Hot exoplanets' Atmospheres

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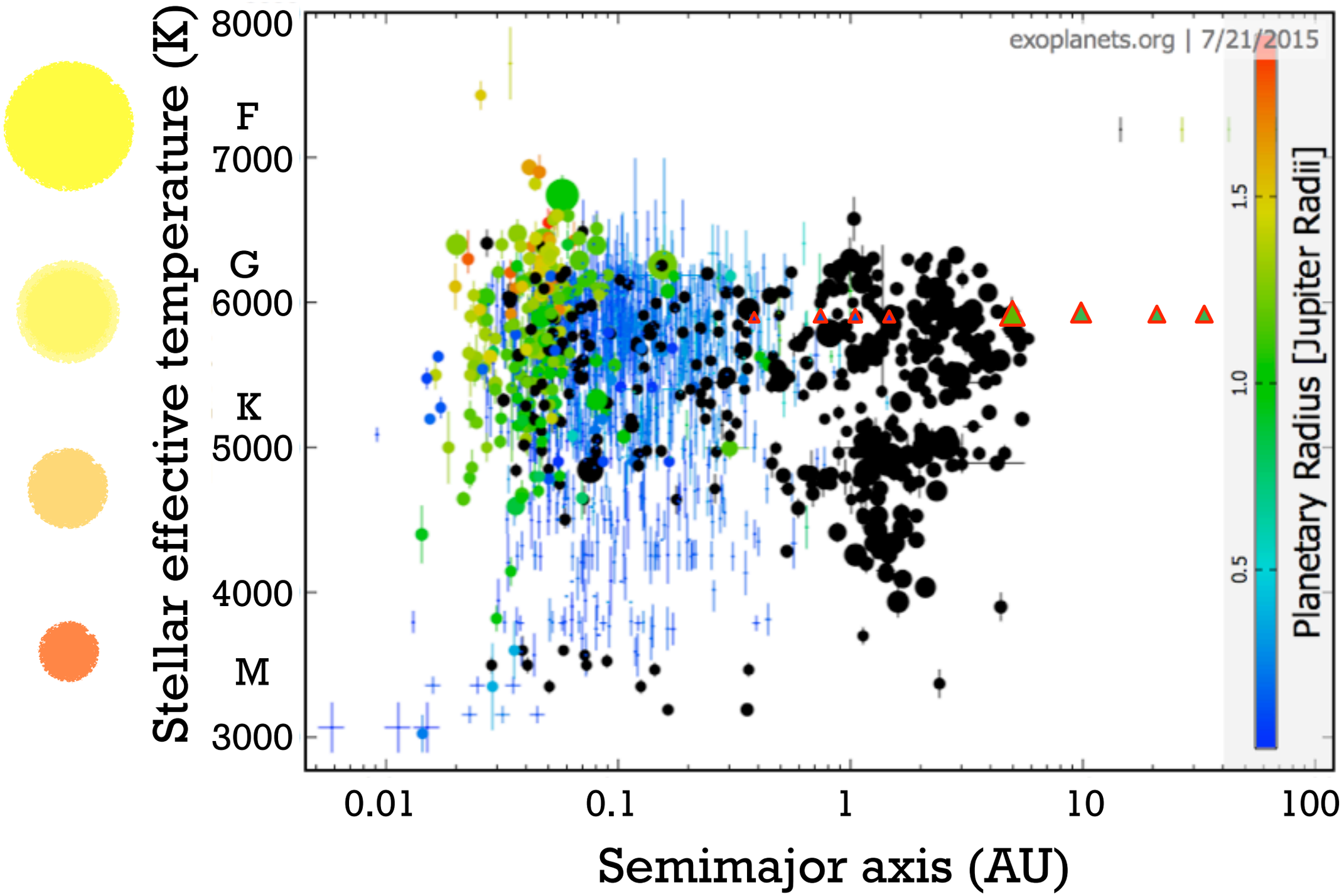
E. Simoncini

Yamila Miguel
Observatoire de la Côte d'Azur

Introduction: exoplanets detected



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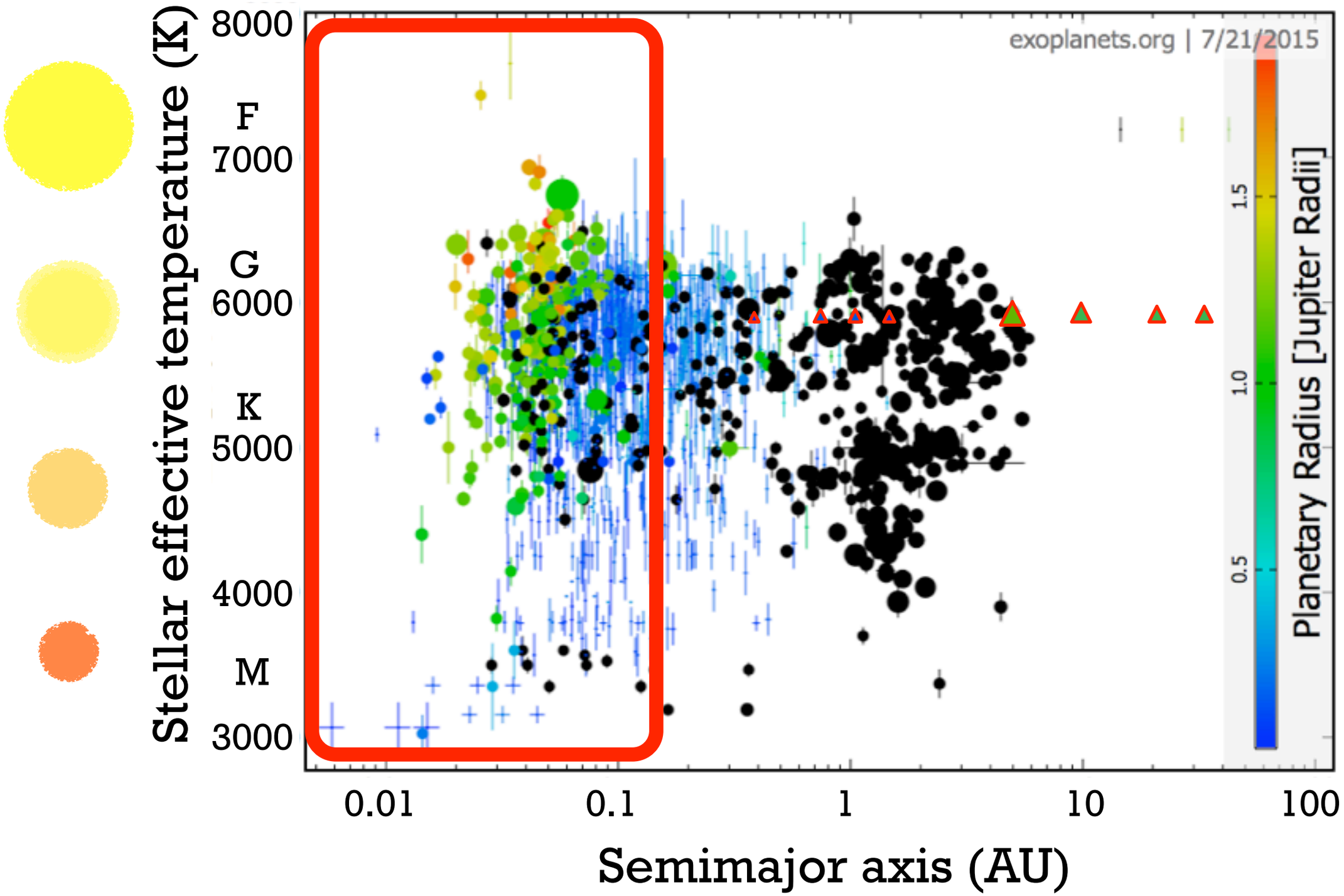
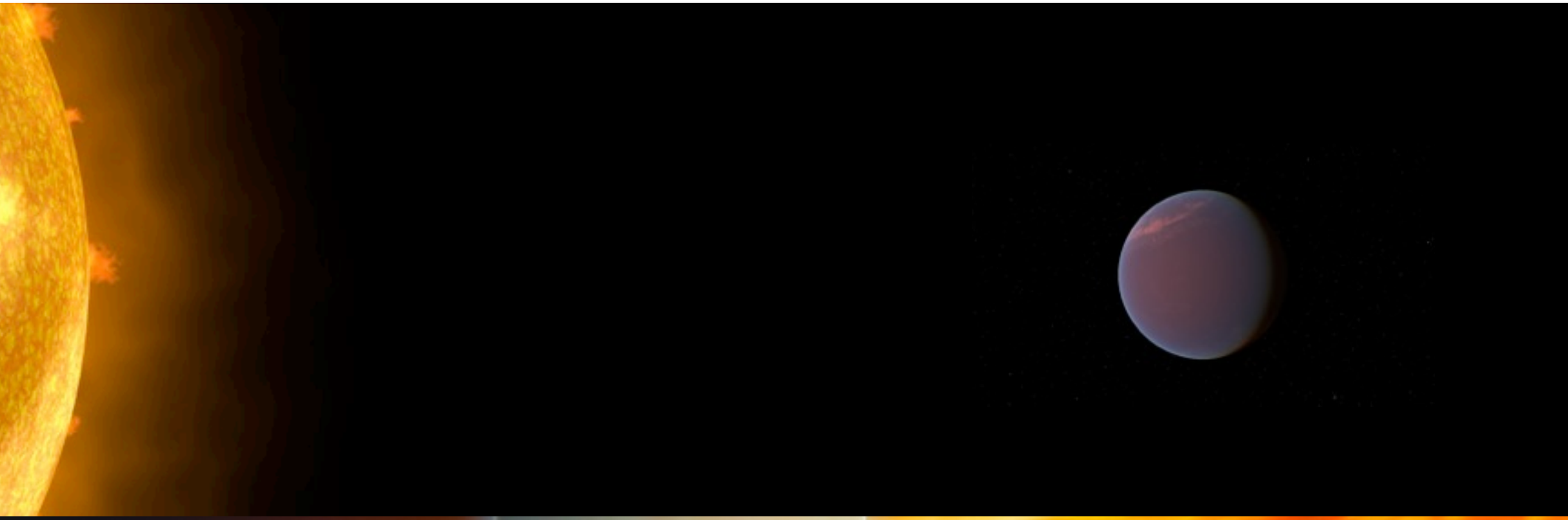


Aim: Link observables to atmospheric composition and spectral features



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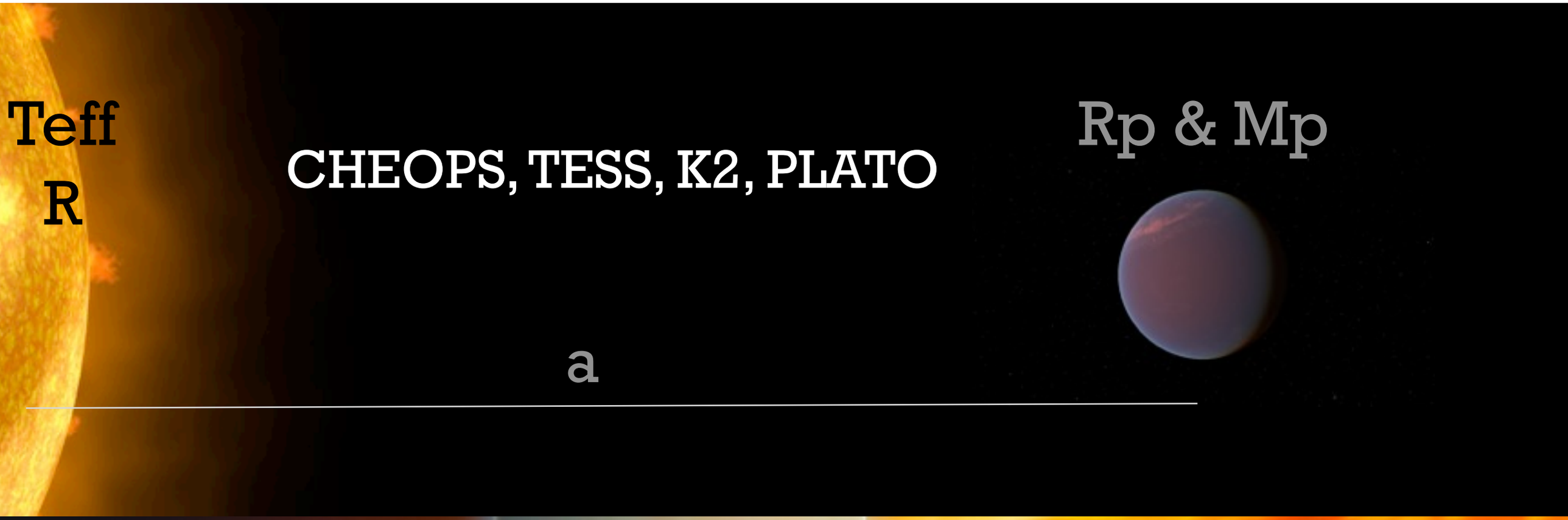

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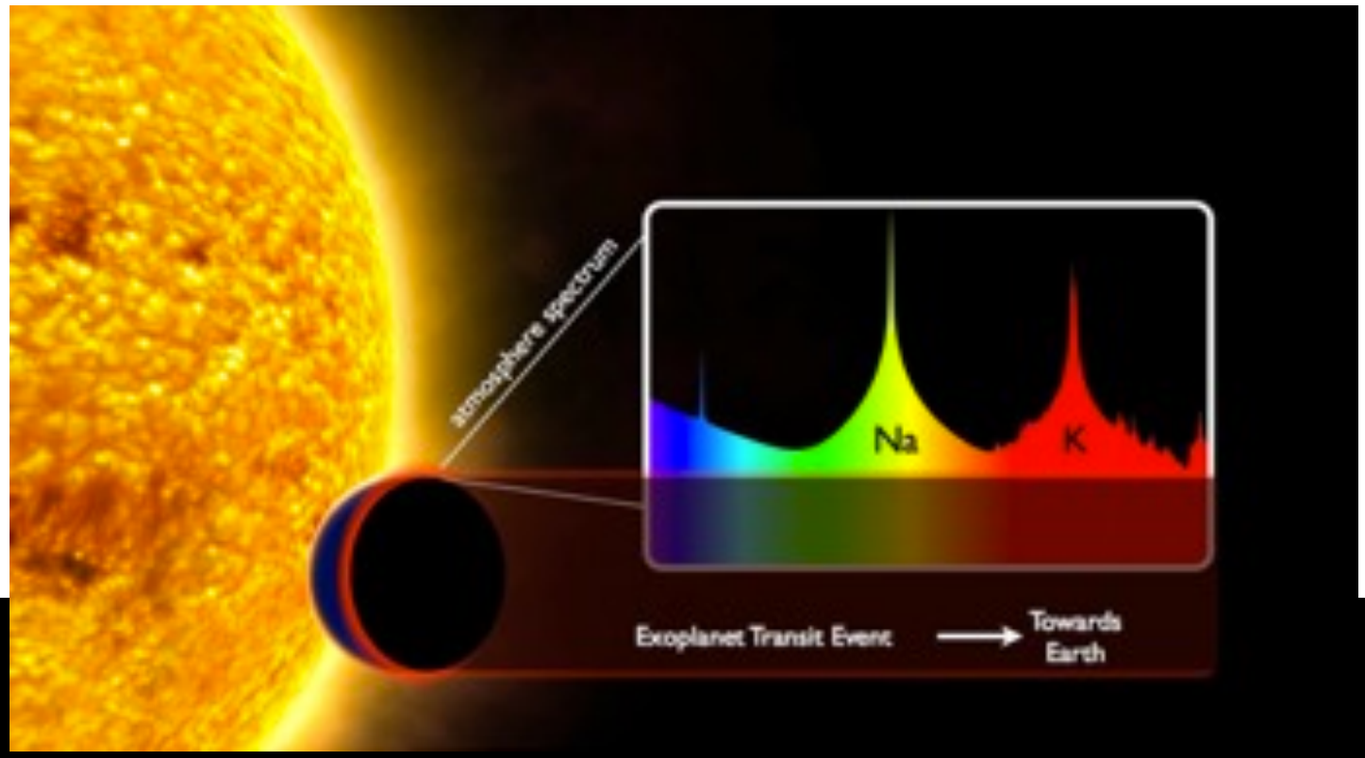


