the aftermath of the Moon-forming giant impact, the Hadean Earth's mantle and surface crystallized from a global magma ocean blanketed by a dense volatile-rich atmosphere. While prior studies have explored the thermal evolution of such early Earth scenarios under idealized, oxidizing conditions, the potential feedback between tidal heating driven by Earth--Moon orbital forcing and variable redox scenarios have not yet been explored in detail. We investigate whether tidal heating could have prolonged this early magma ocean phase and supported quasi-steady state epochs of global radiative equilibrium: periods of thermal balance between outgoing radiation and interior heat flux. Using the PROTEUS simulation framework, we simulate Earth's early evolution under a range of plausible tidal power densities, oxygen fugacities, and volatile inventories. Our results suggest that feedback between tidal heating and atmospheric forcing can induce substantial variation in magma ocean lifetimes, from ~30 Myr up to ~500 Myr, sensitive to interior redox conditions. Global radiative equilibrium epochs commonly arise across this range, lasting from ~2 to ~320 Myr, and typically occur from 24 Myr after the Moon-forming impact. Under oxidizing conditions late-stage $H_20$ degassing promotes melt retention and sustained heating due to its significant contribution to greenhouse forcing. Weak tides increase the atmospheric abundance of $H_2S$ and deplete CO. Therefore, the feedback between tides and atmospheric forcing induces a disequilibrium signature in the magma ocean atmosphere.

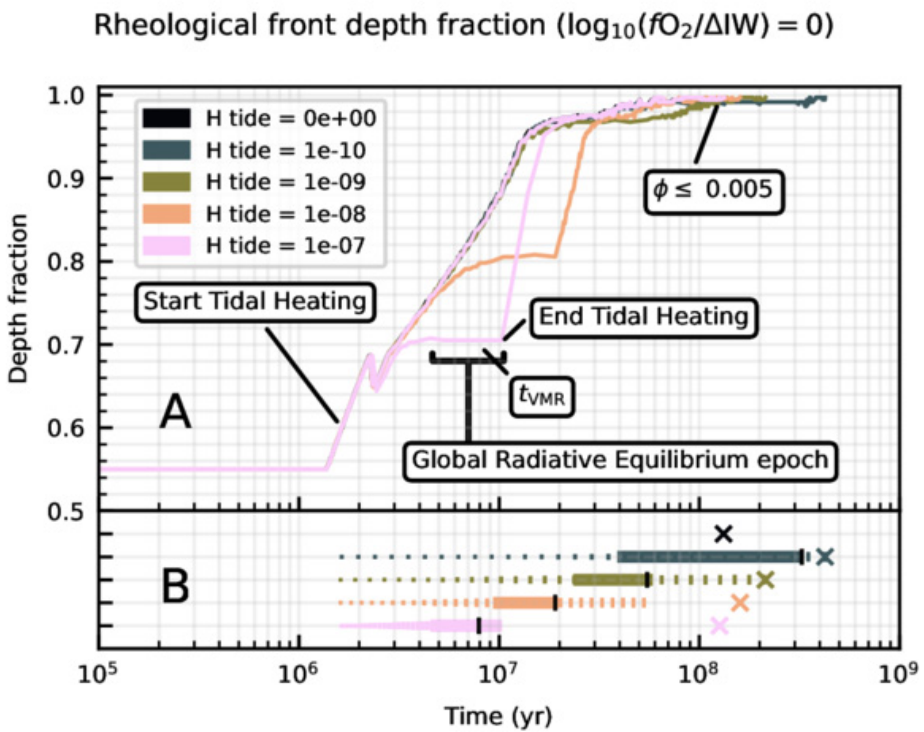

***Figure 1**: Simulation results for nominal abundance and $fO2 = \Delta IW + 0$ across all tidal power densities (see Section 2.3). The horizontal axis shows time [yr] since the Moon-forming impact on a logarithmic scale. Panel (A): evolution of the rheological front (vertical axis: mantle depth fraction). Panel (B): evolution of tidal dissipation for each case (vertical axis: cases). Dotted lines trace cumulative tidal energy dissipation; marker size scales with total dissipated energy. Solid lines indicate tidal heat-supported GRE. Black markers (|) denote the time tV MR at which we extract the volume mixing ratio for plotting in Figure 2. Note that the particular choice of tV MR is arbitrary so long as it lies within the temporal range of GRE, indicated by the solid lines in the bottom panel. Crosses (×) mark mantle solidification ($\phi < 0.005$).*