

Rocky exo-planet diversity from protoplanet solidification

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Dan Bower (U Bern)

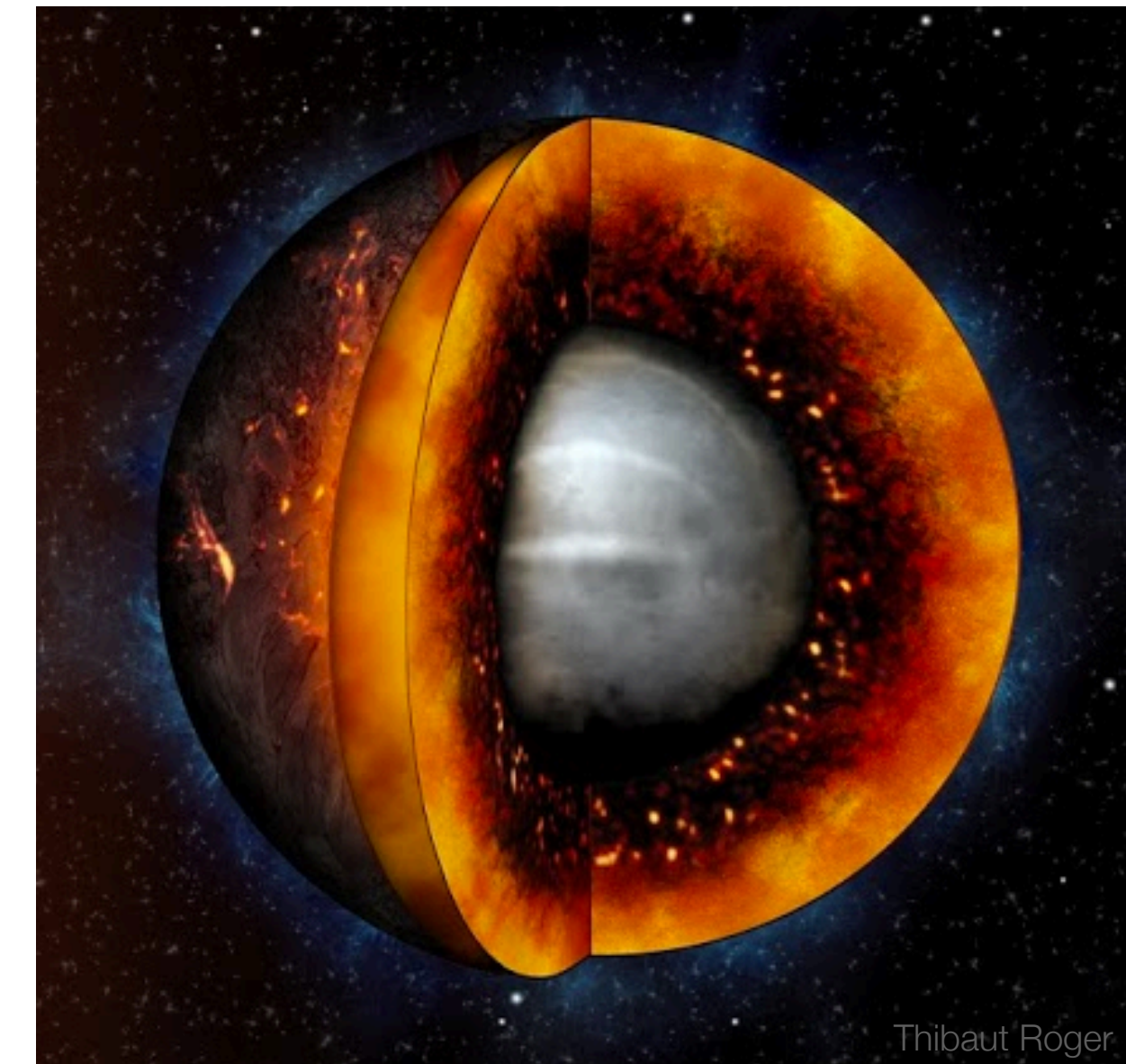
Patrick Sanan (ETH Zurich)

Ryan Boukrouche (Oxford)

Mark Hammond (Oxford)

Shami Tsai (Oxford)