Teff
R

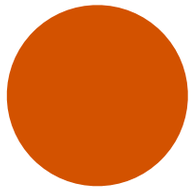
CHEOPS, TESS, K2, PLATO

Rp & Mp

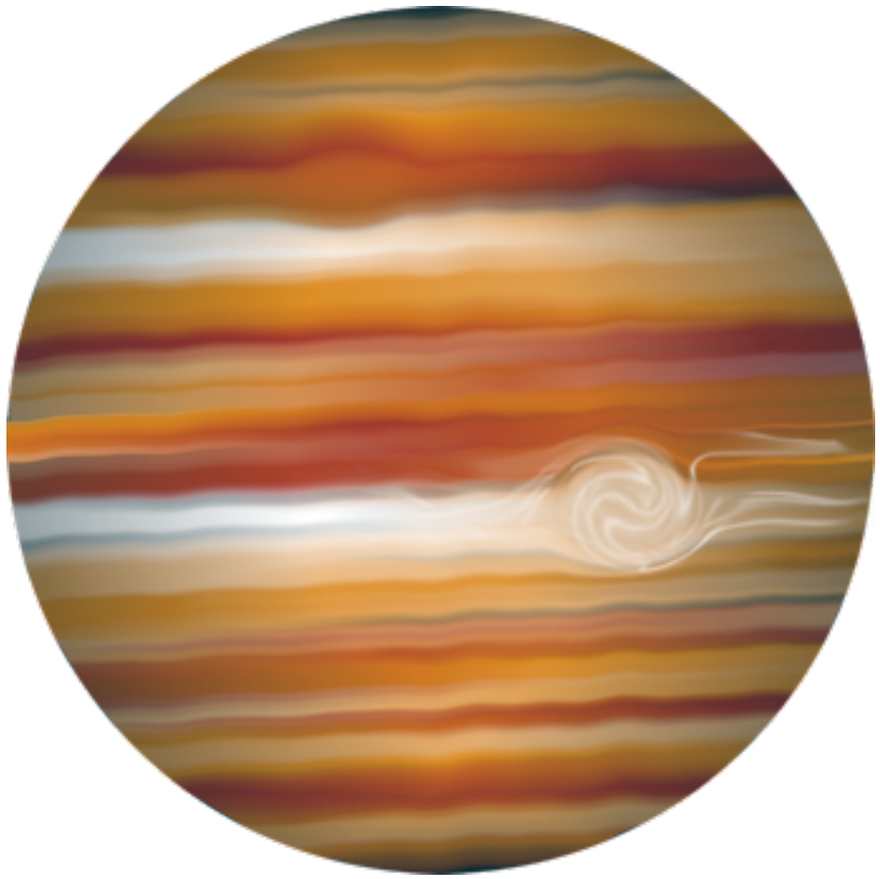
a

Outline

Hot-rocky planets
secondary (outgassed)
atmospheres



Hot-giant planets
primary atmosphere



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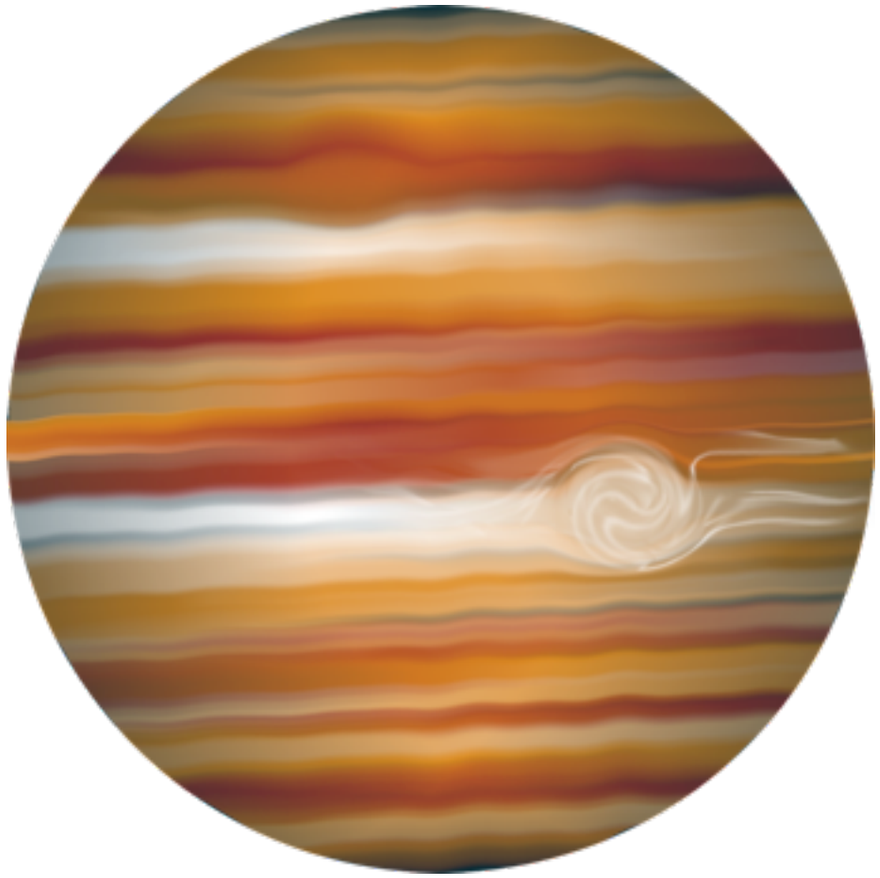
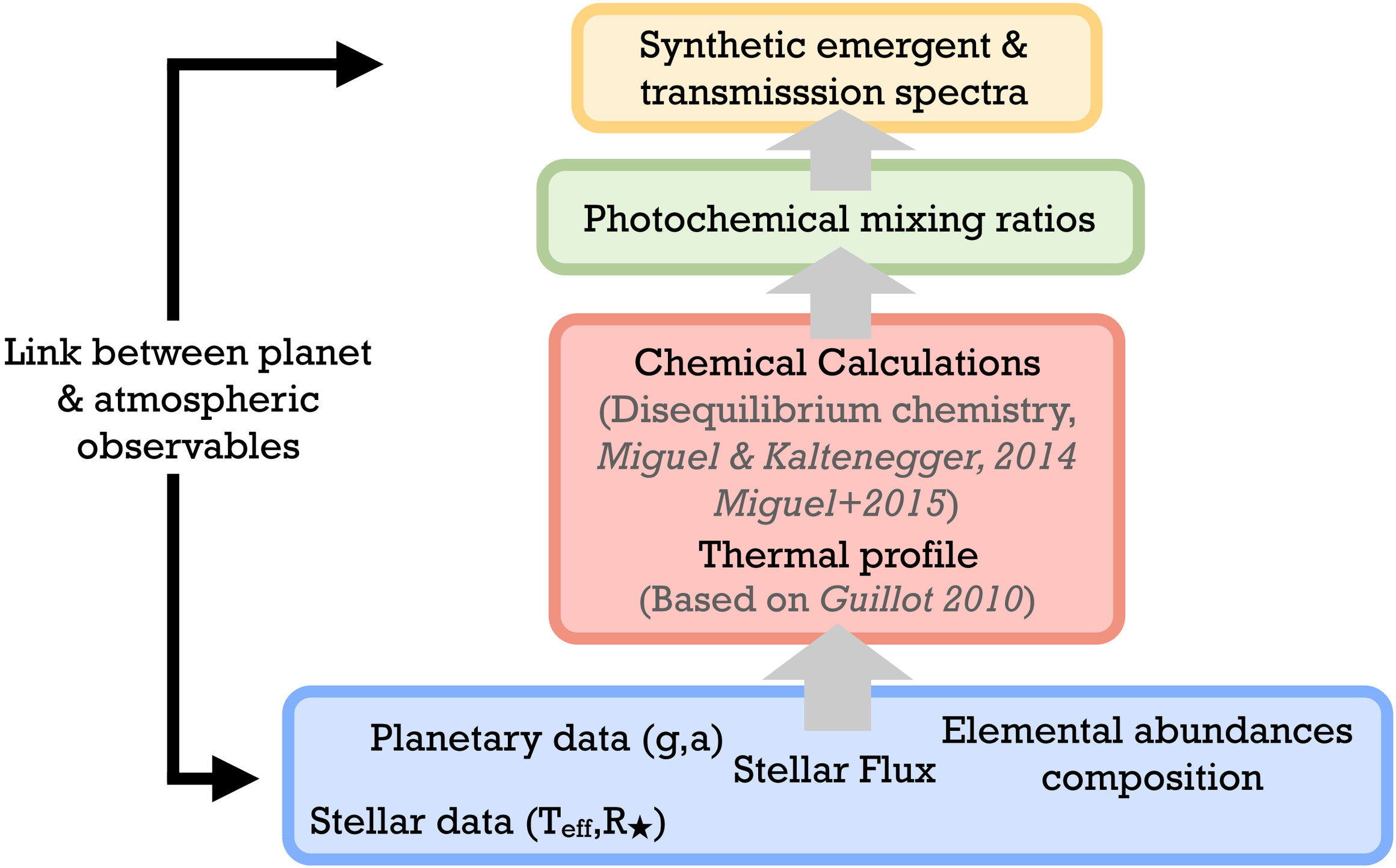
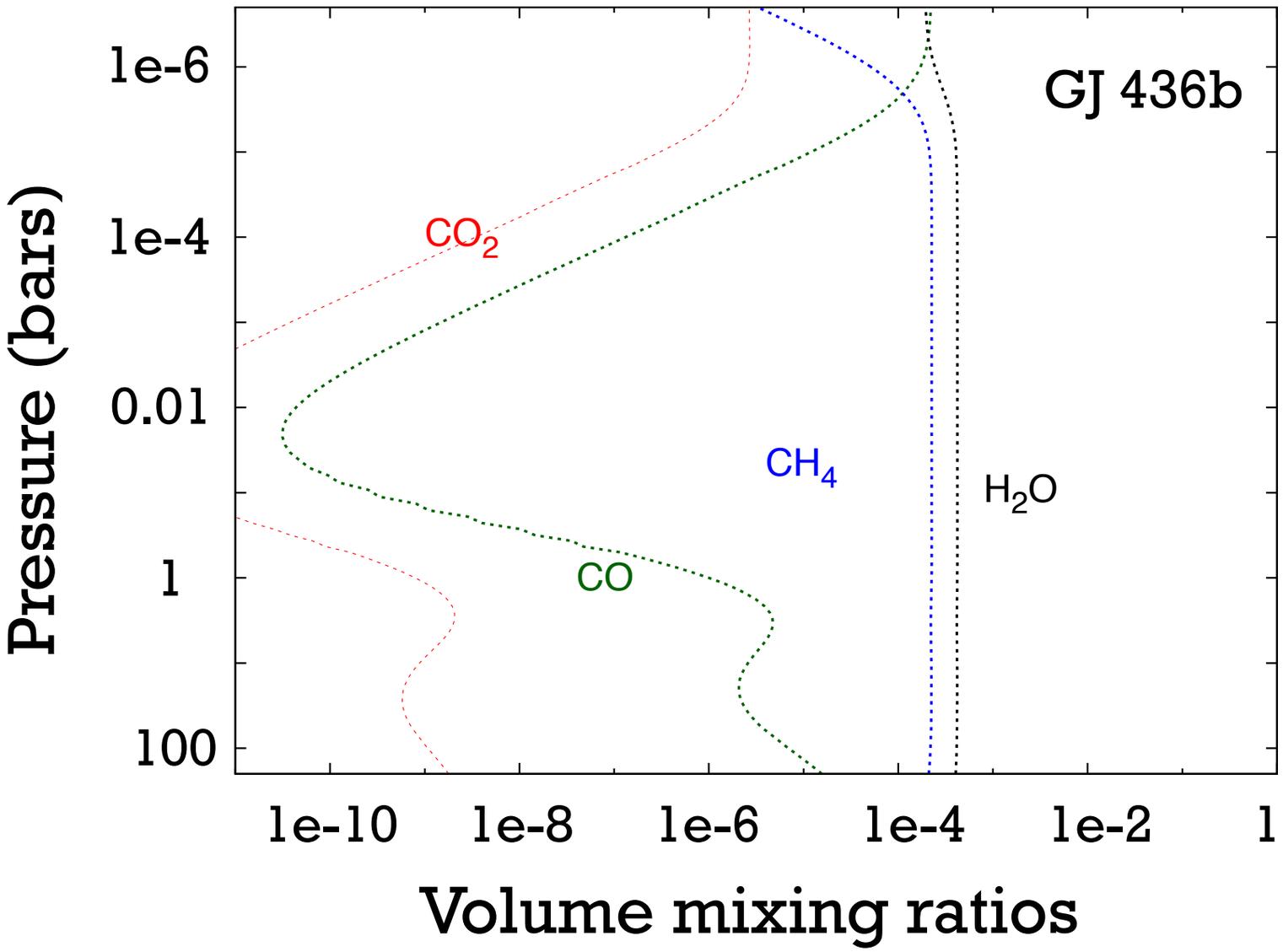


Modeling hot mini-Neptunes & hot Jupiters



Modeling hot exoplanets
equilibrium vs. disequilibrium chemistry



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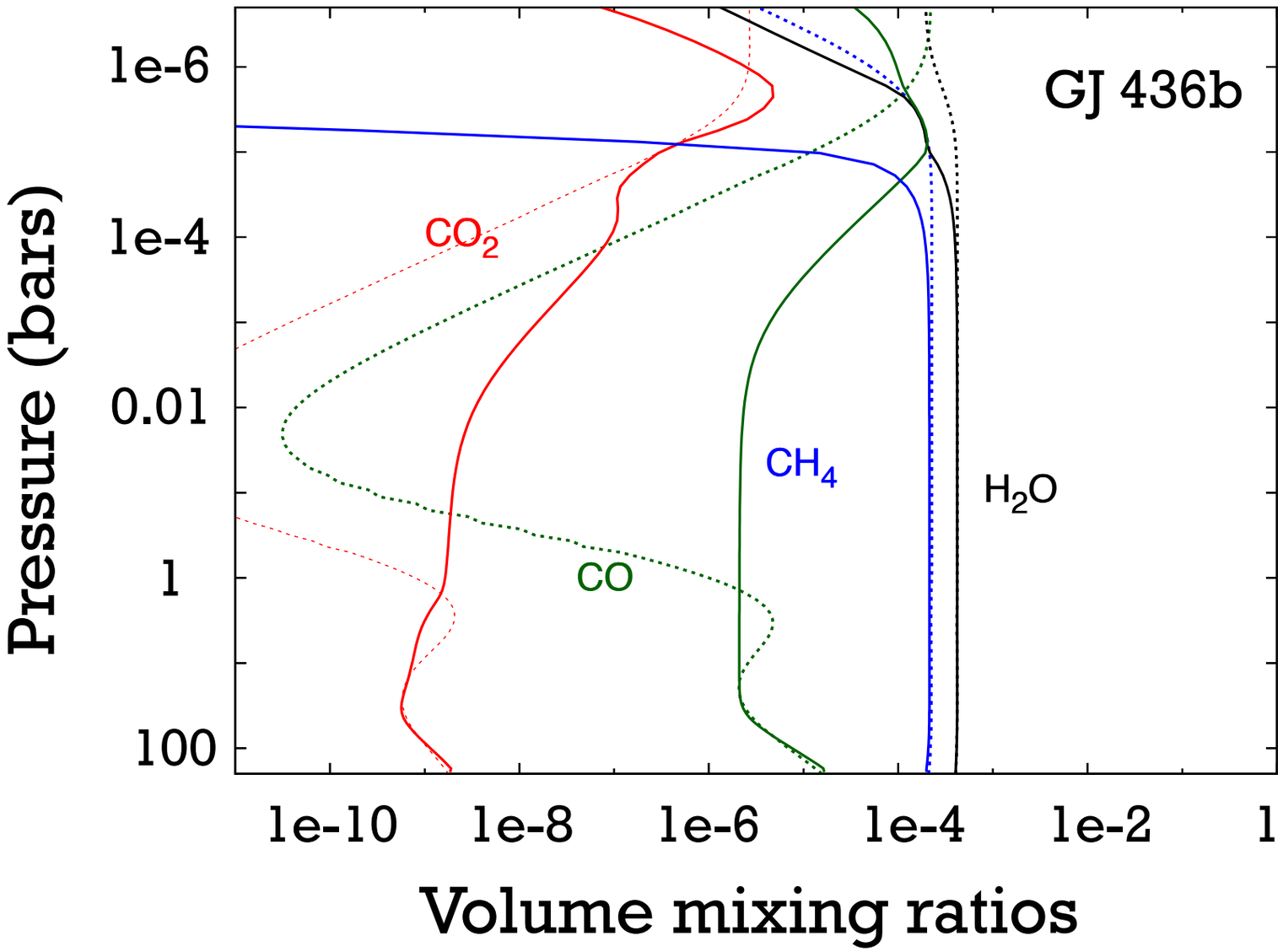

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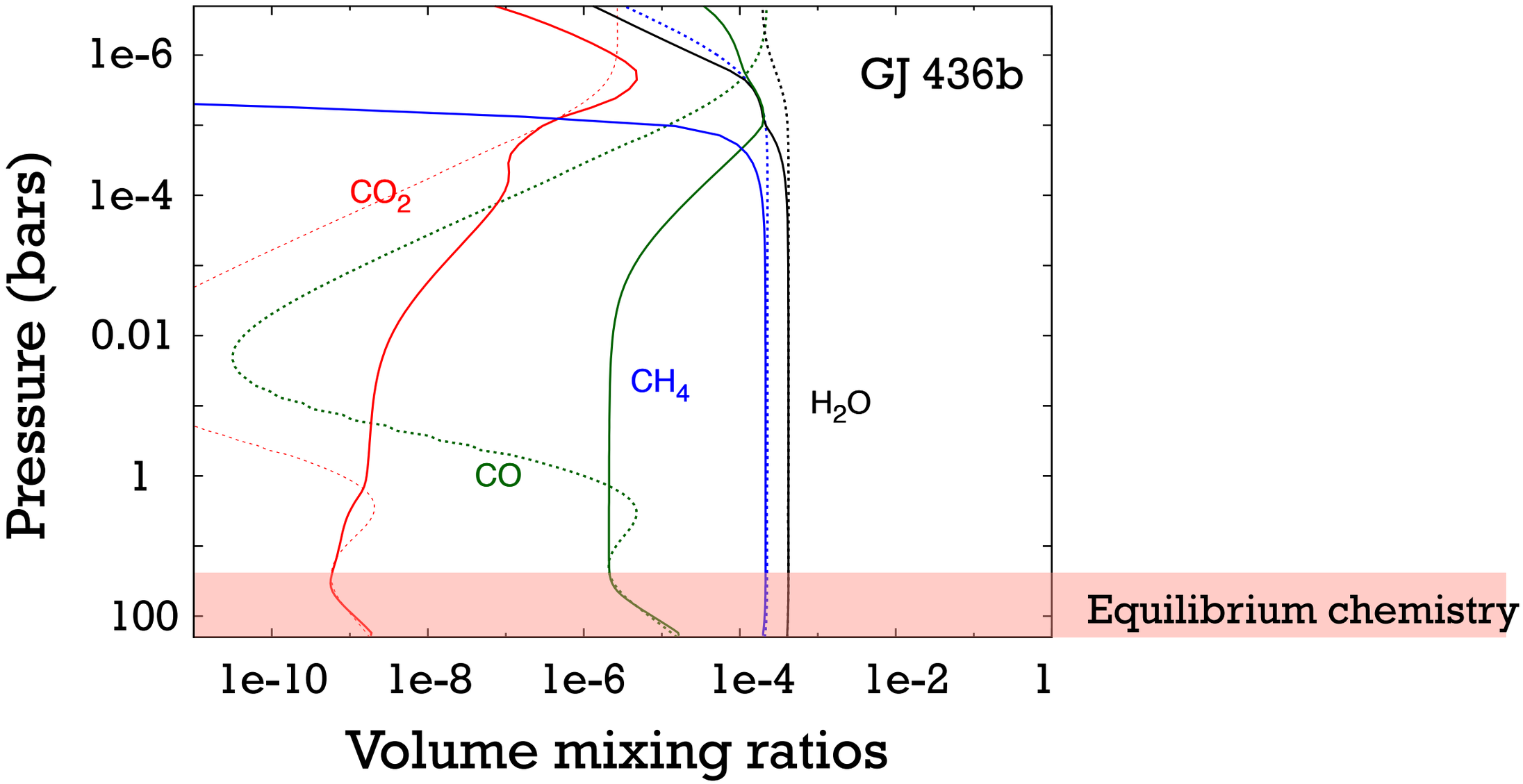

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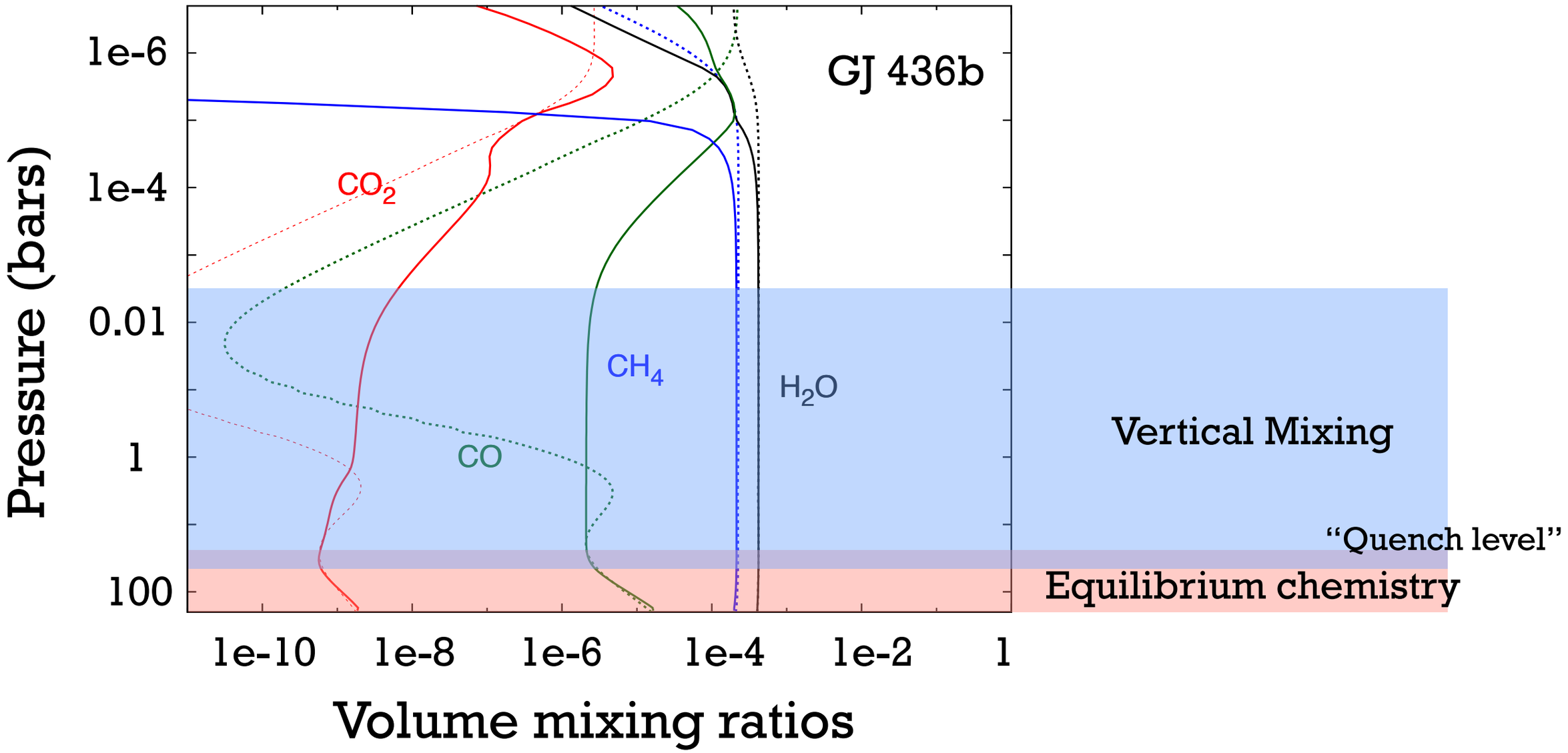

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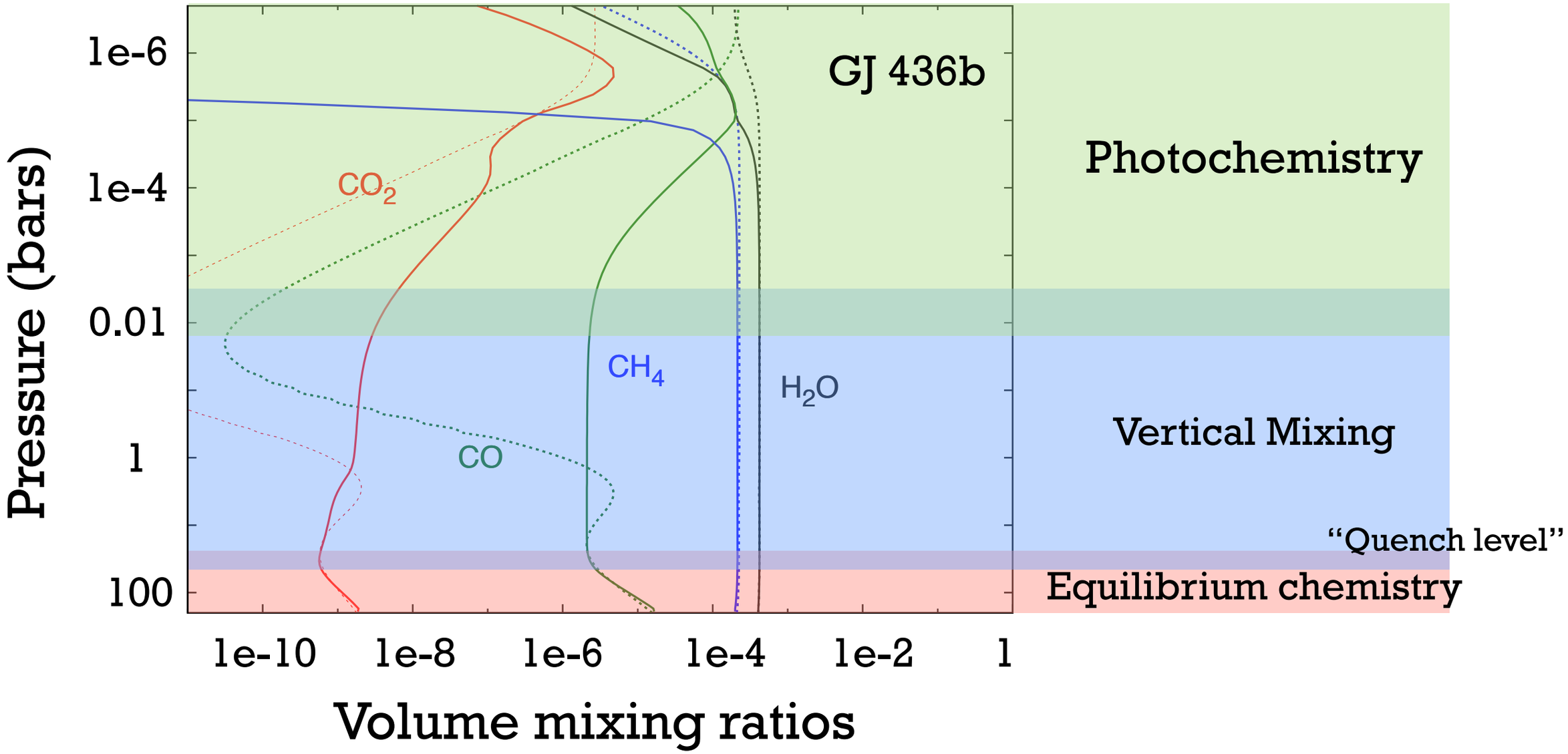
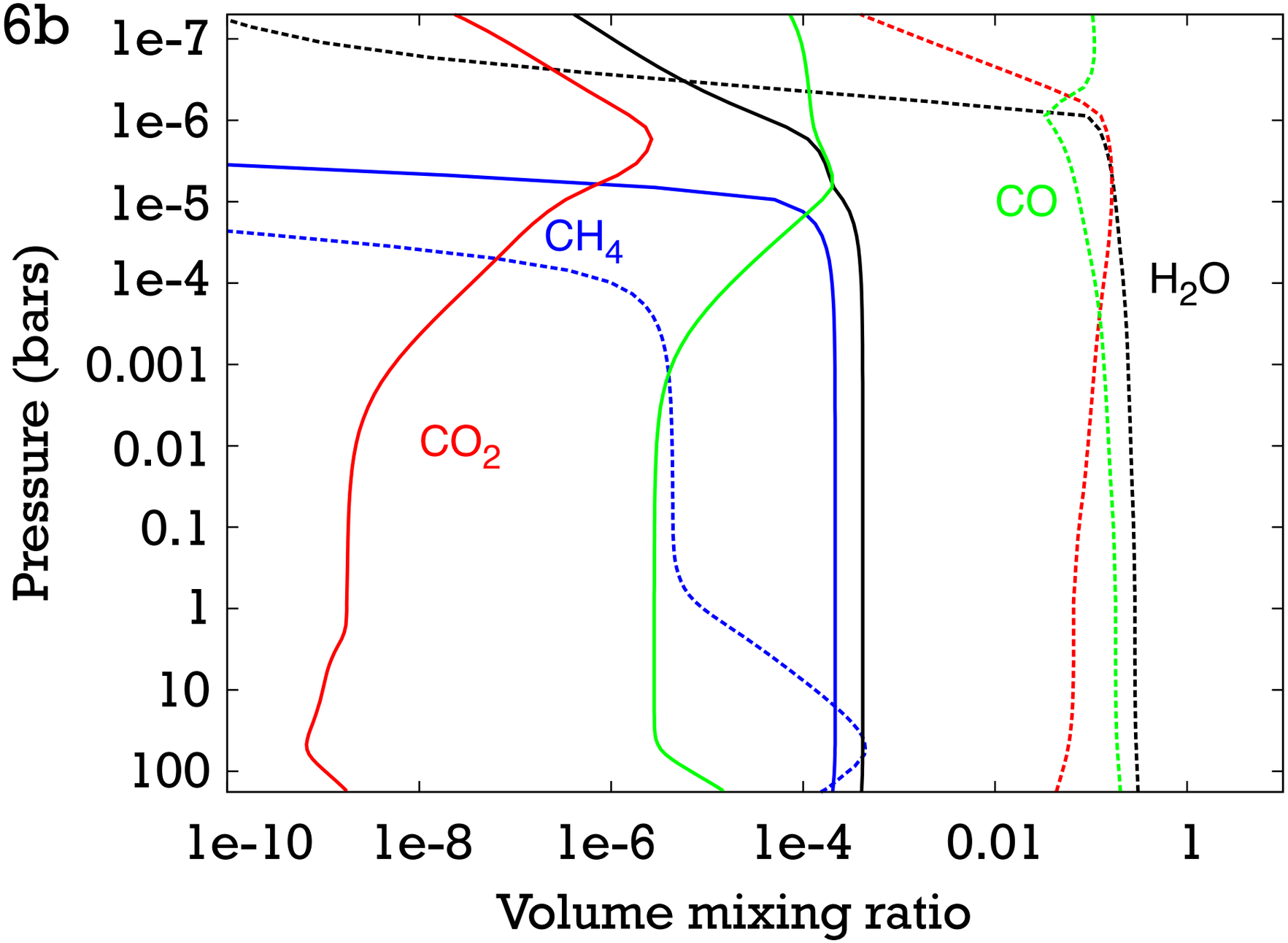


Mini-Neptune Models: synthetic transmission & emergent spectra

GJ 436b



Miguel+2014, Miguel+in prep.
also:
Moses+2013, Agundez+2014

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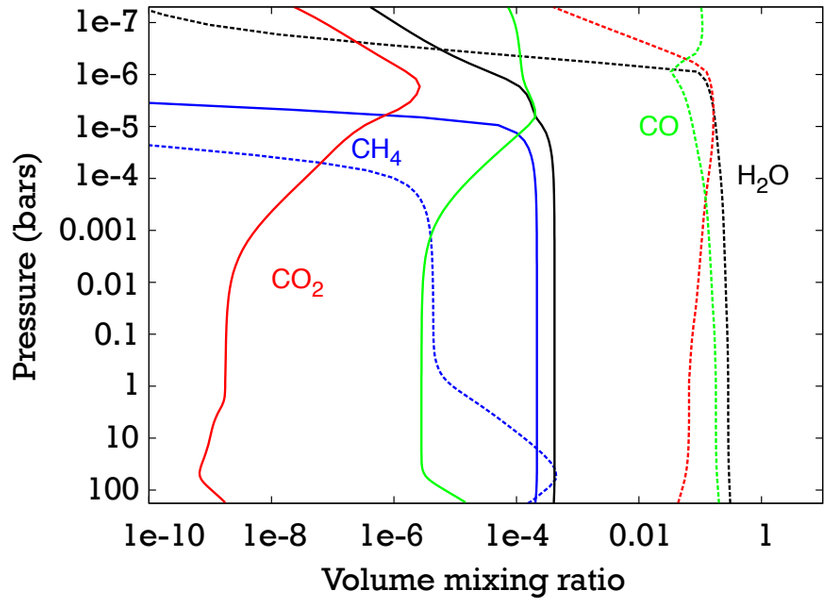

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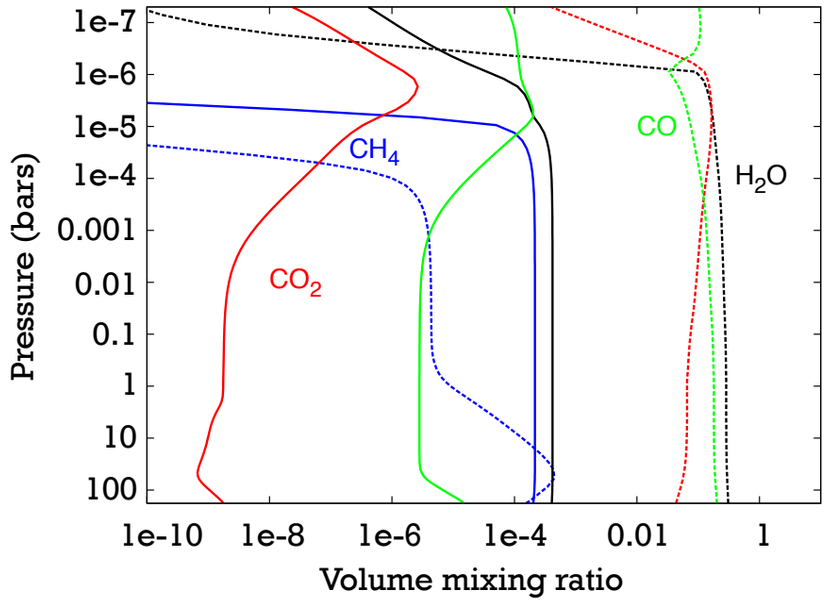

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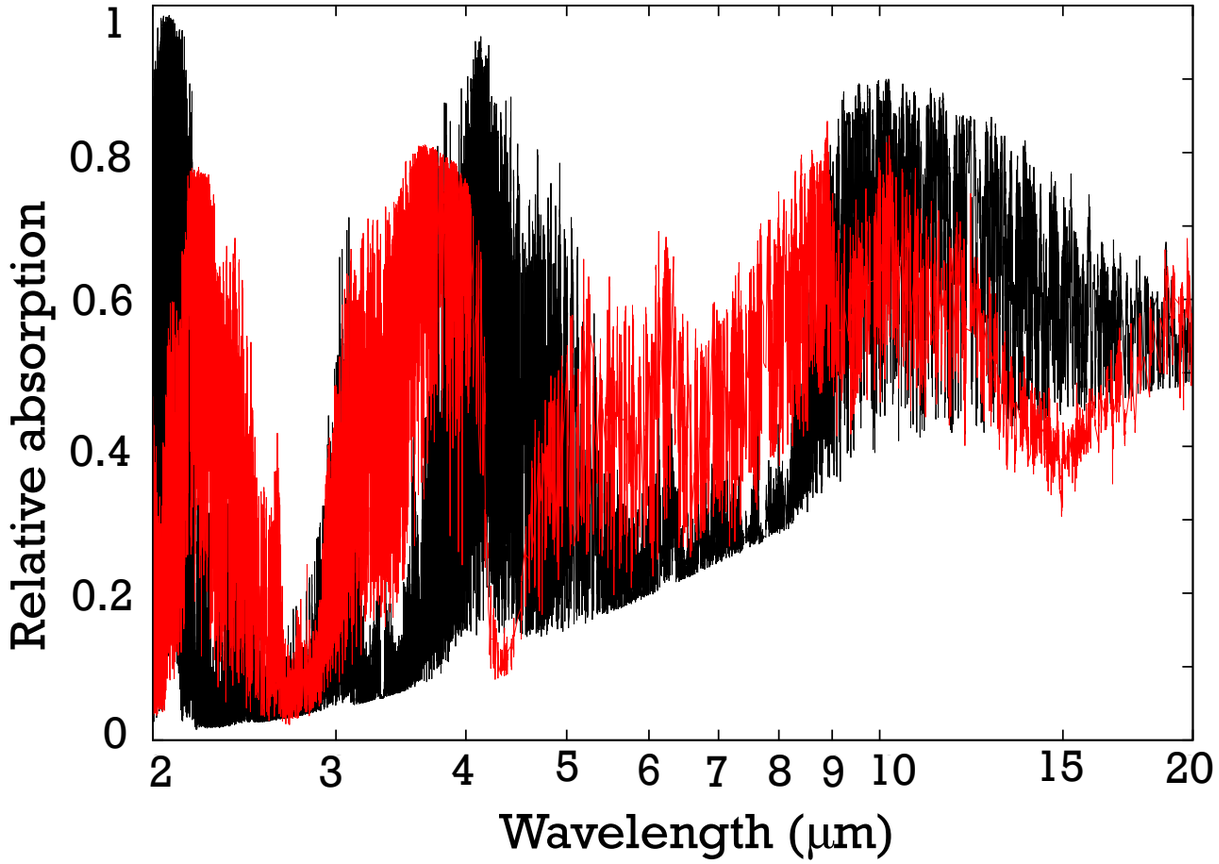
Emergent spectra



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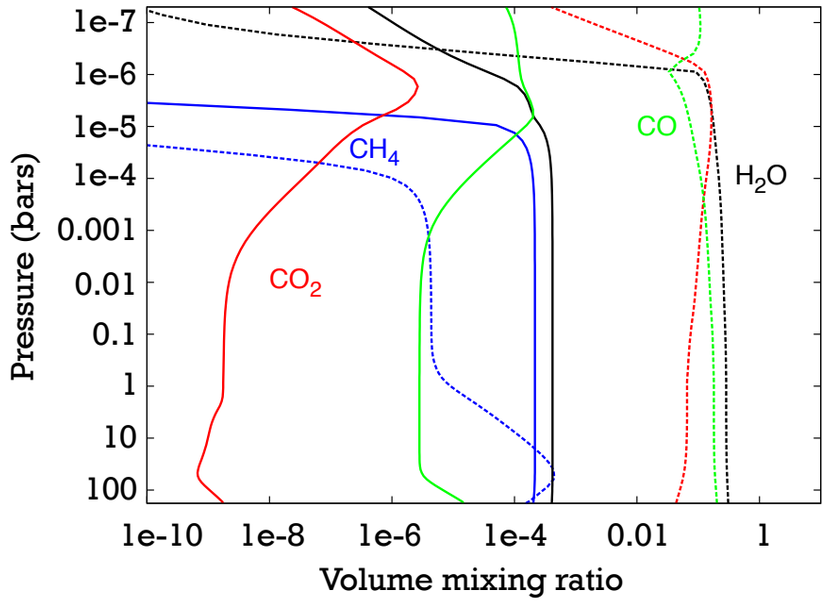

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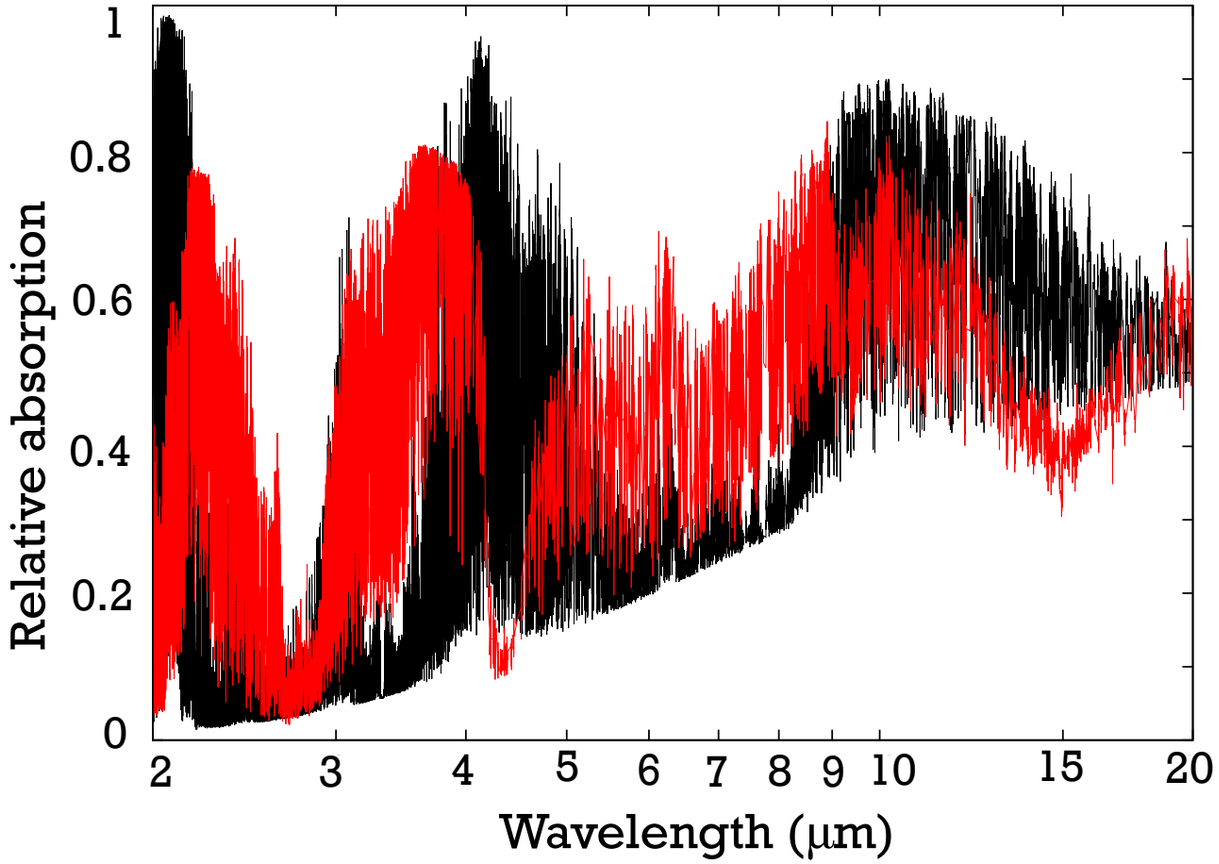
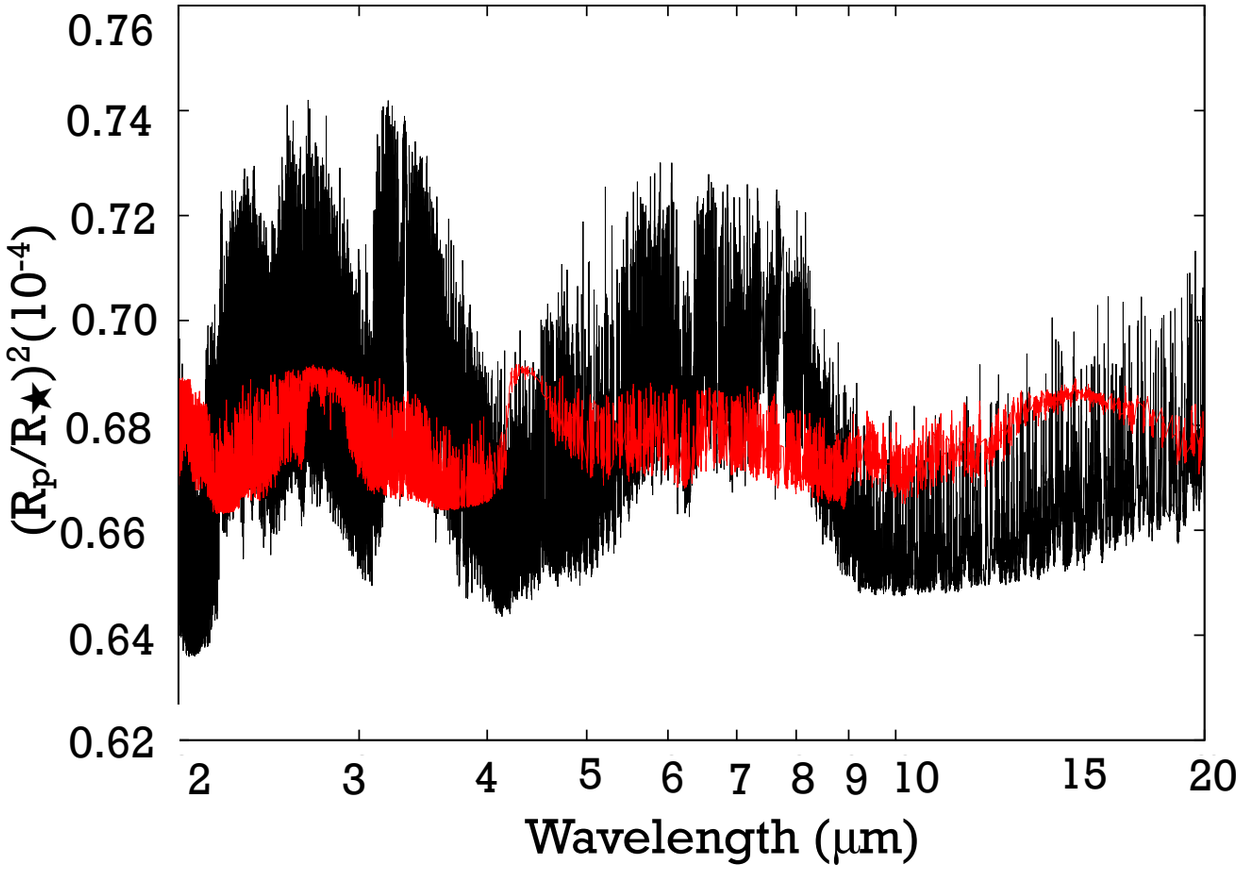