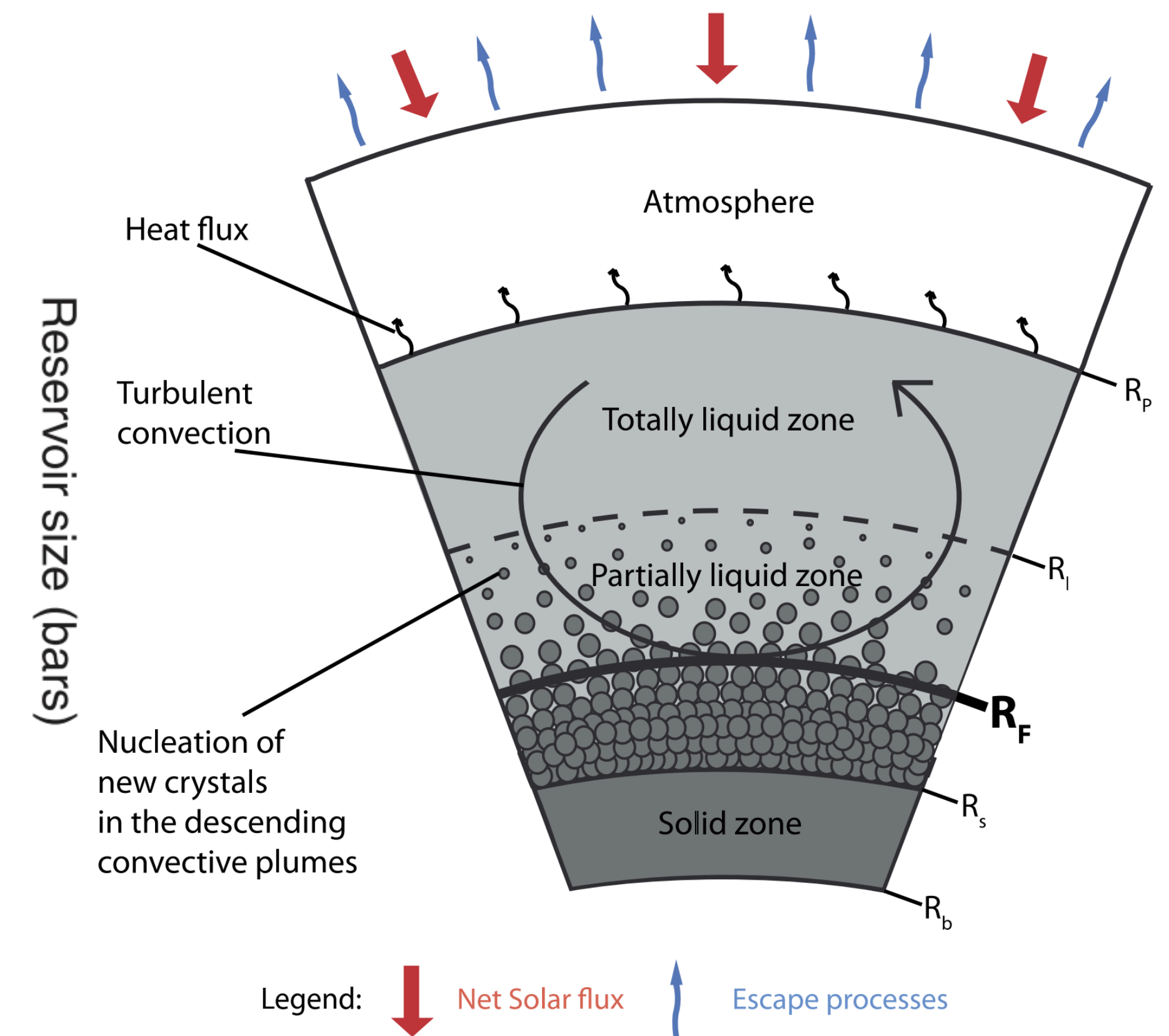
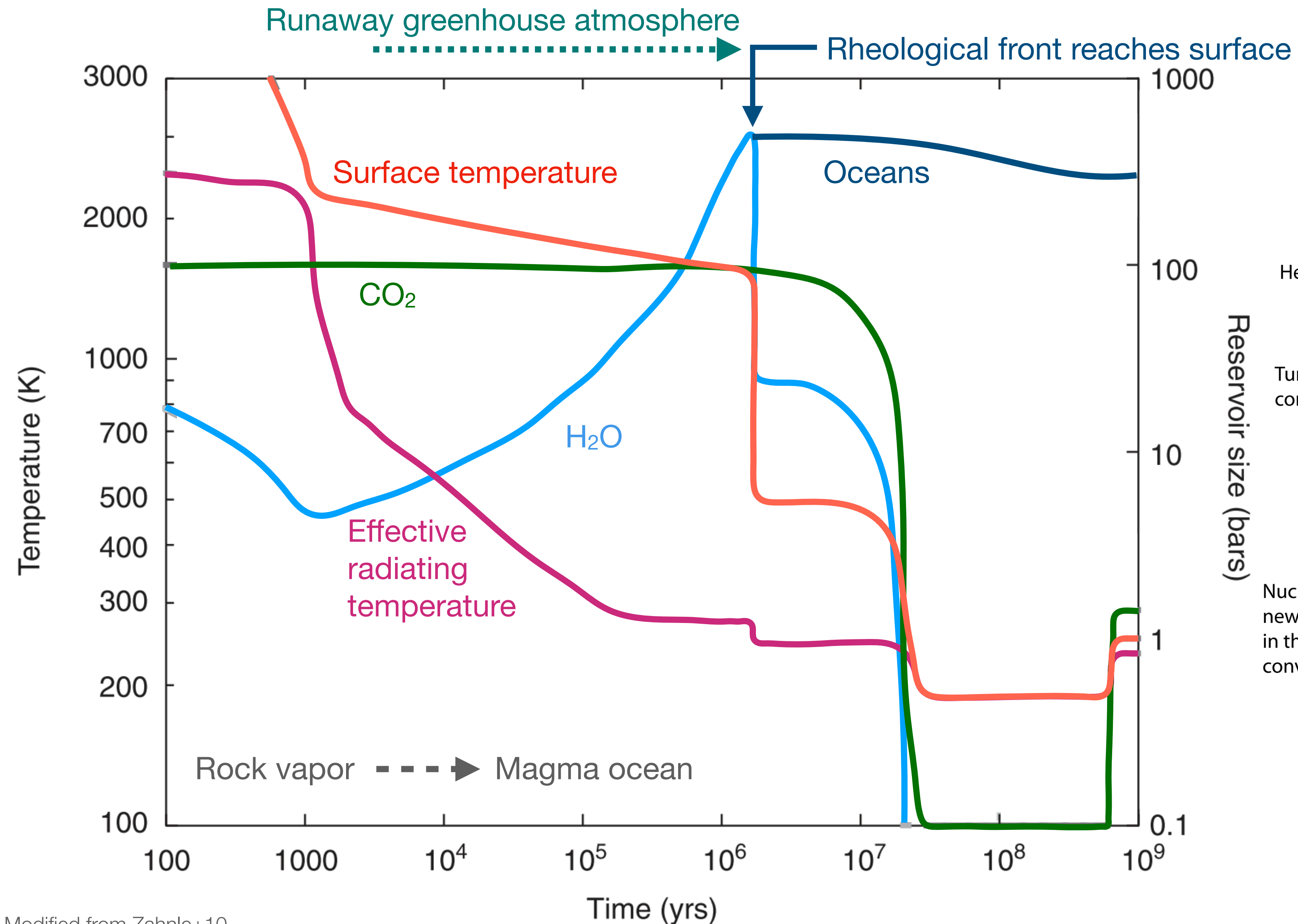
Raymond Pierrehumbert (Oxford)



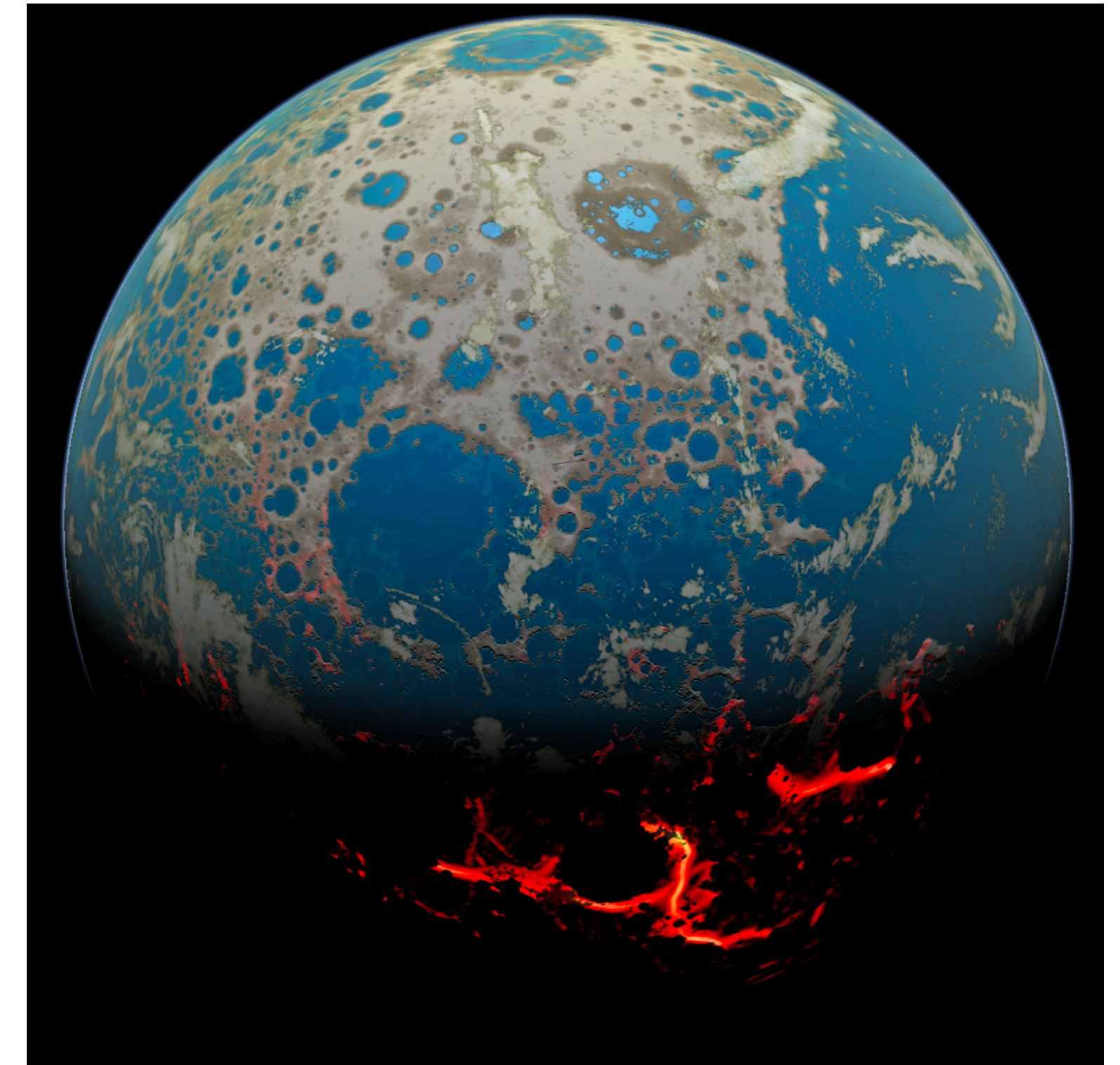
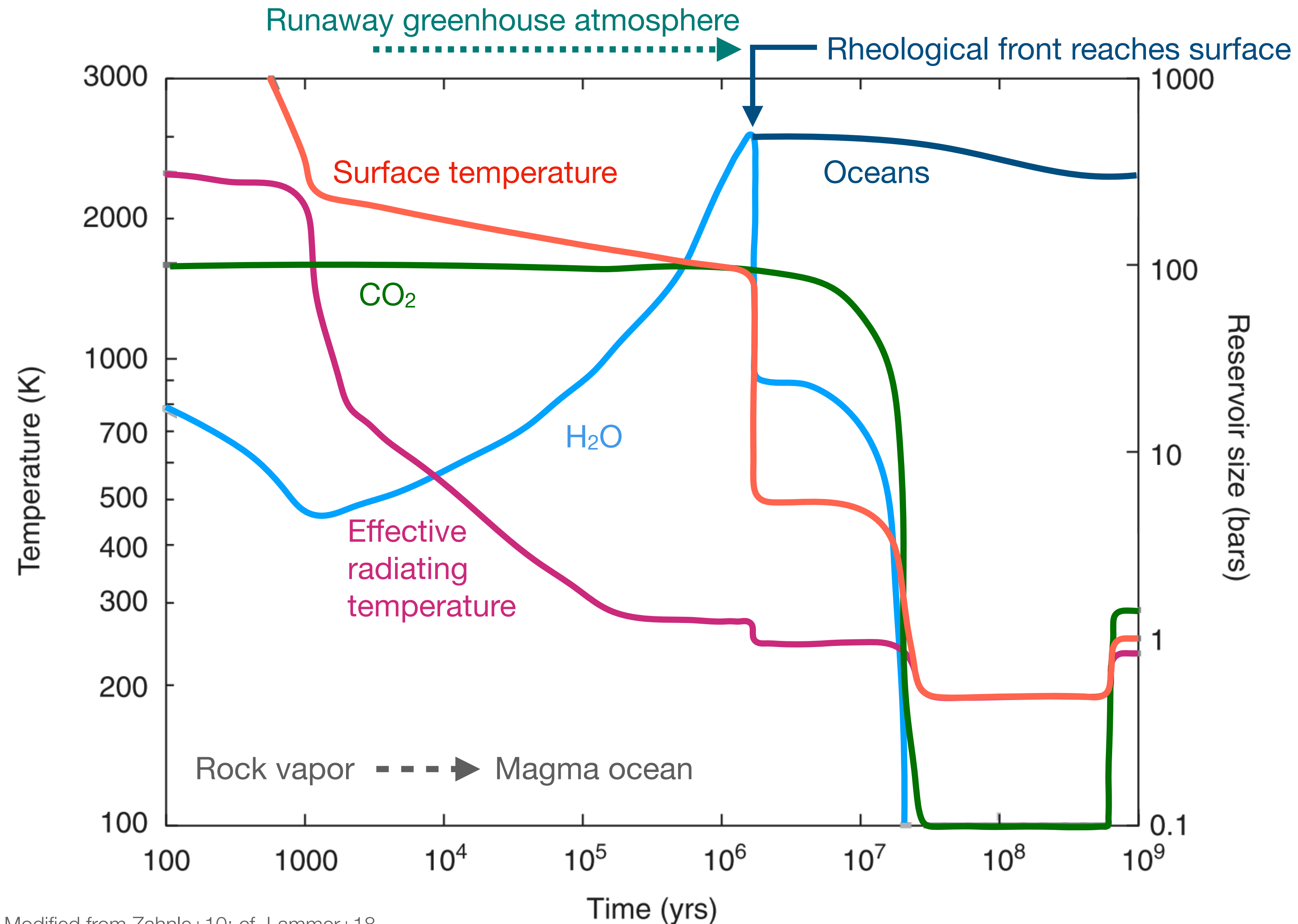


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from