Transmission spectra



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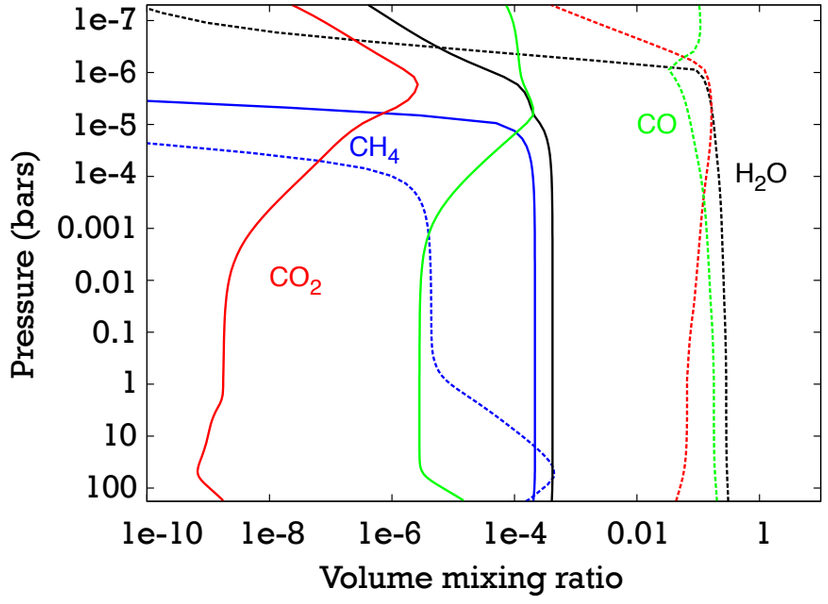

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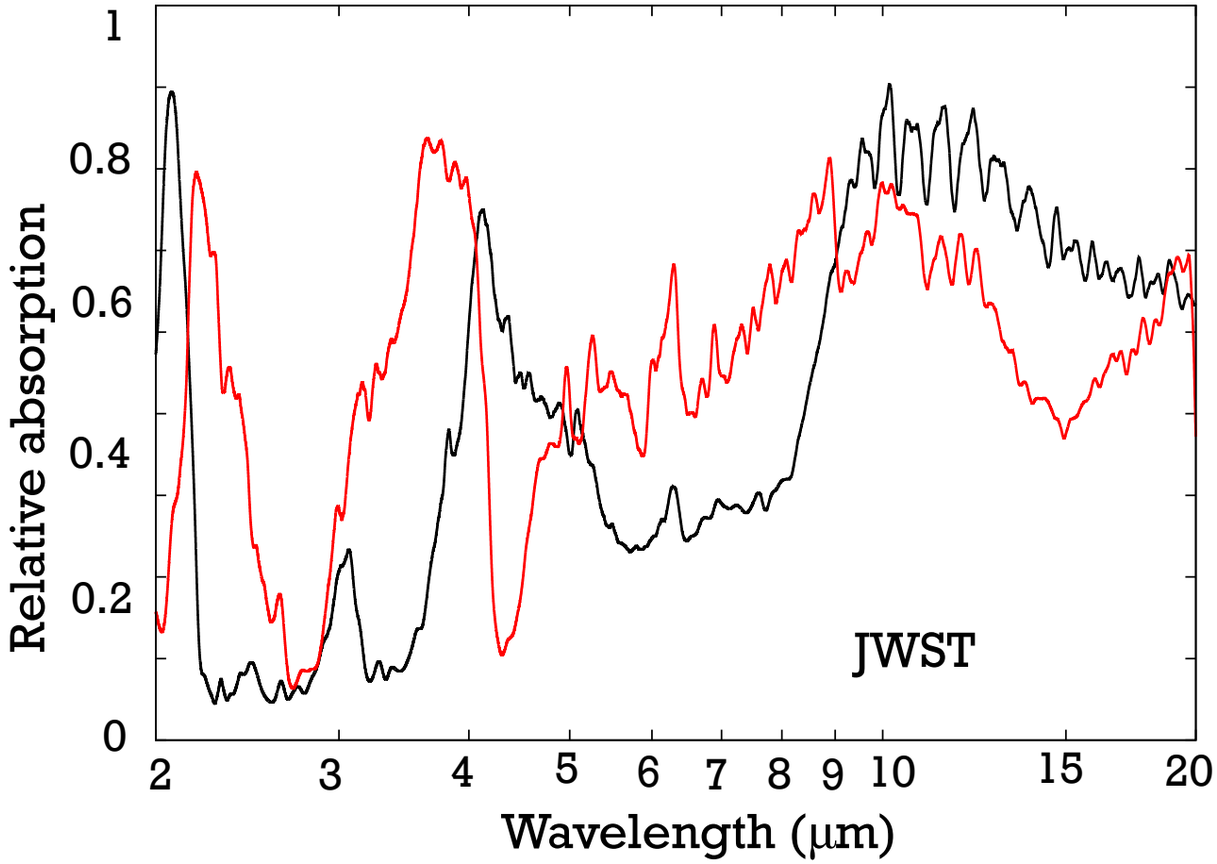

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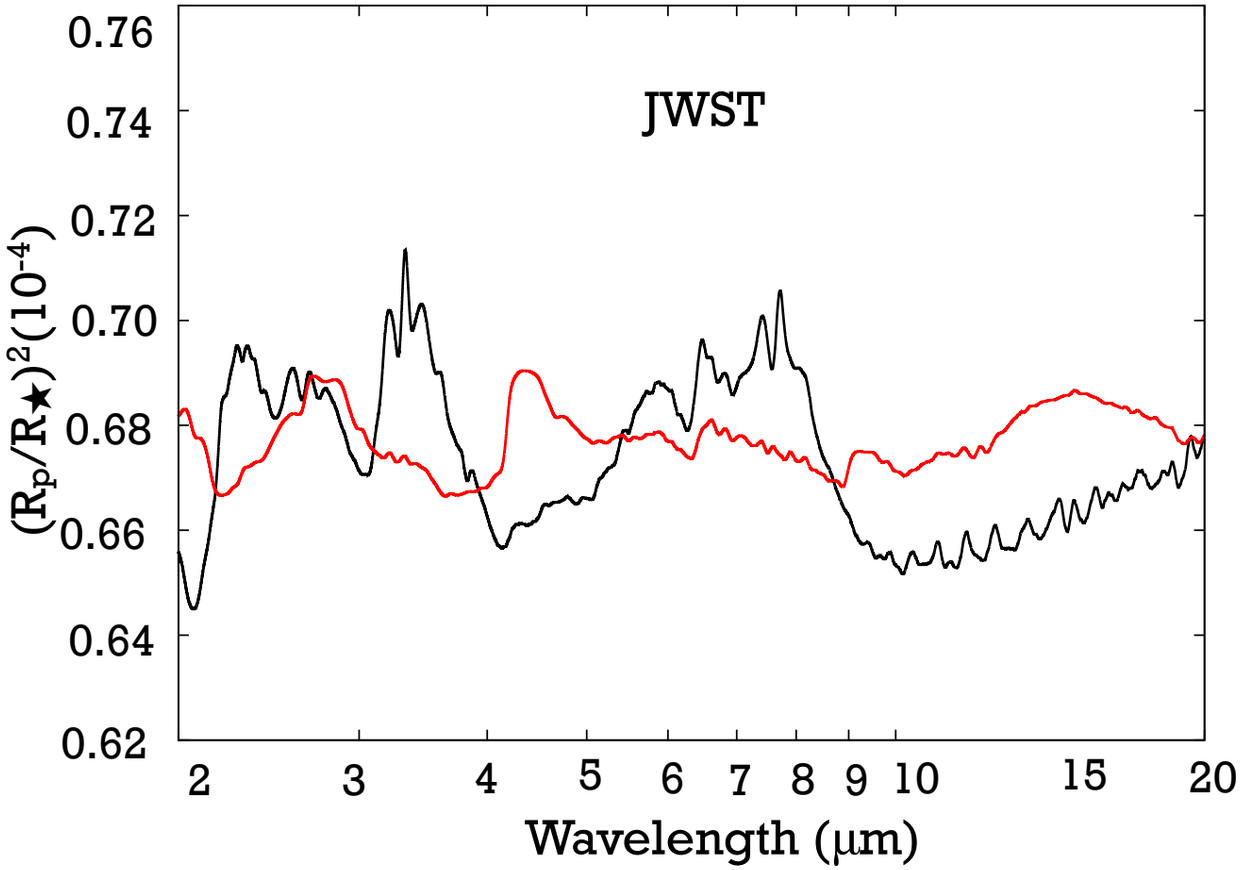

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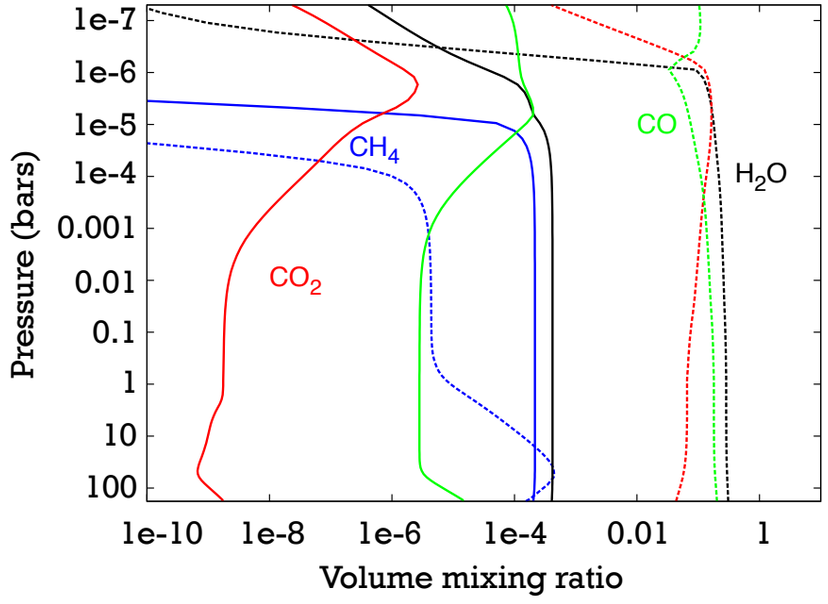

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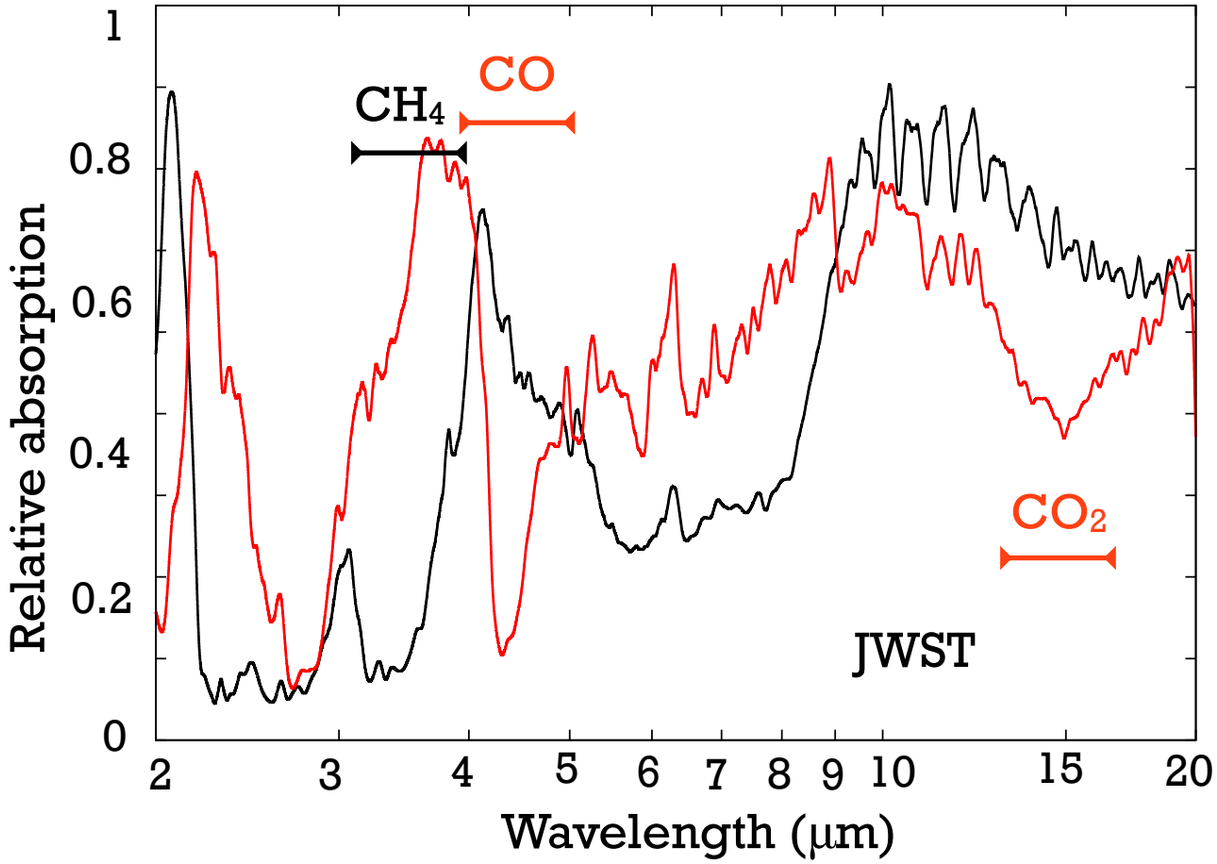

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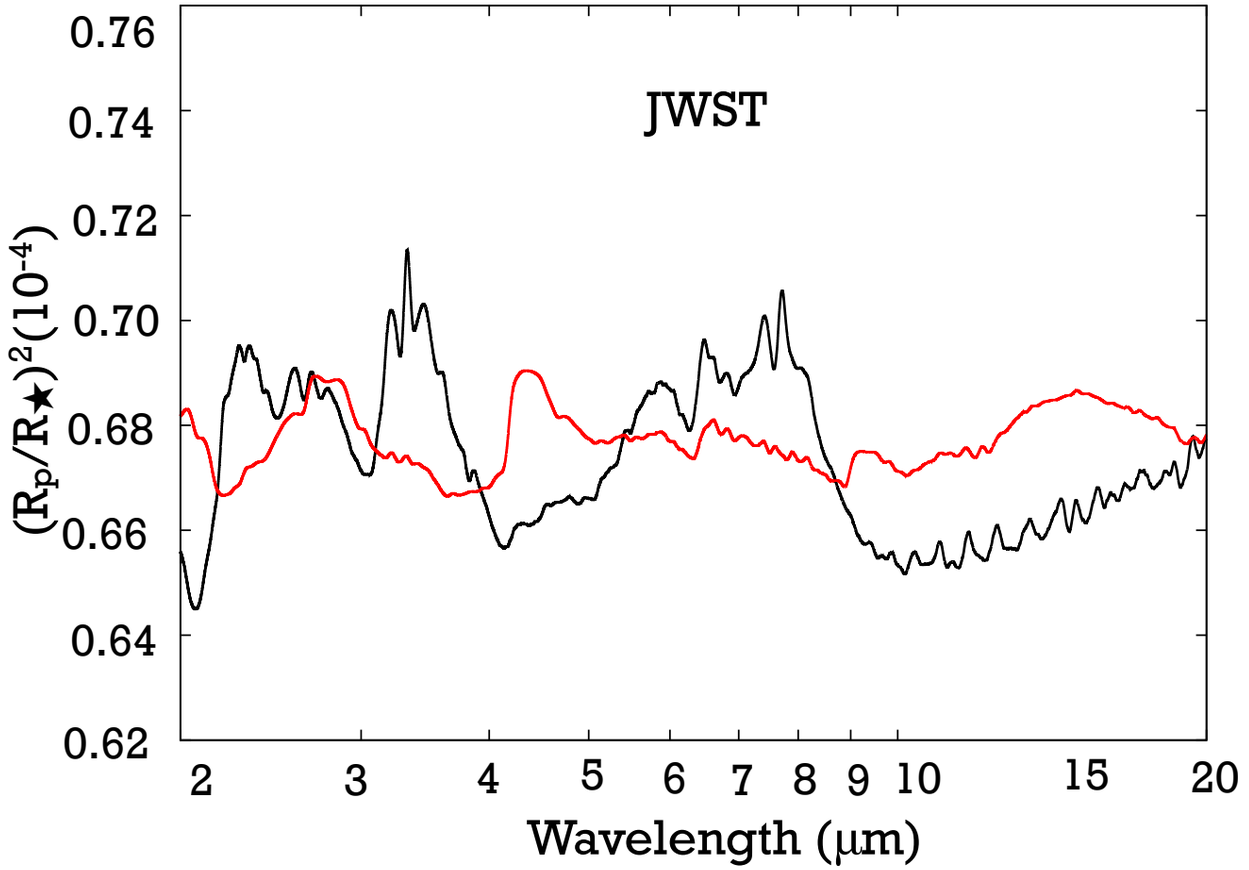

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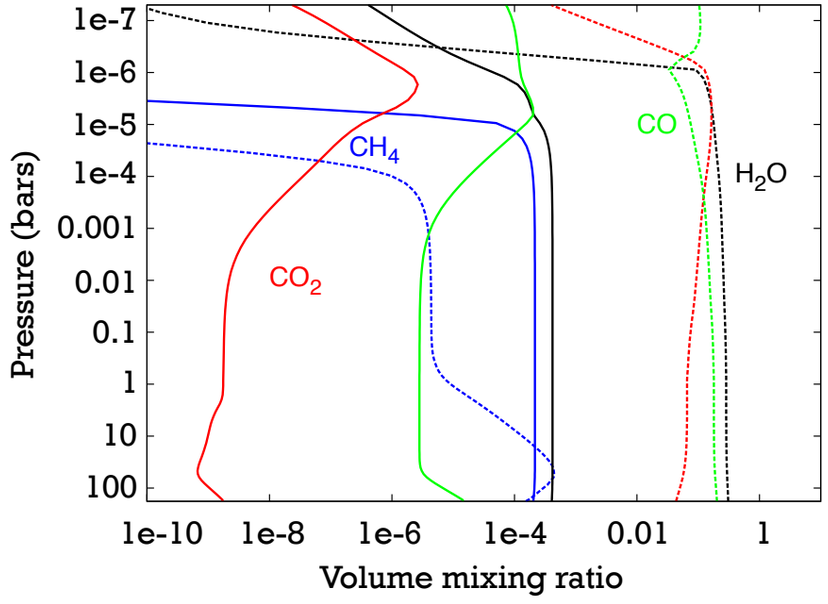

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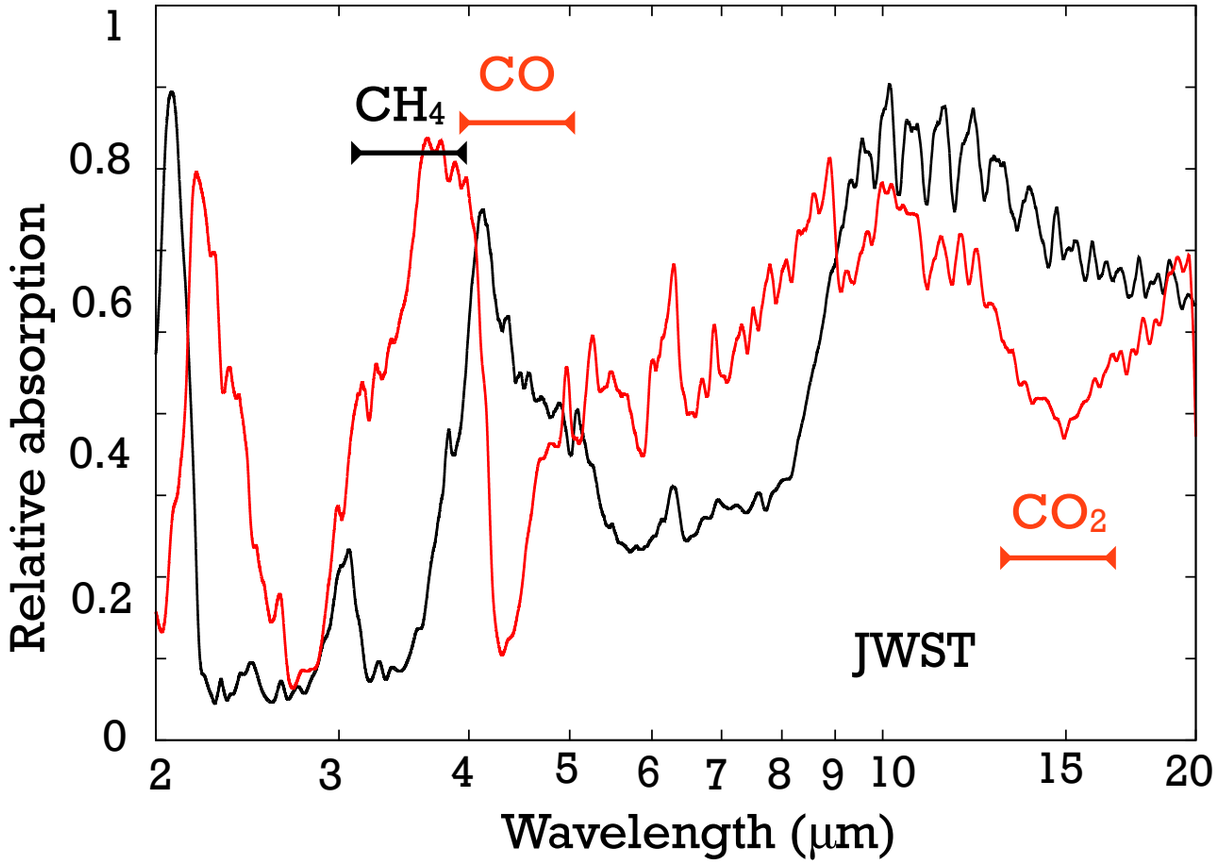

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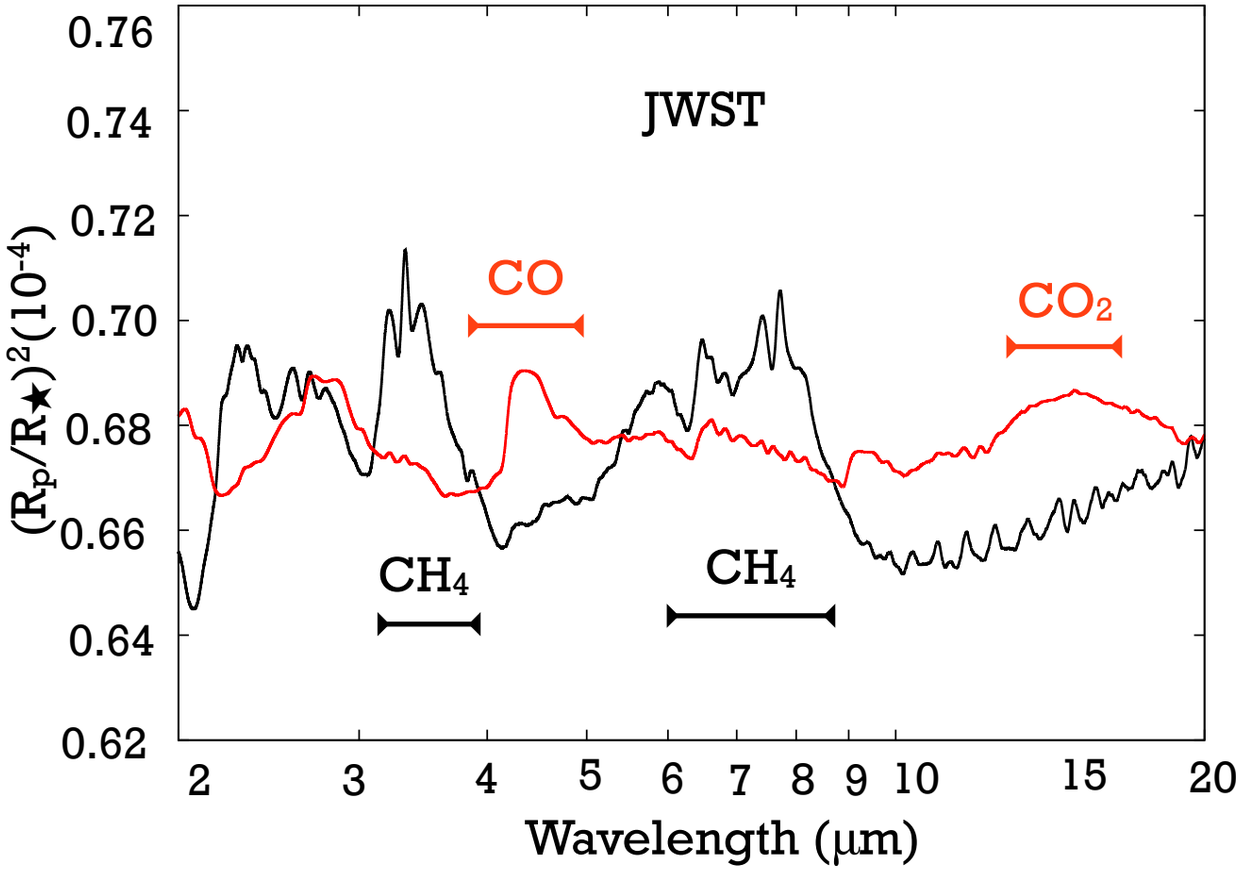
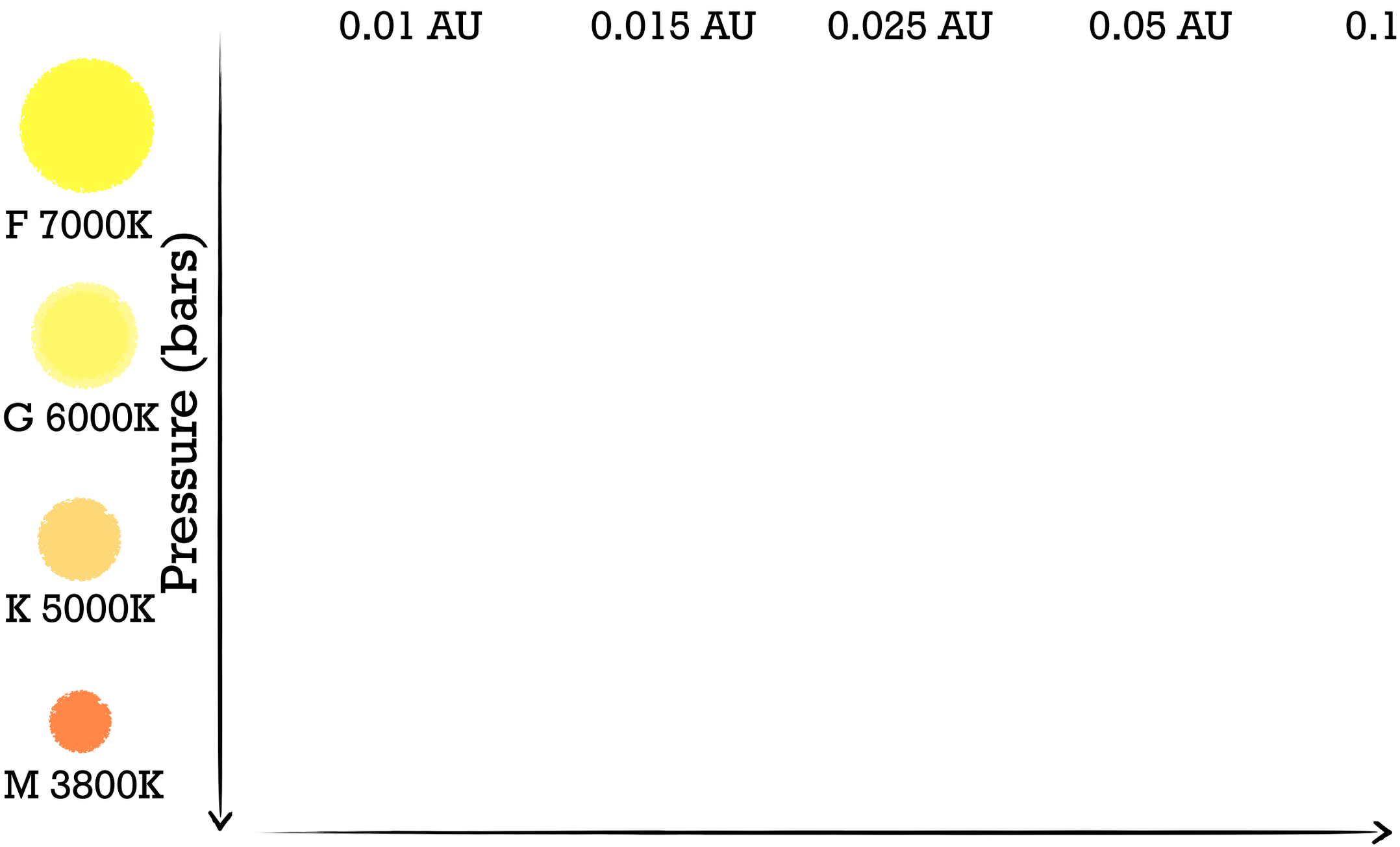


Mini-Neptune Models: photochemistry at ≠ *a* & stellar types



Other photochamical models on EPGs: *Zahnle+2009a,b, Line+2010, 2013, Moses+2011,2012, 2013, Venot+2012, Kopparapu+2012*

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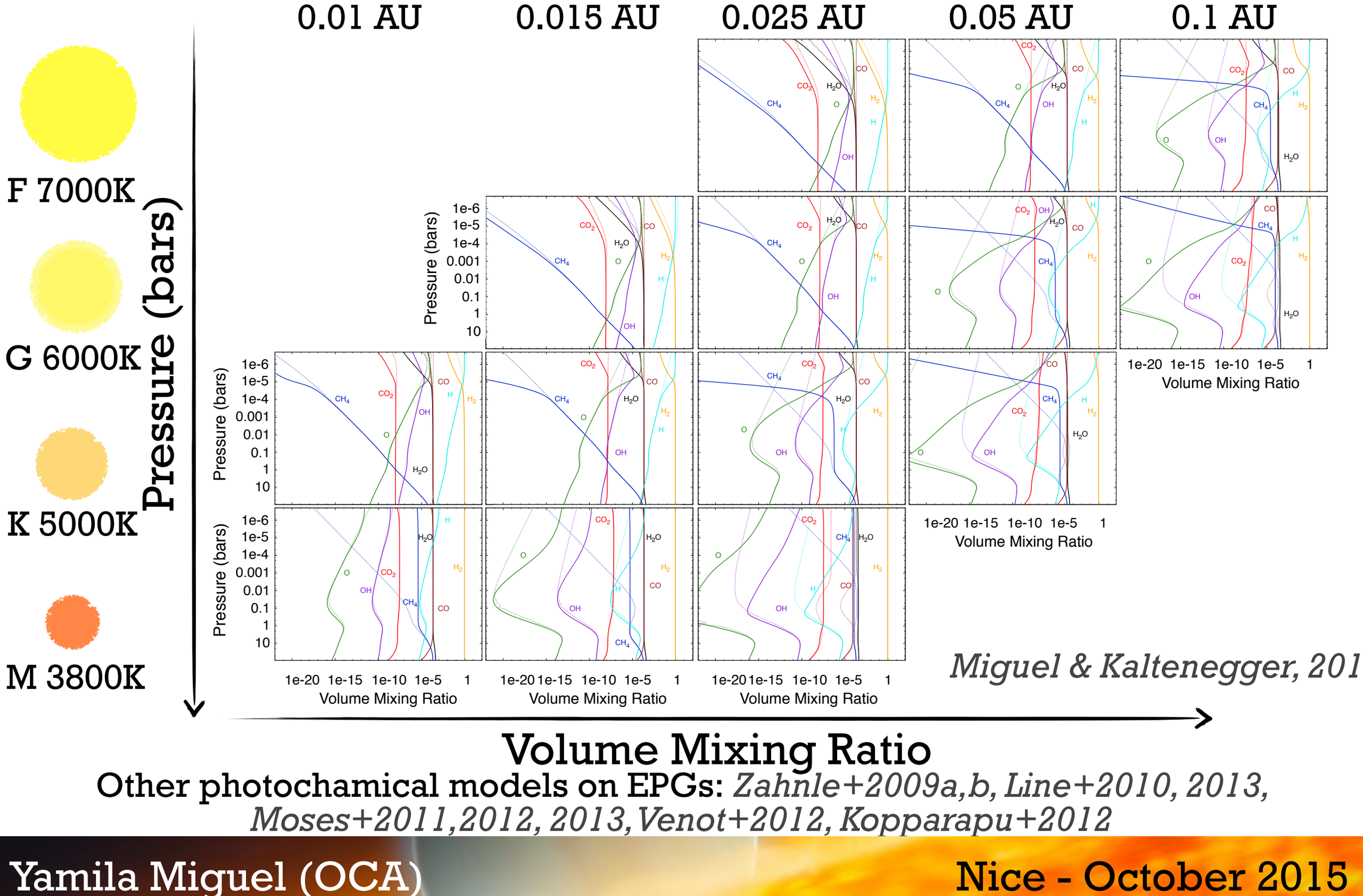

Miguel & Kaltenegger, 2014

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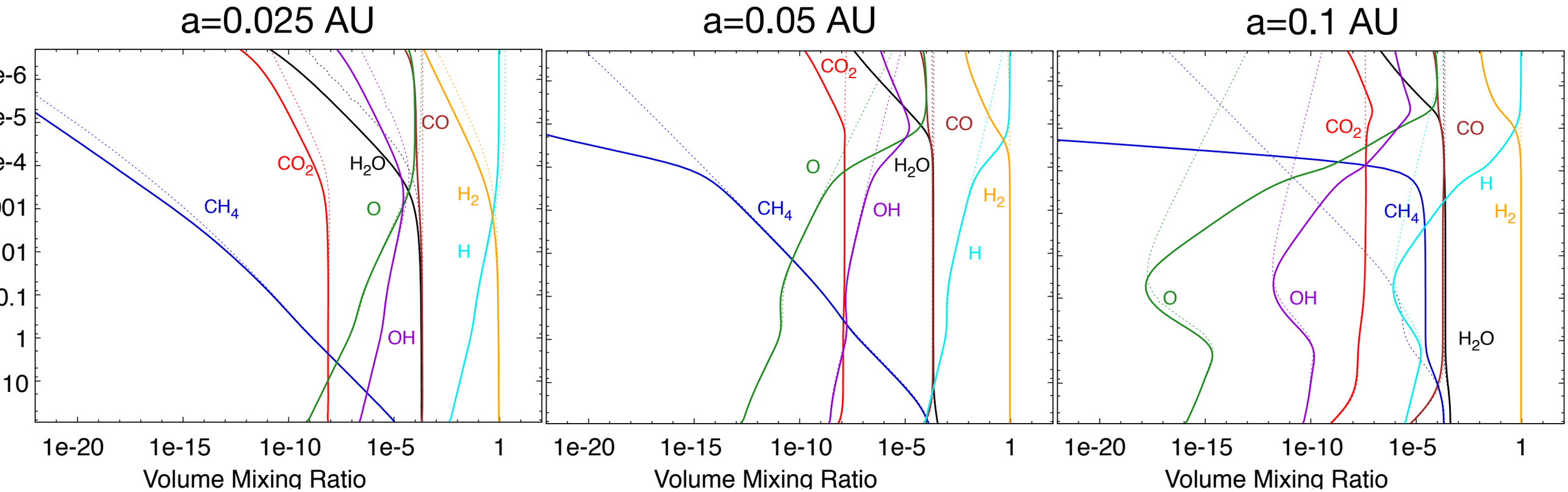
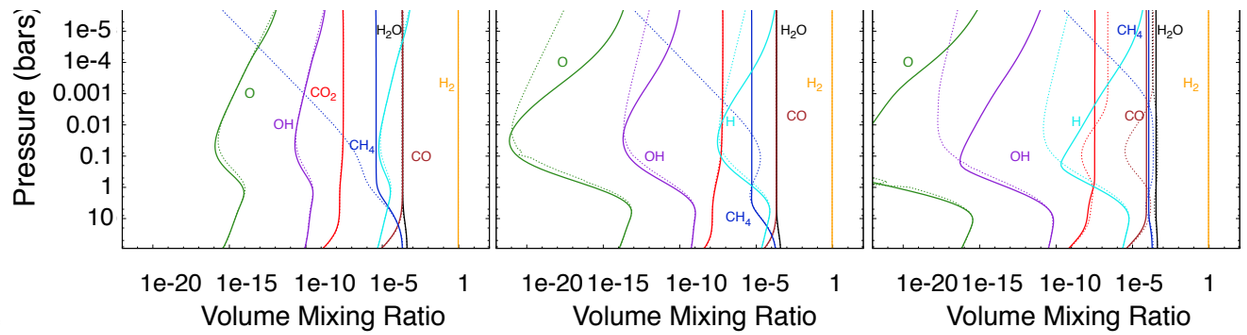


K 3000K

M 3800K



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Volume Mixing Ratio

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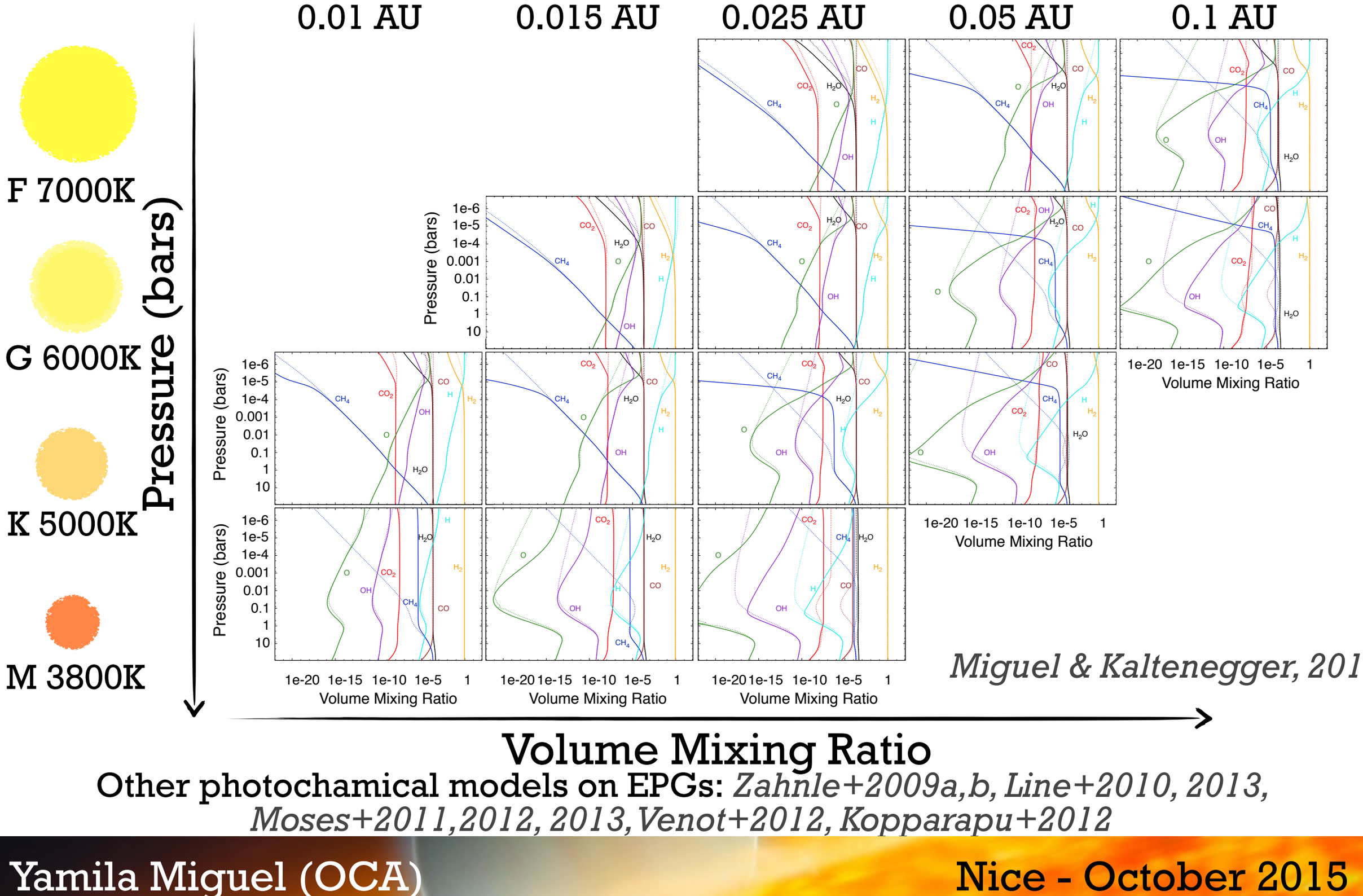

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Mini-Neptune Mo photochemistry a