protoplanet solidification

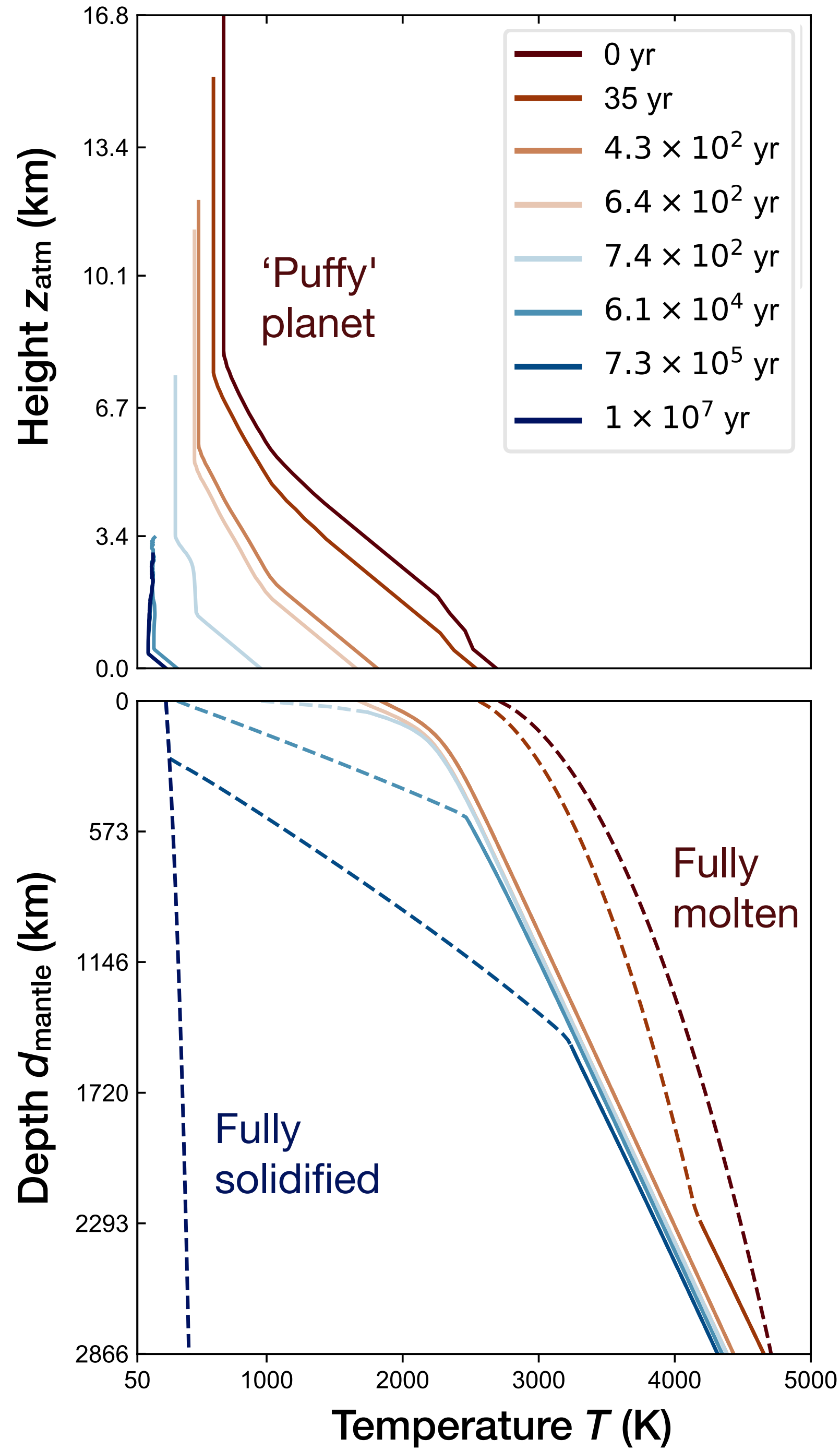
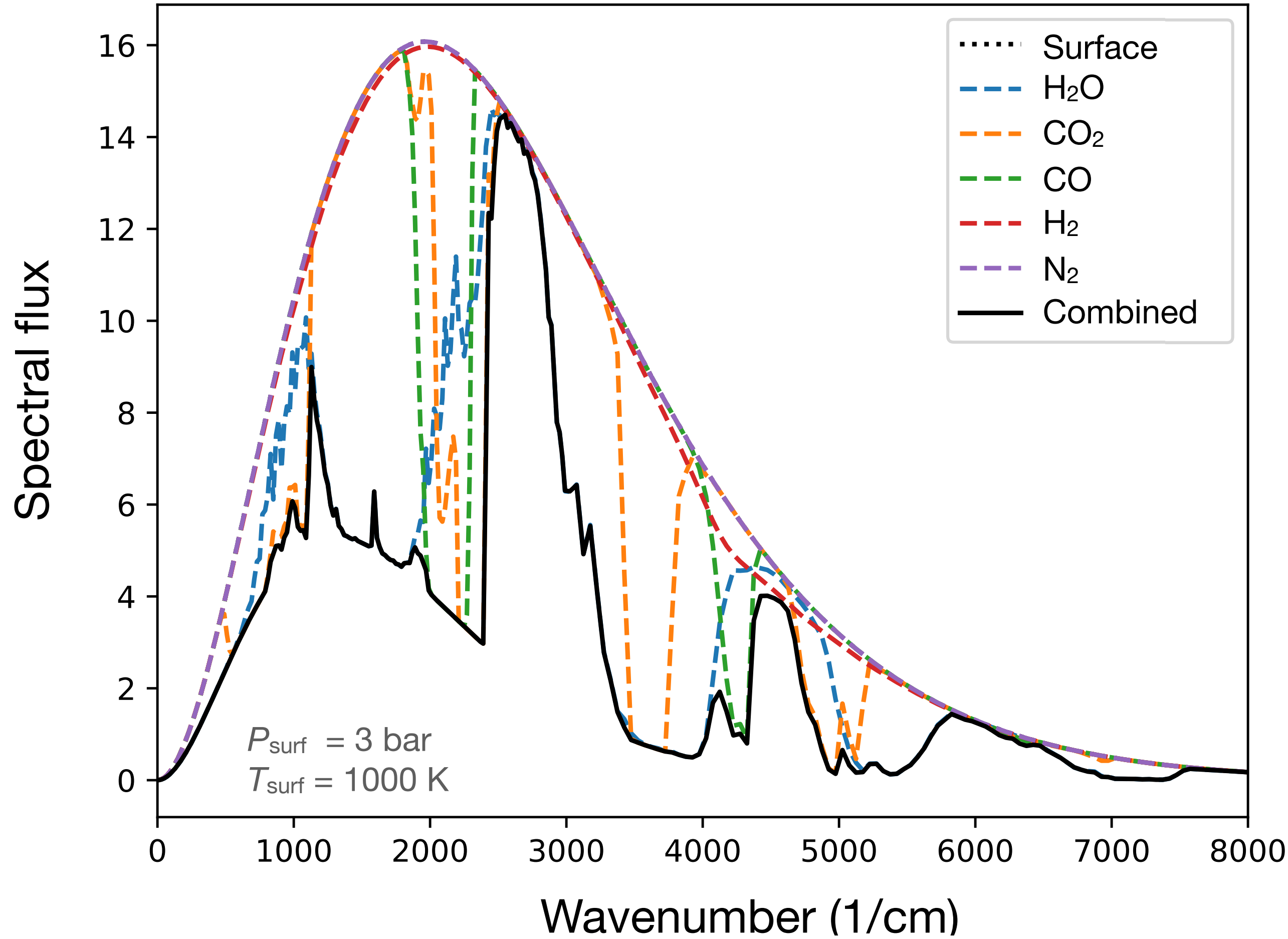
Haden Earth: from magma- to water-oceans