0.01 AU

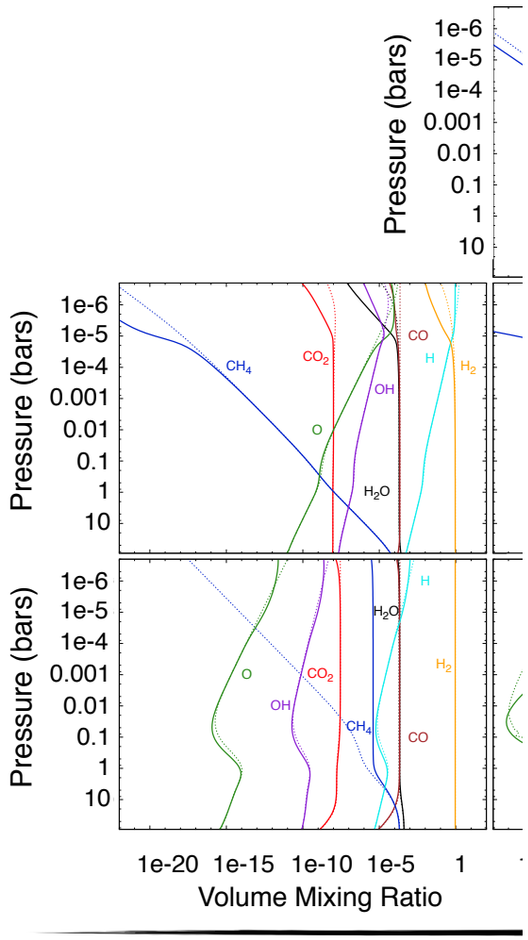
F 7000K

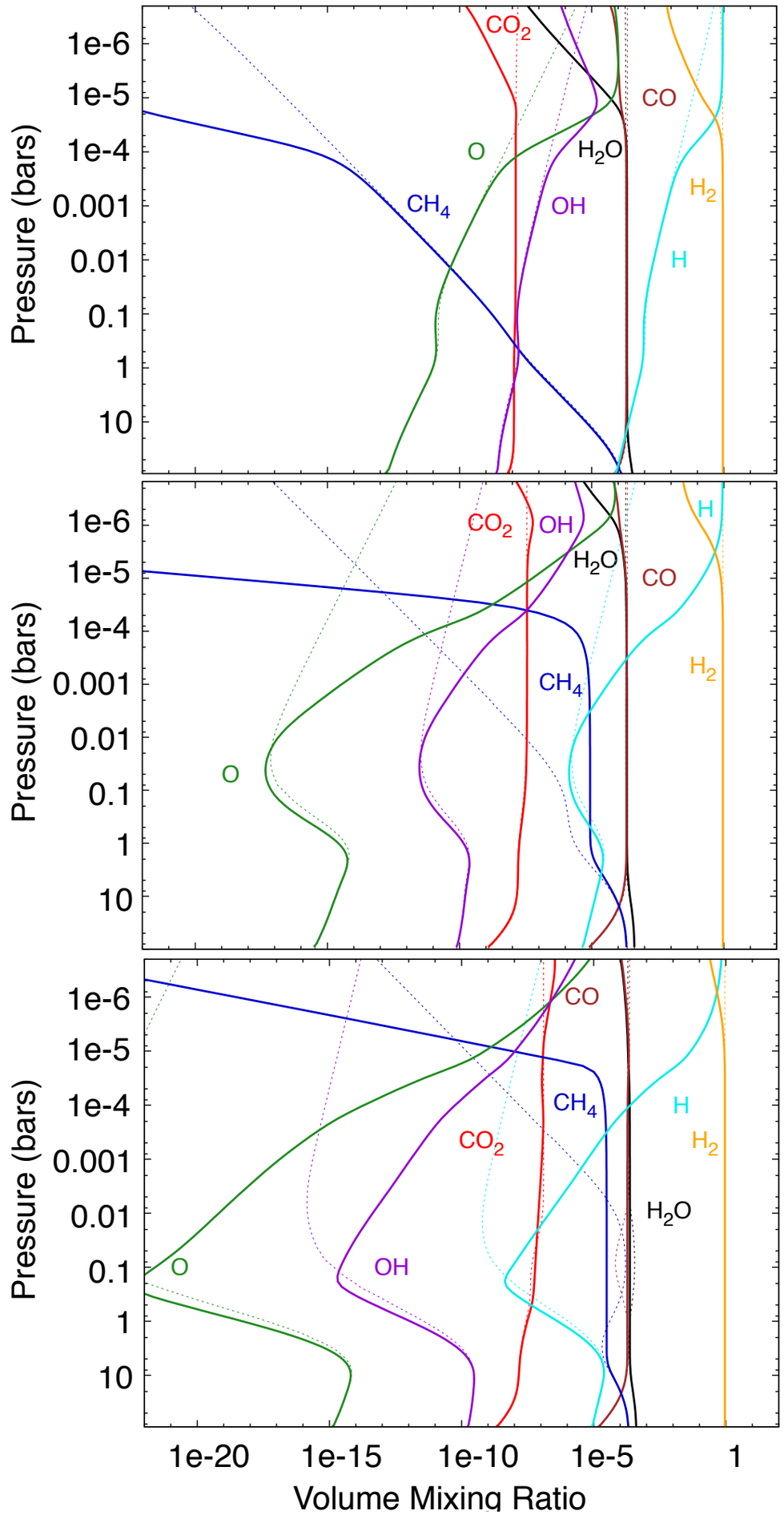
G 6000K

K 5000K

M 3800K

Pressure (bars)





AU

Other photochamical mo

Moses+2011,20

gger, 2014

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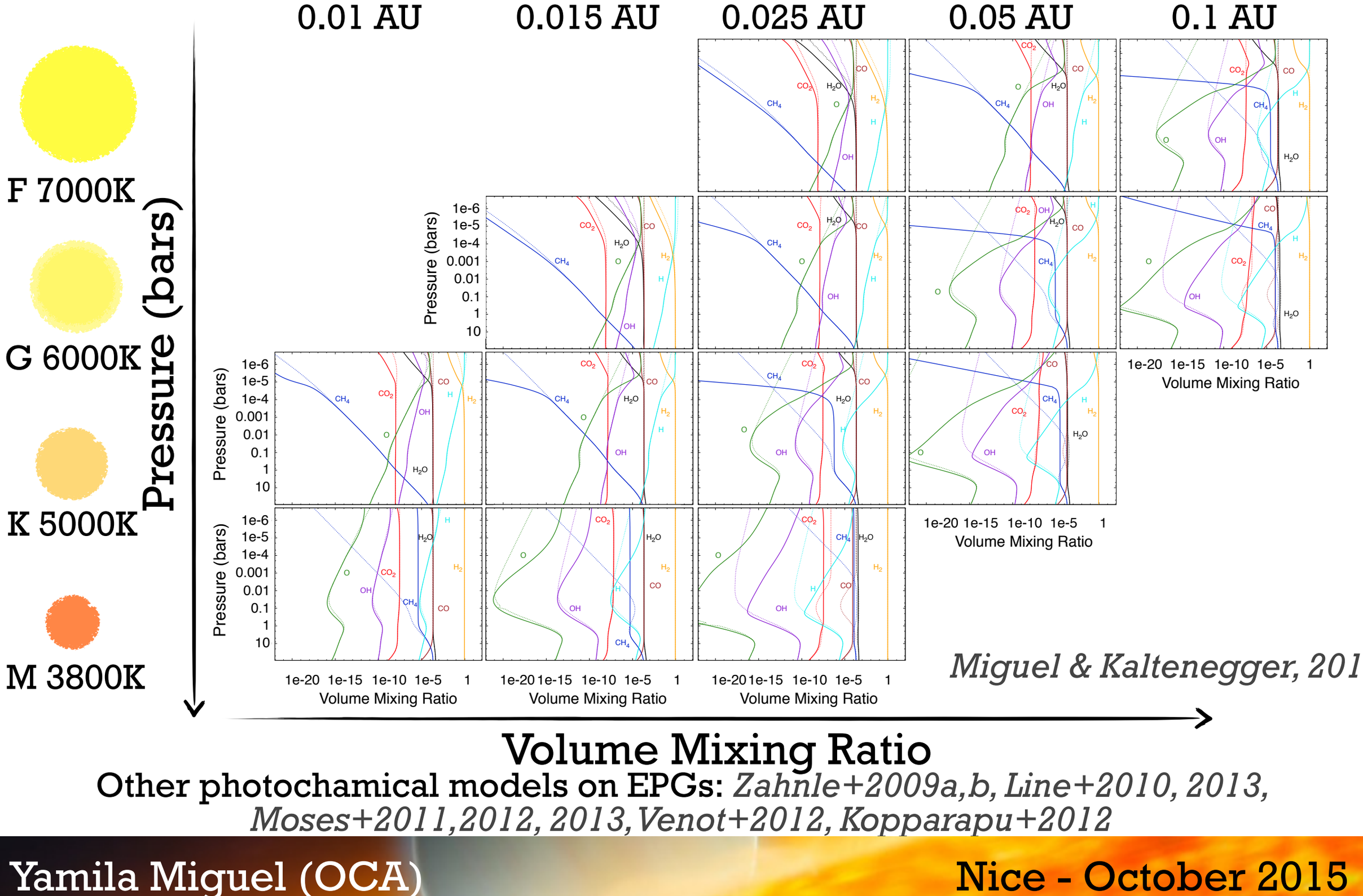
Yamila Miguel (OCA)

r 2015

Mini-Neptune Models: photochemistry at ≠ *a* & stellar types



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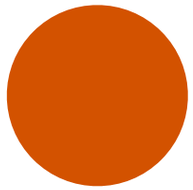
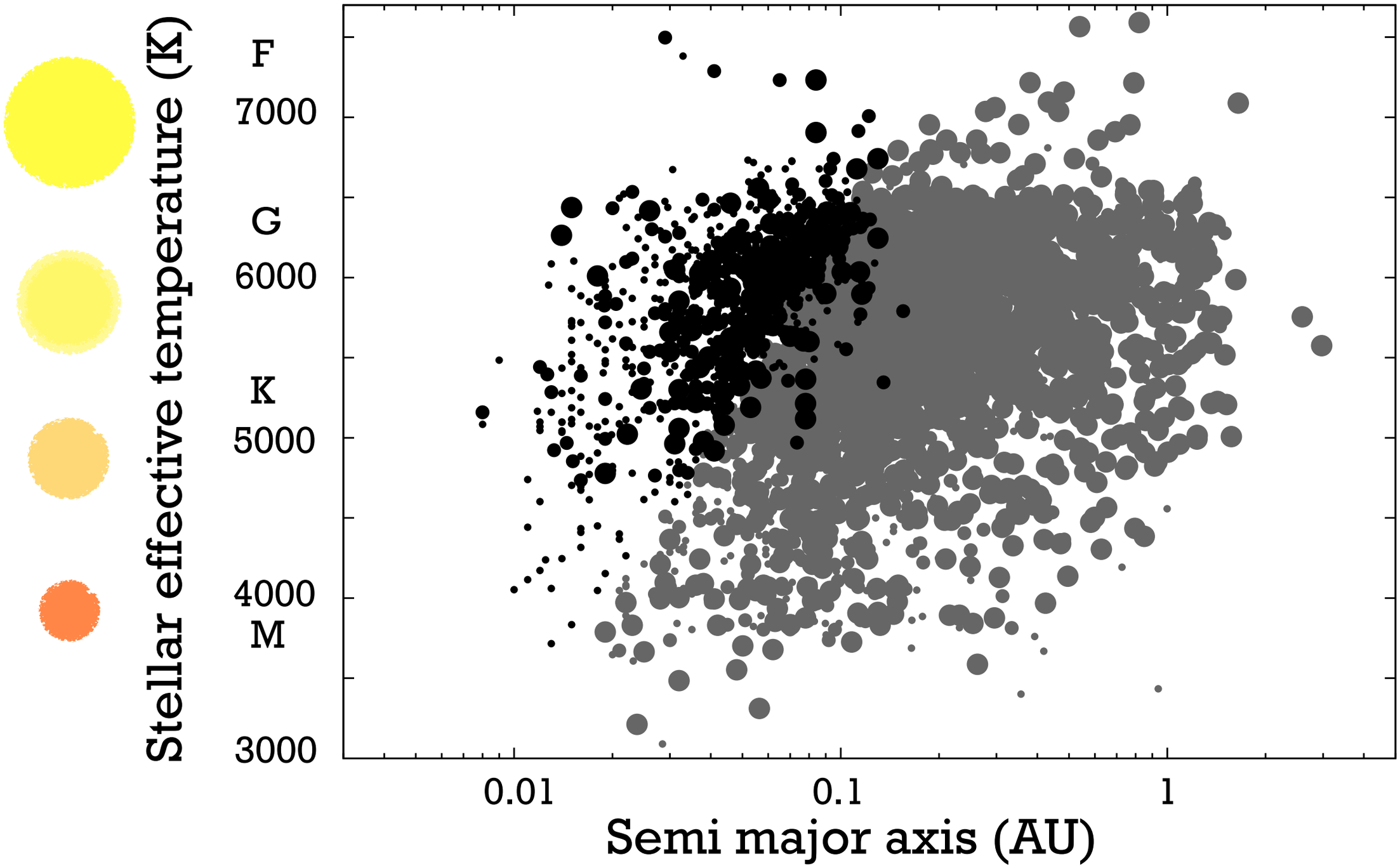


Motivation: Hot rocky Kepler candidates



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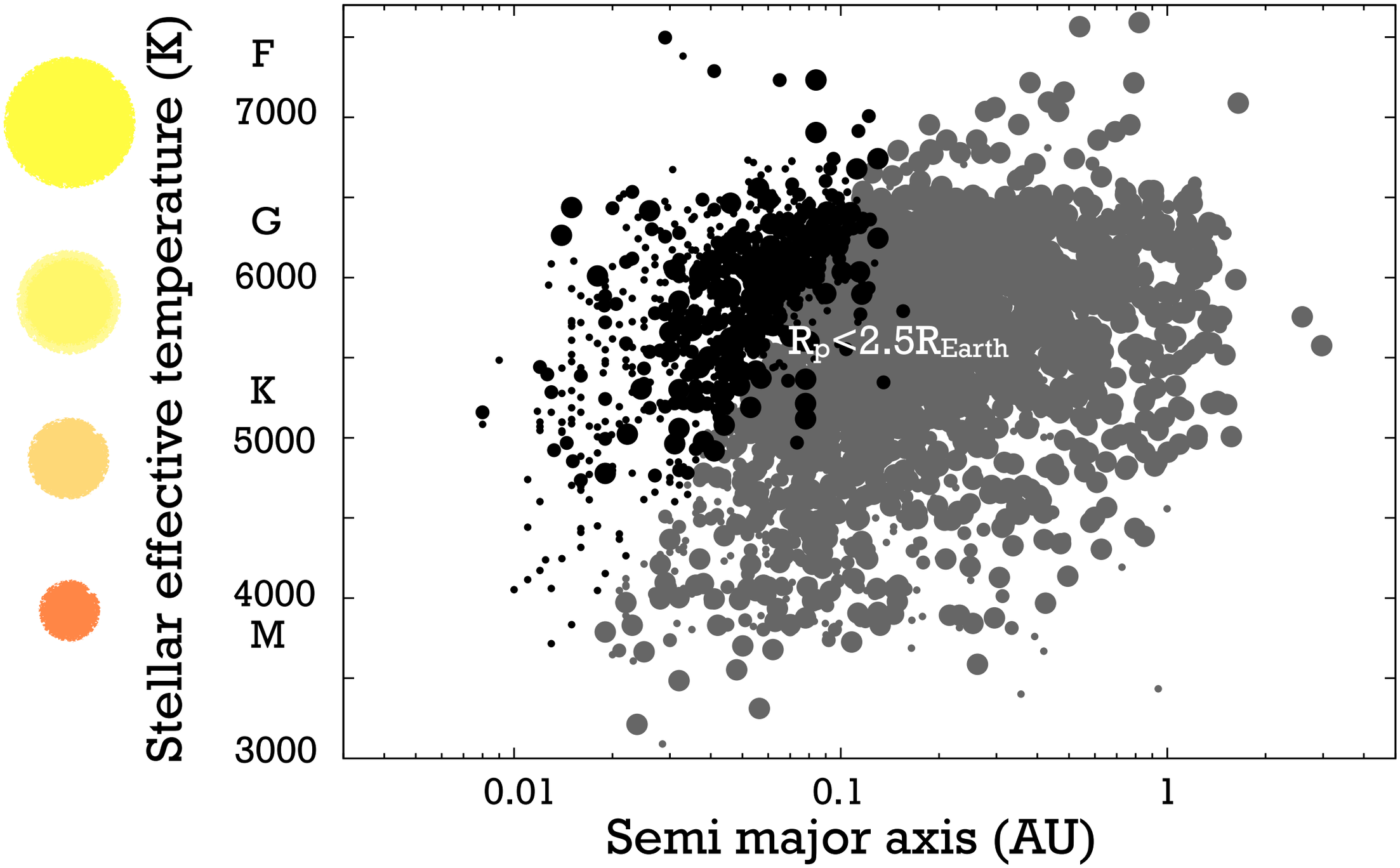

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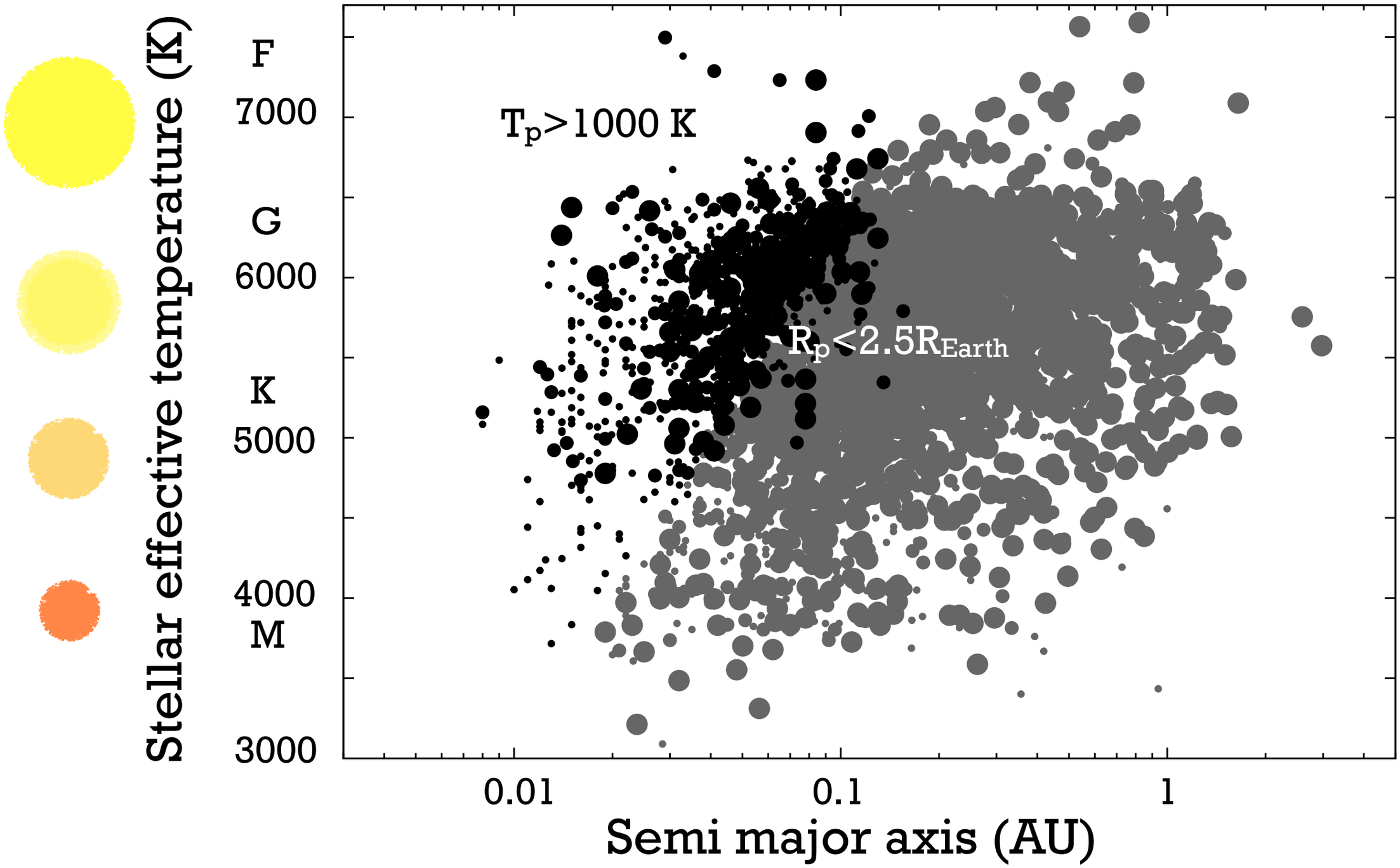