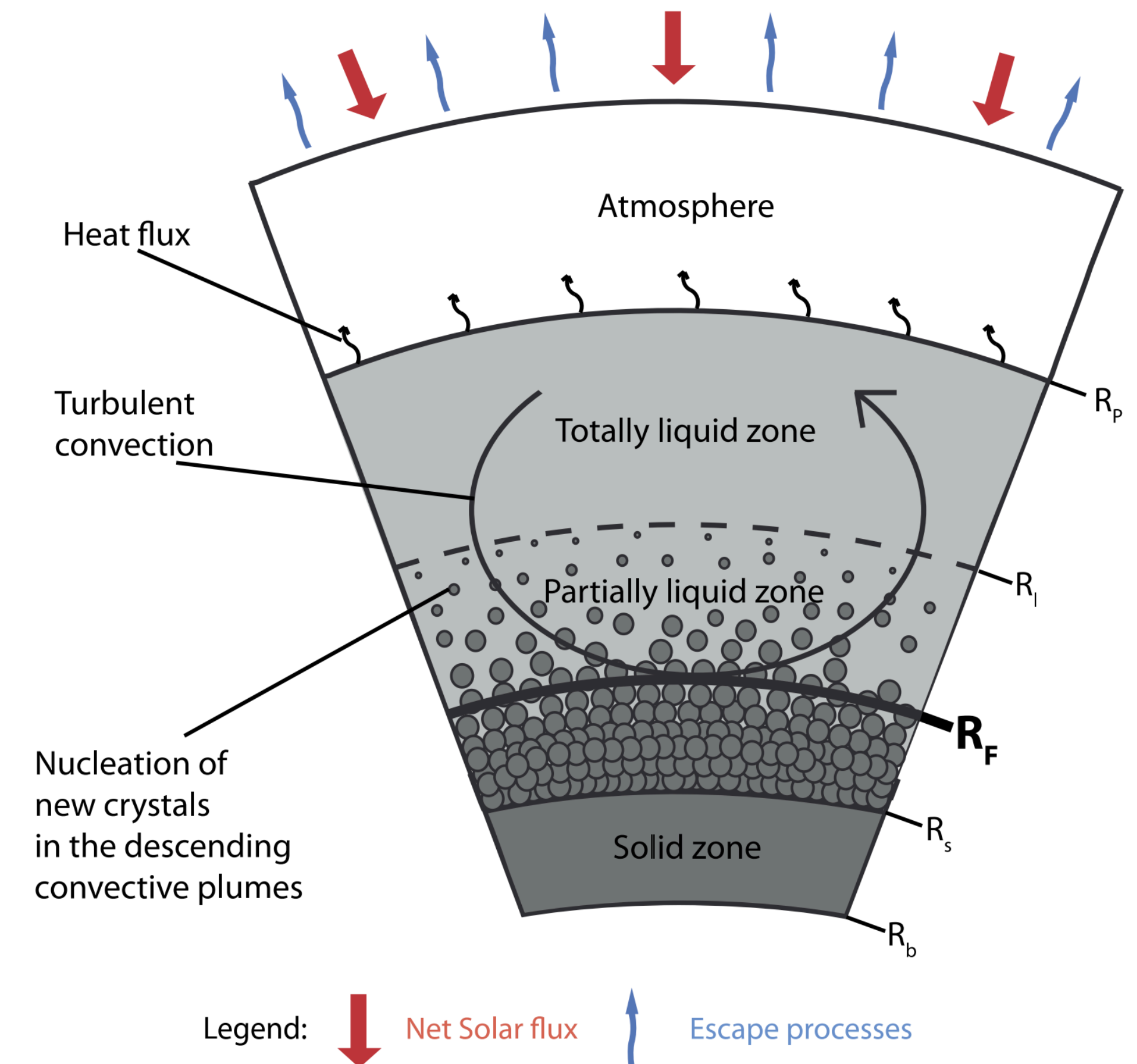
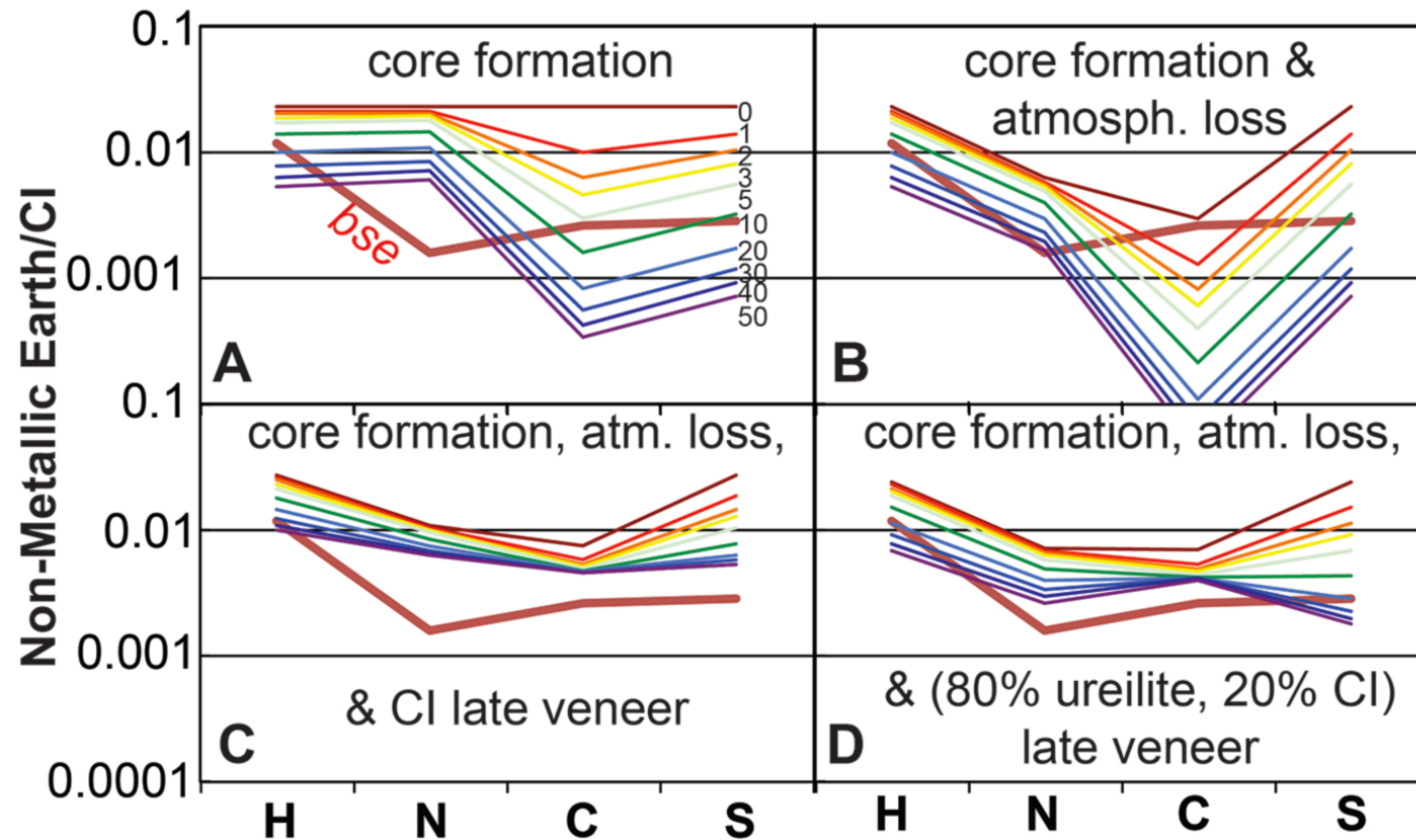
Haden Earth: from magma- to water-oceans



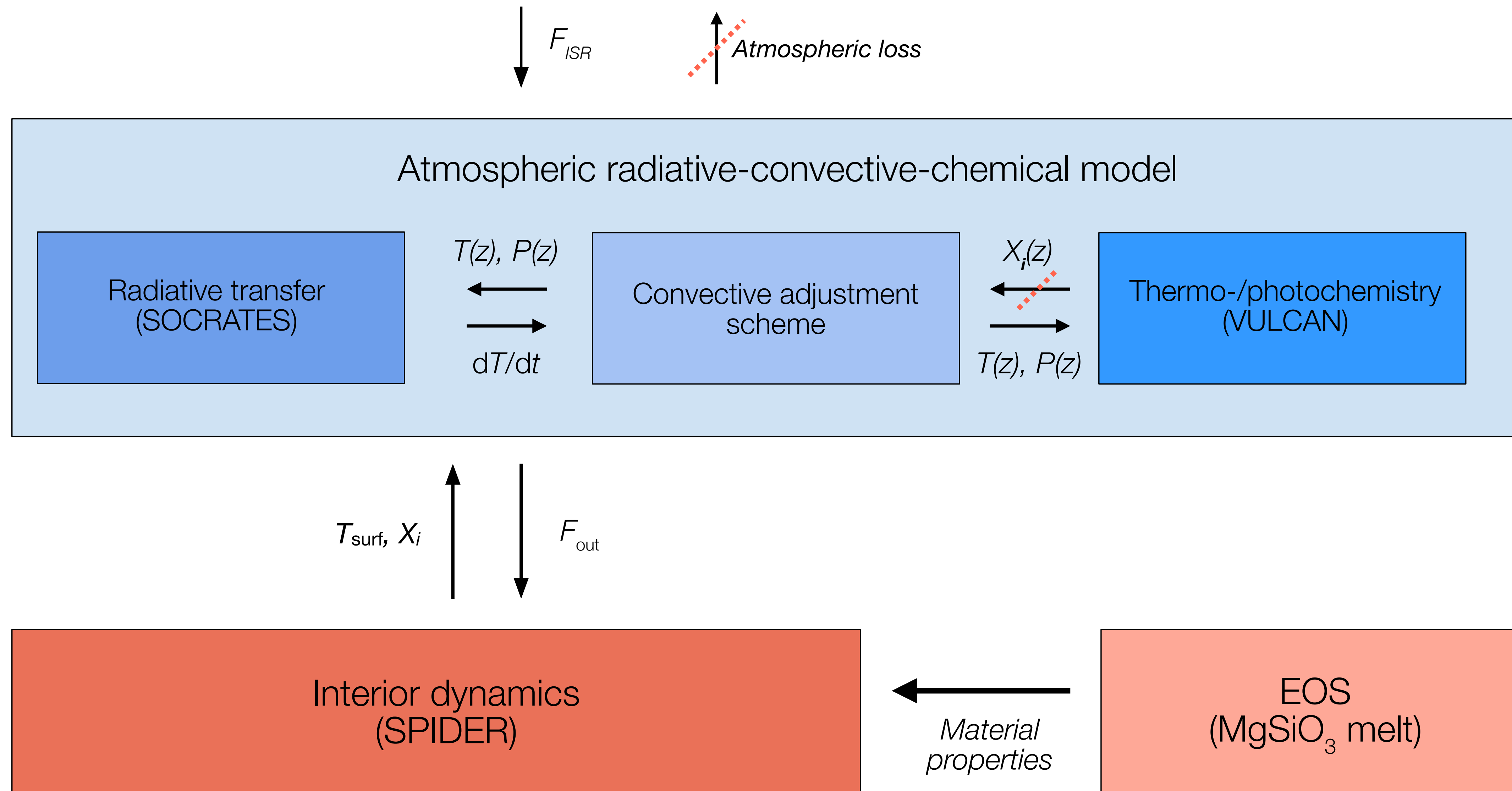
Cooling timescale & planet structure function of atmospheric speciation