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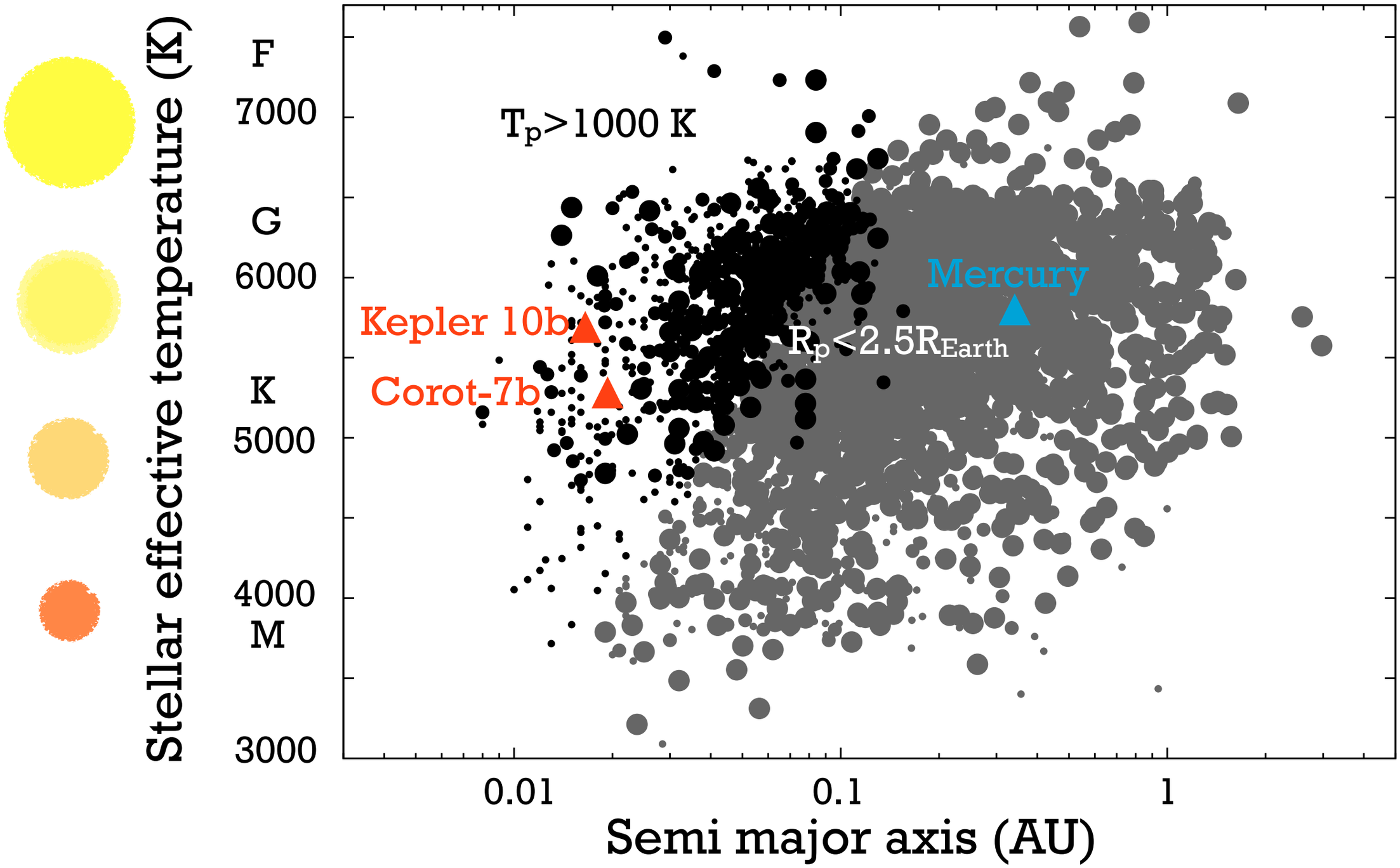

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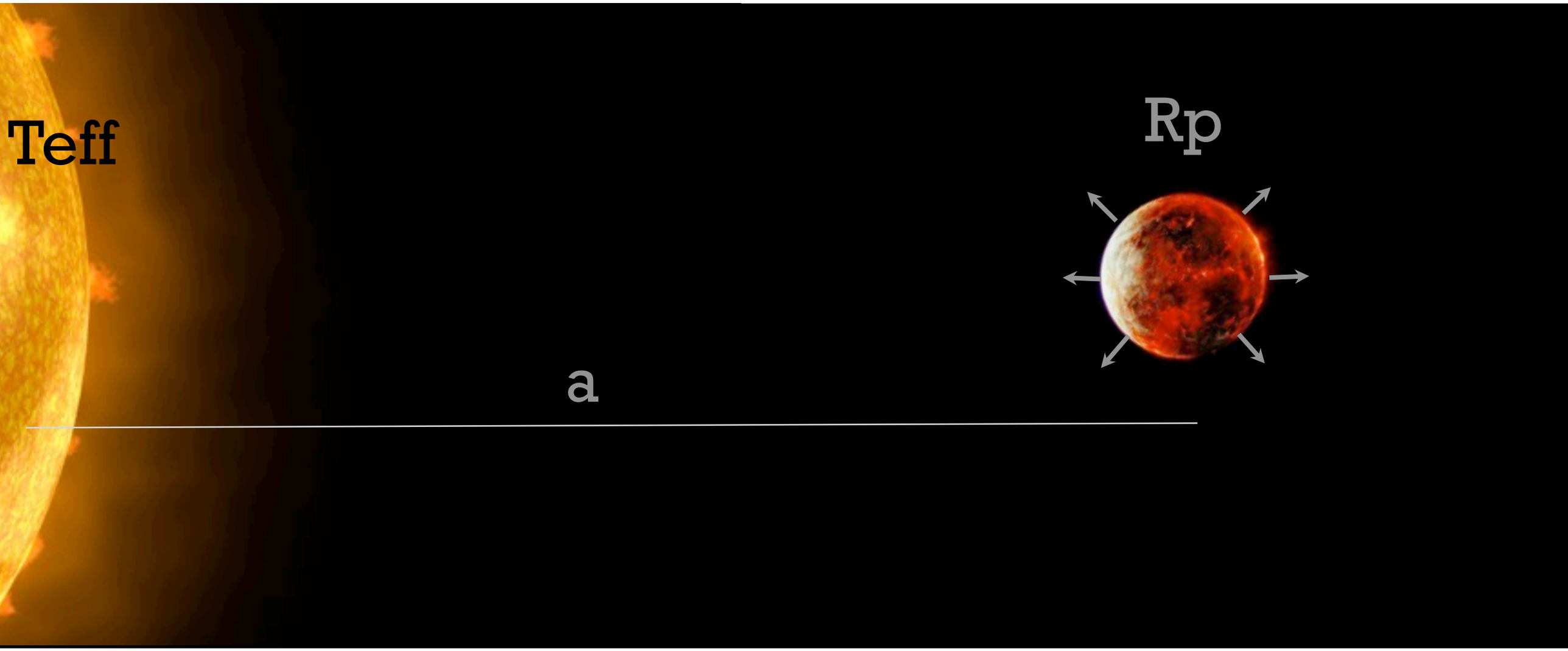
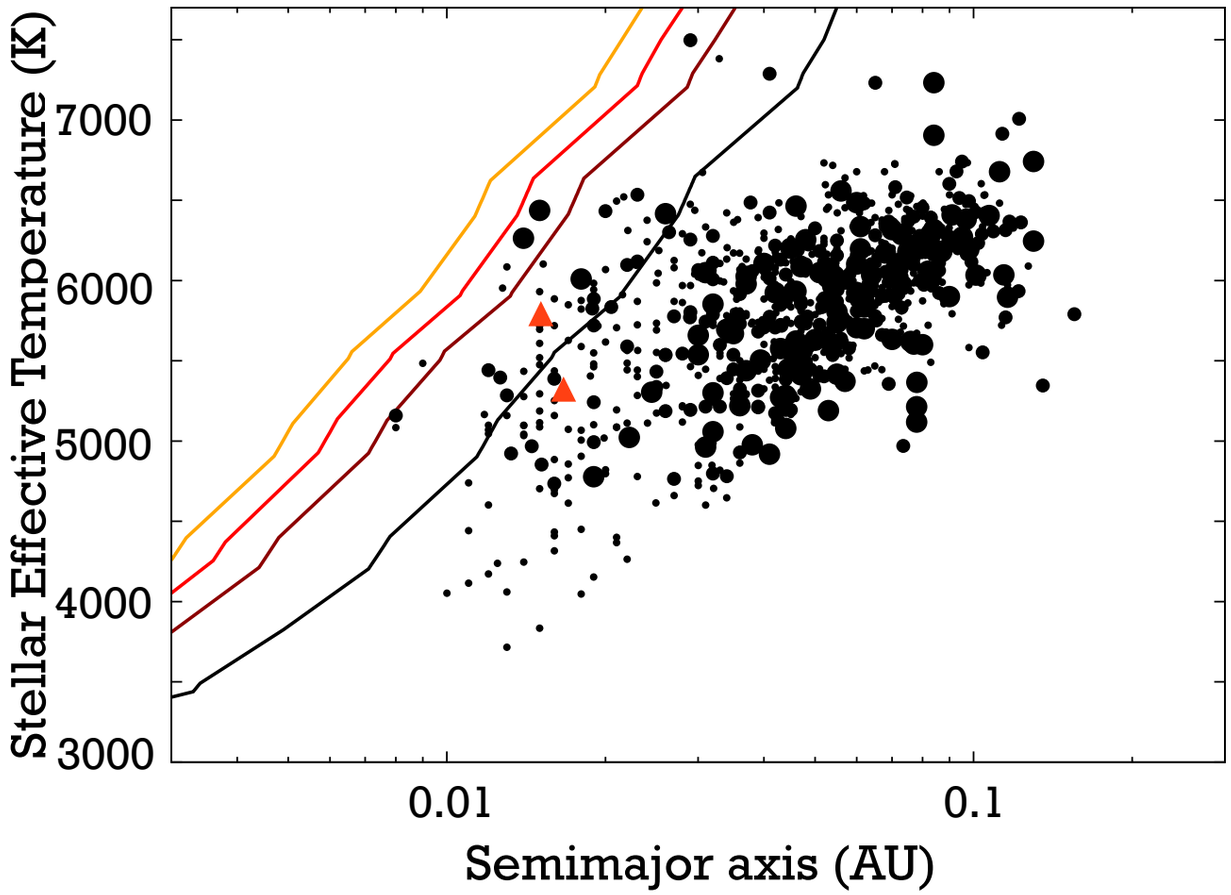


Hot rocky exoplanet's have silicates atmospheres!



Miguel+ 2011 - updated 2014

see also Schaefer & Fegley 2009

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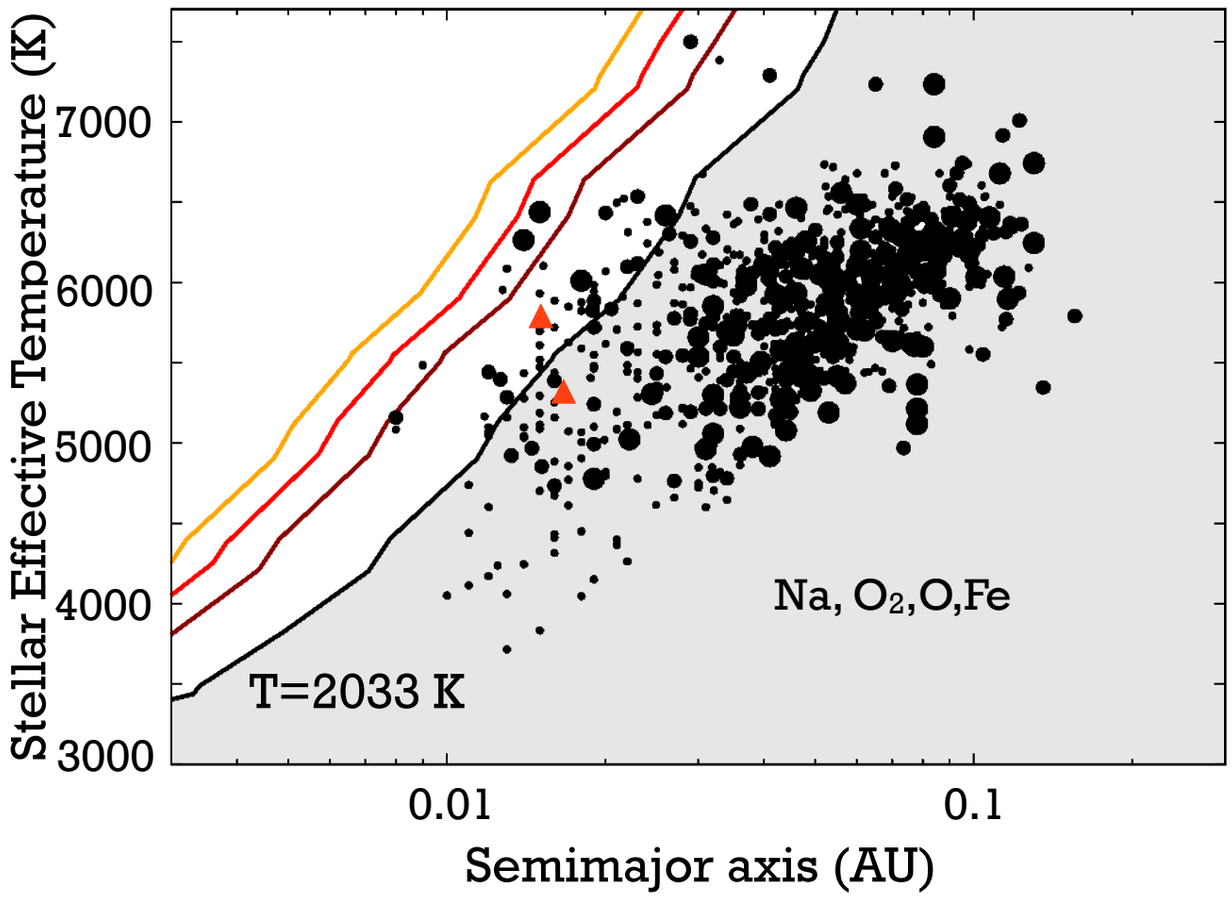

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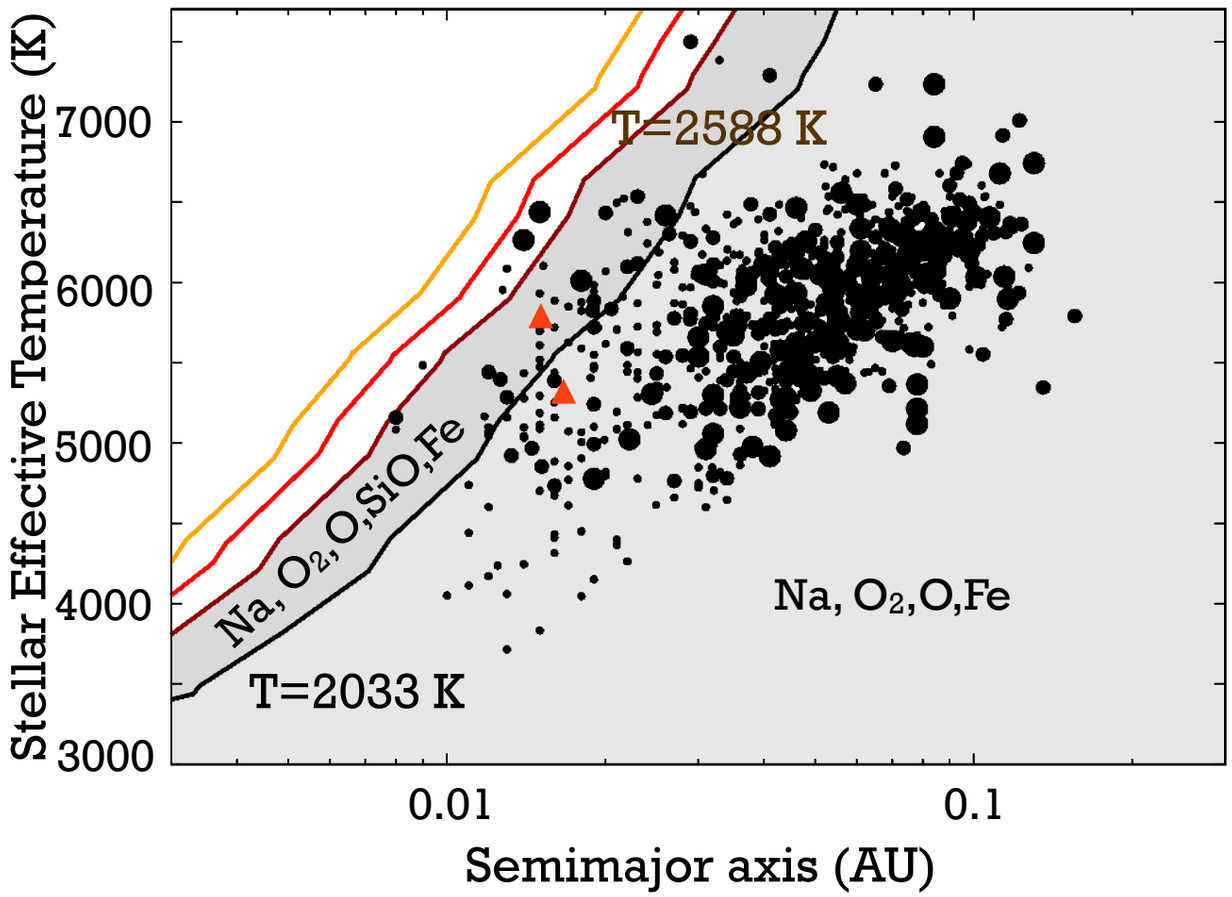

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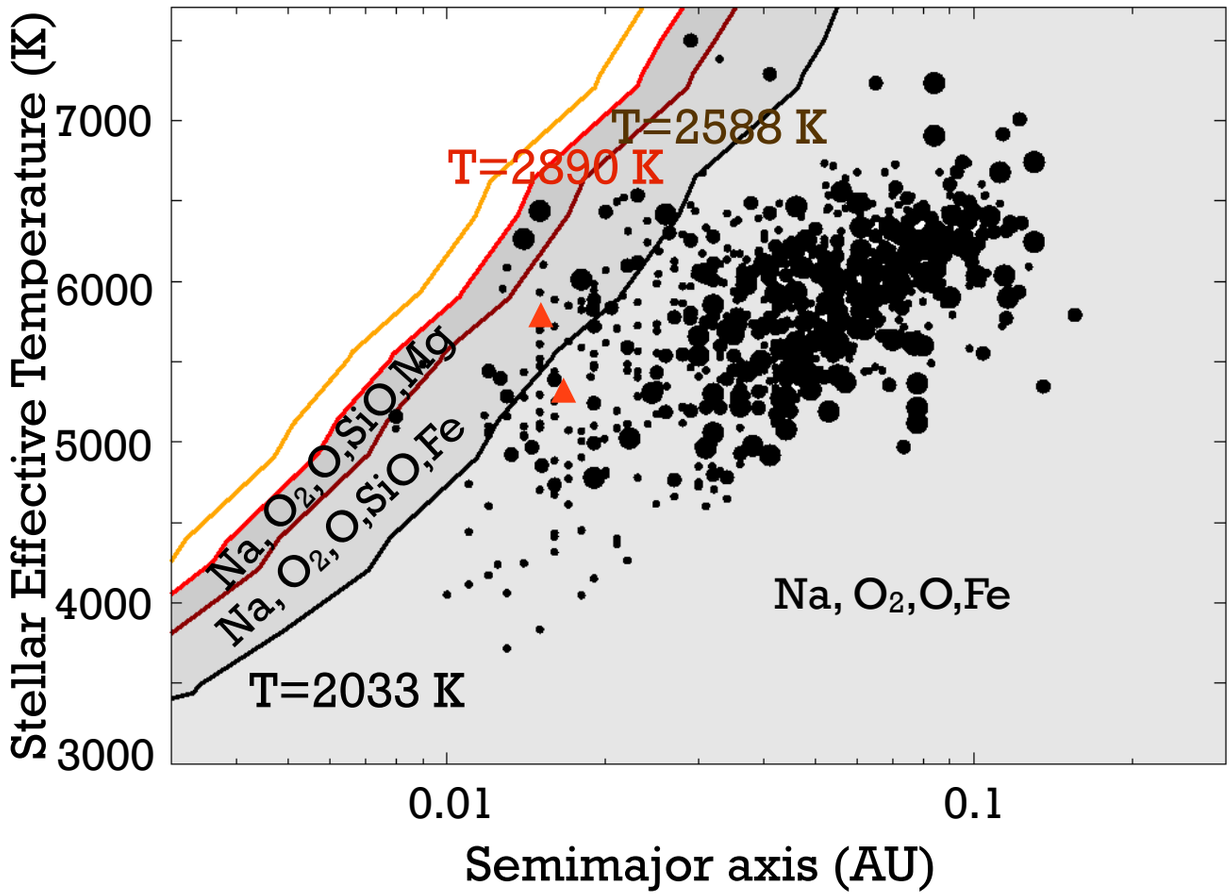

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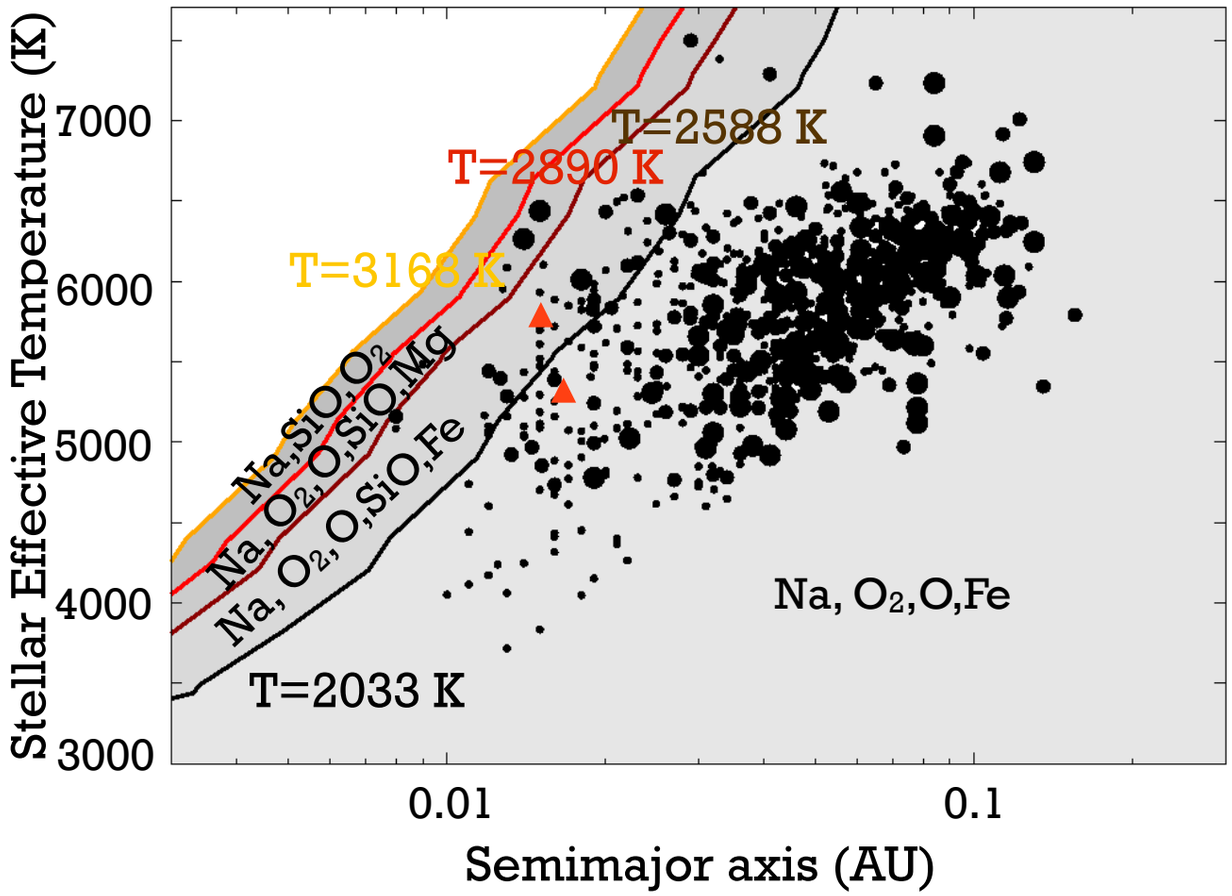

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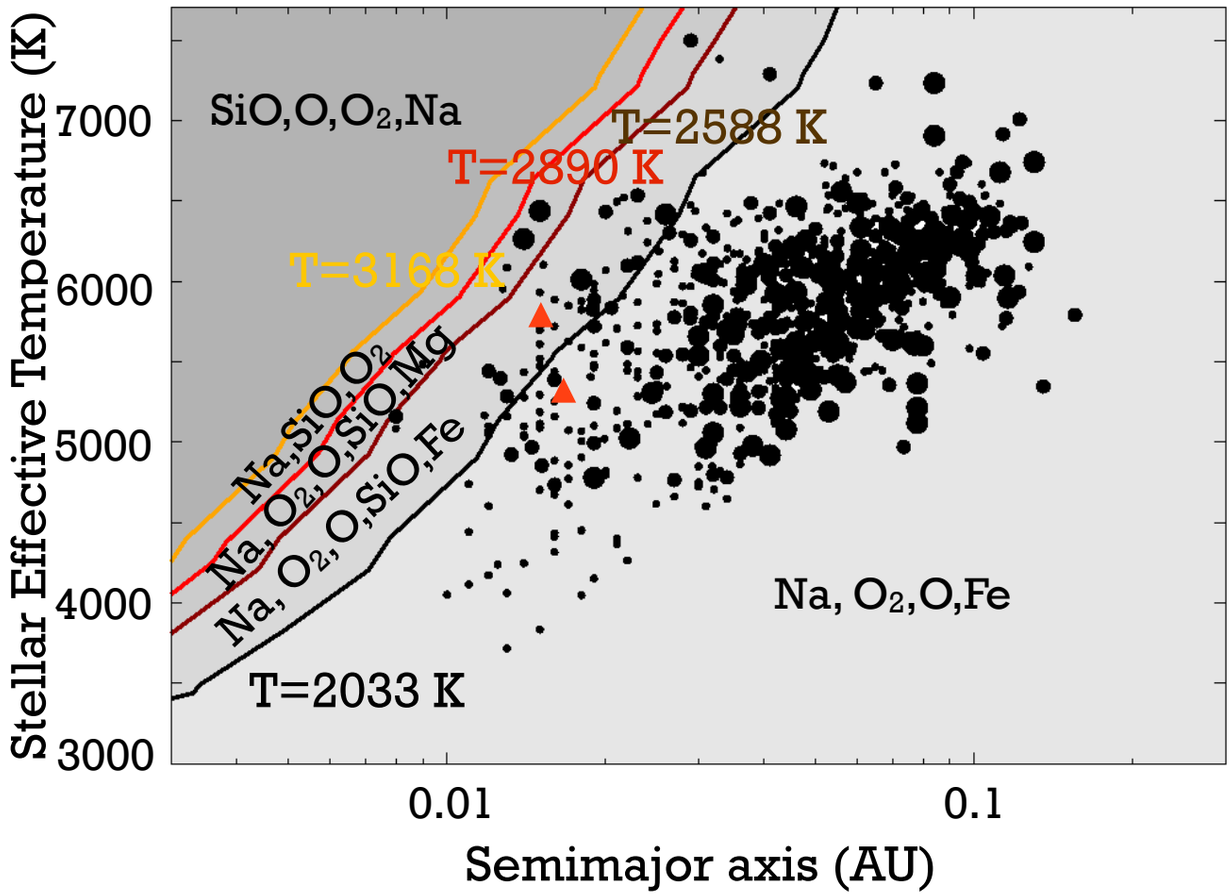

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Interior from atmospheric data

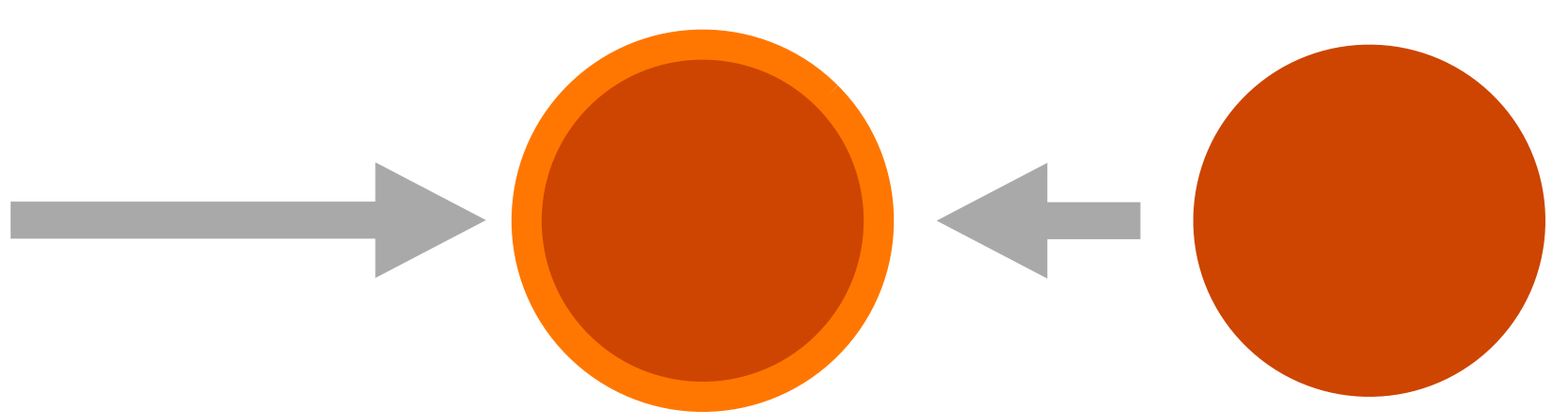
Observables (a, R_p, $T_{\star eff}$)

Interior from atmospheric data

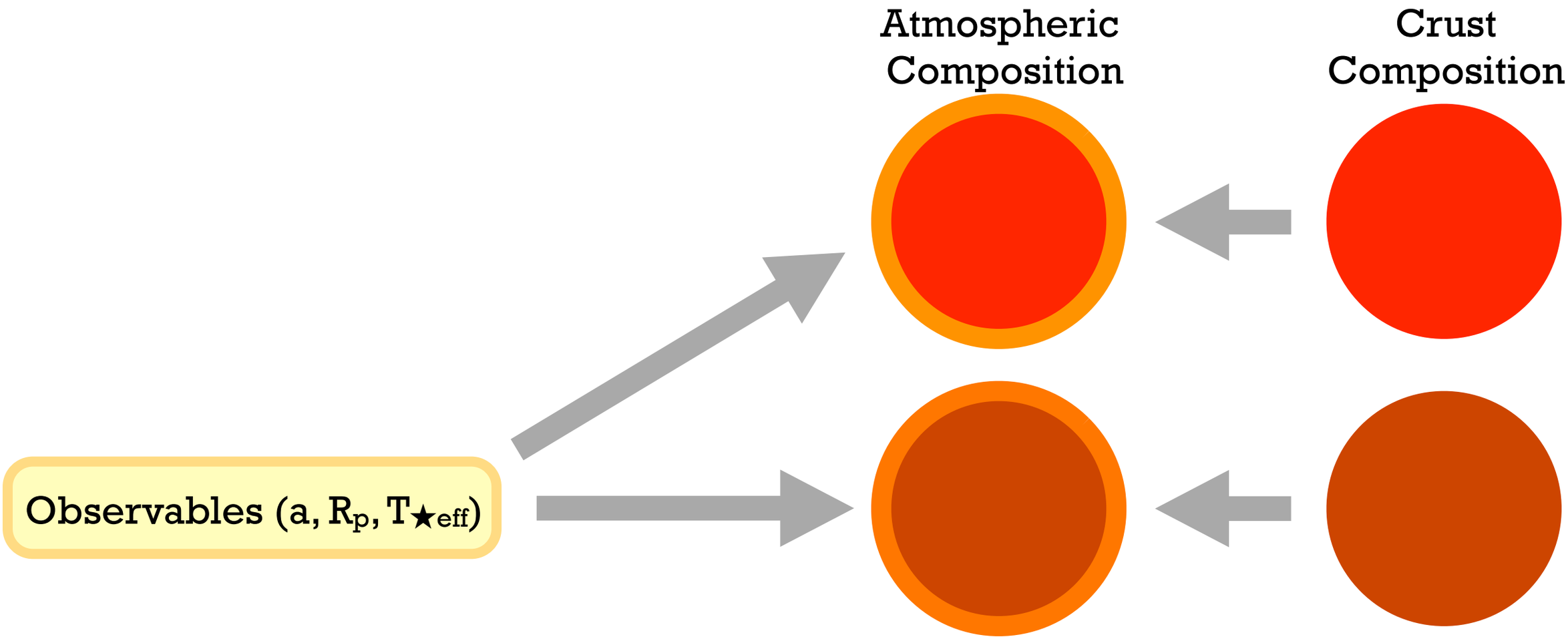
Atmospheric Composition

Crust Composition

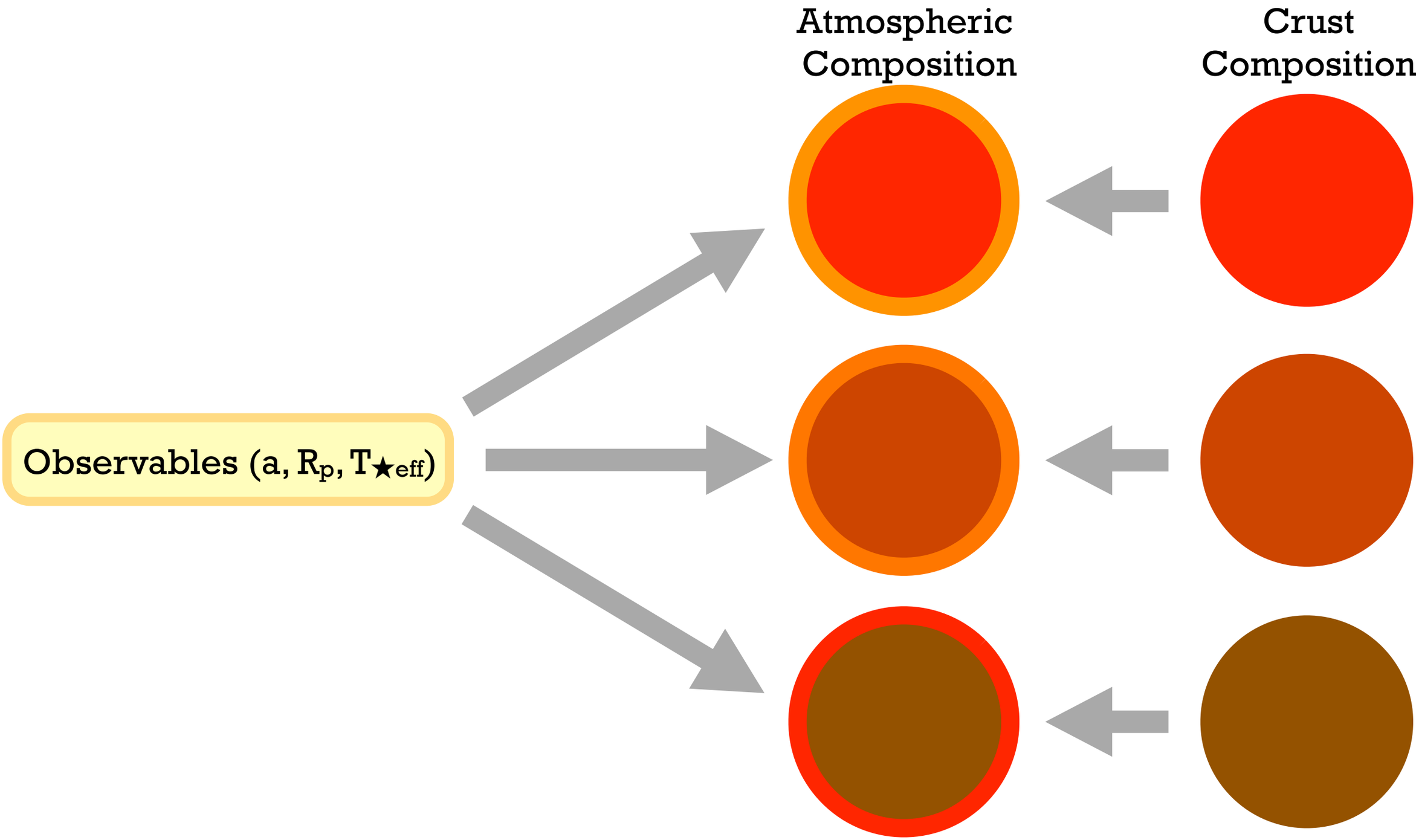
Observables ($a, R_p, T_{\star eff}$)



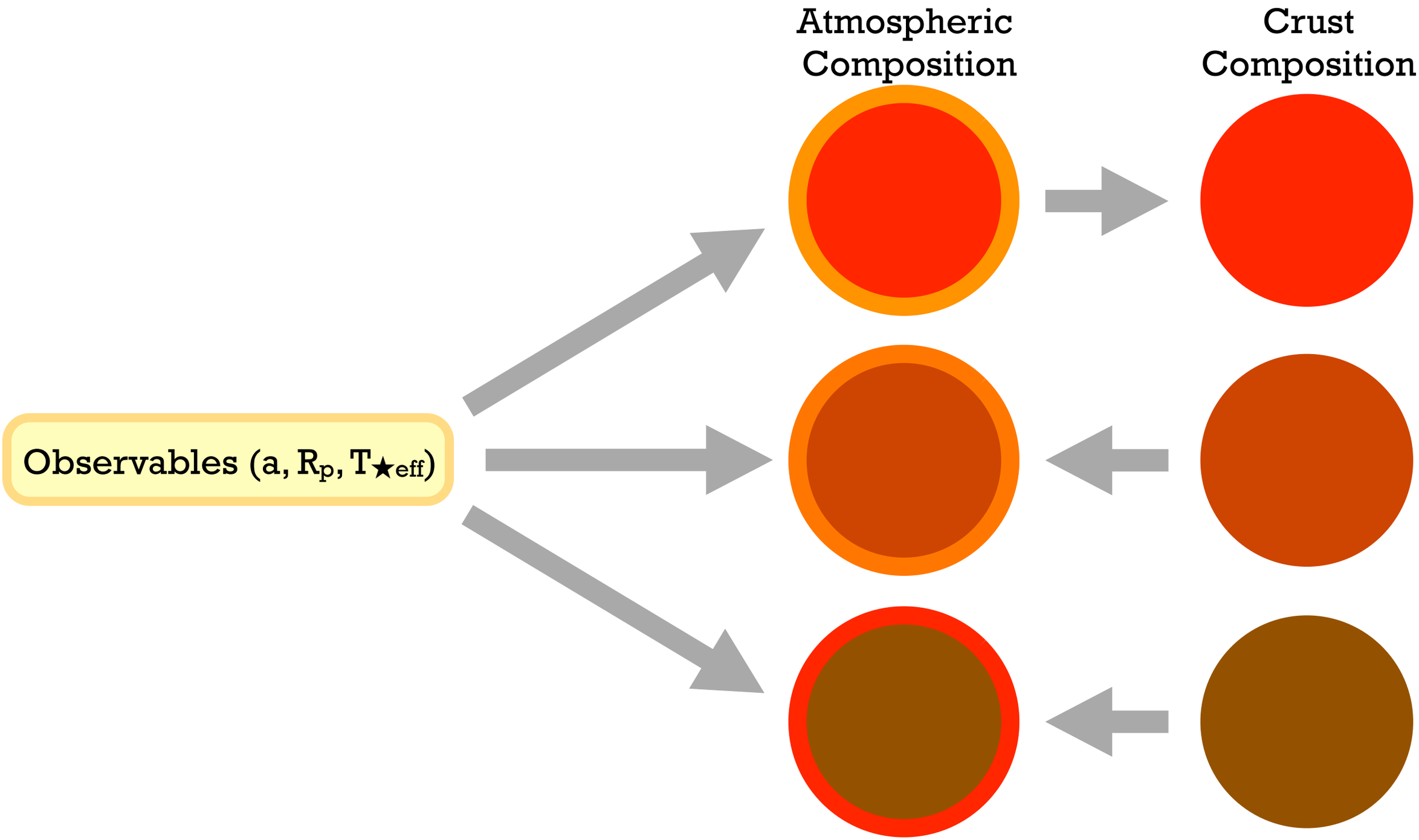
Interior from atmospheric data



Interior from atmospheric data



Interior from atmospheric data

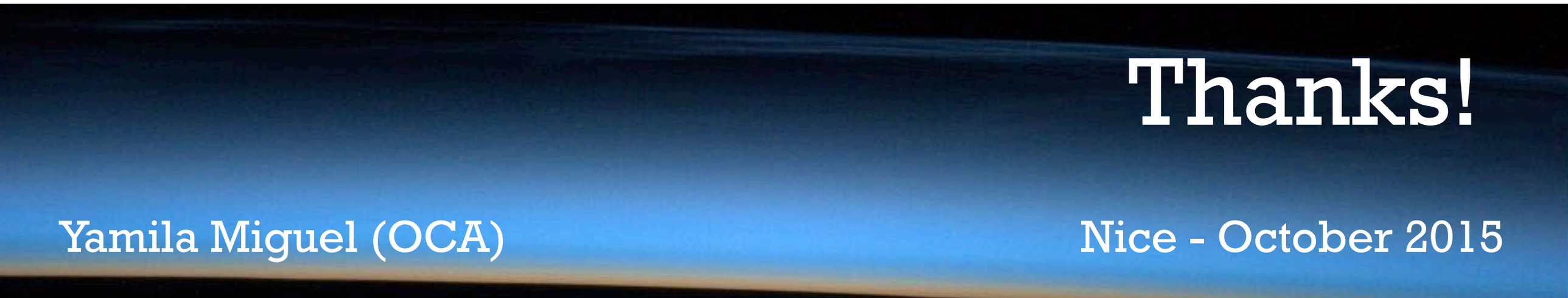


Take home message!

Hot-Giants: we link observables (a, $T_{eff\star}$, $R_\star$) with atmospheric TP profile, chemistry and observable spectral features using disequilibrium chemistry.

Our grid can be used to select targets, characterise exoplanets and interpret atmospheric retrieval analysis.

Hot-rocky: we calculated the gases outgassed from the surface and built the atmosphere. The most abundant species are Na and SiO, we found less O_2 . Disequilibrium chemistry -specially vertical mixing- is extremely important.



Thanks!

Yamila Miguel (OCA)

Nice - October 2015