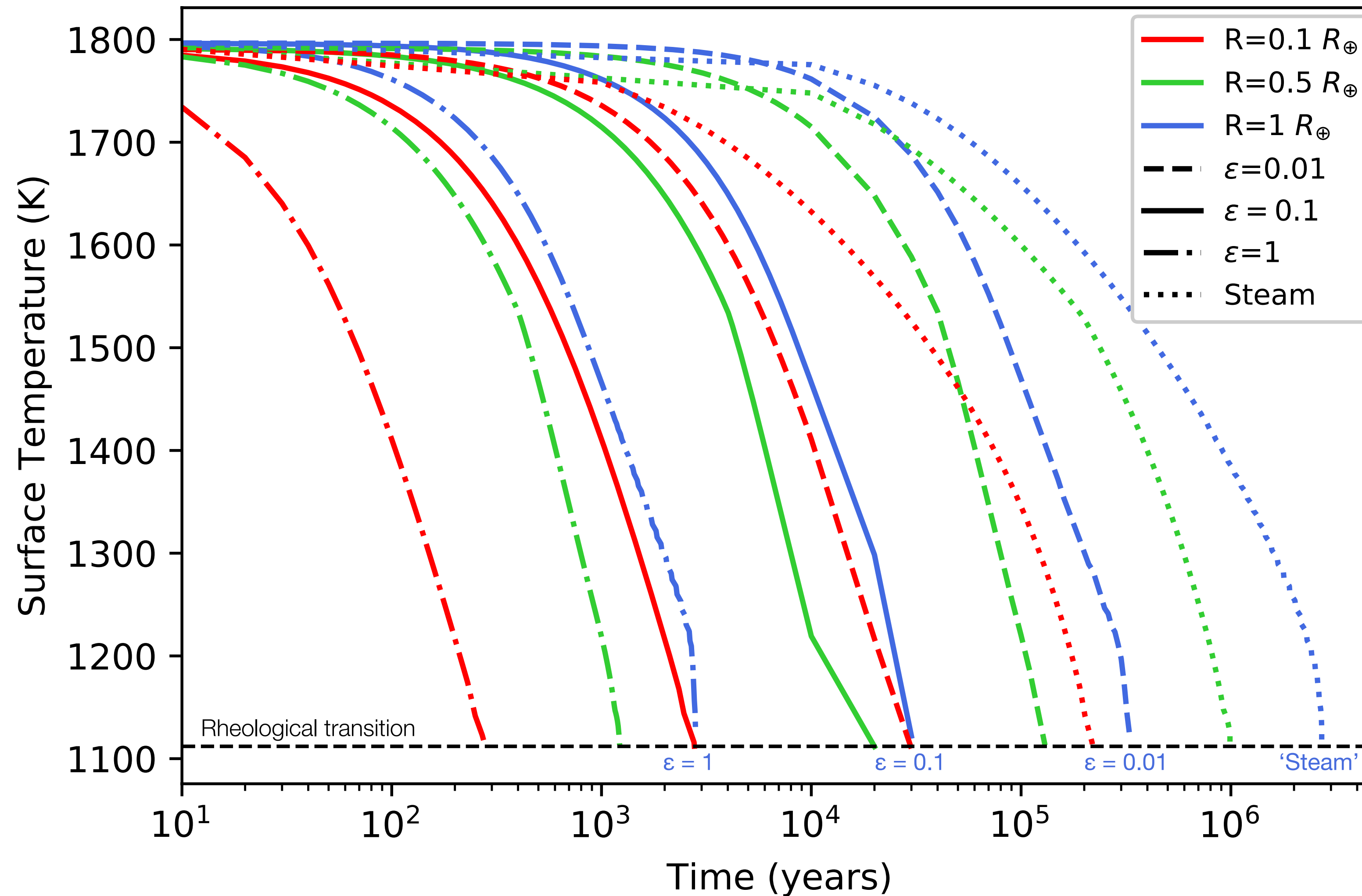
Volatile fractionation from core formation + atmospheric loss



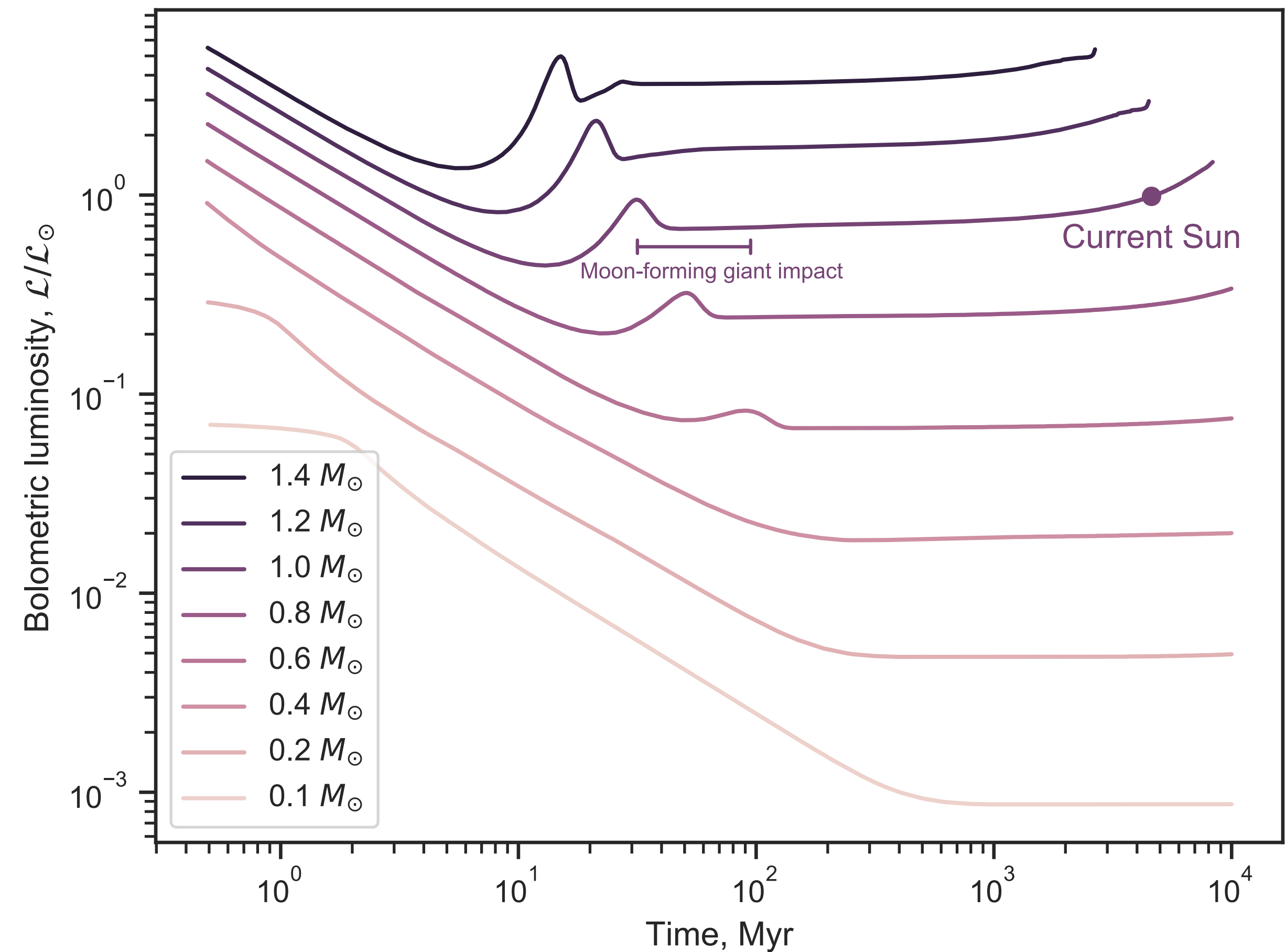
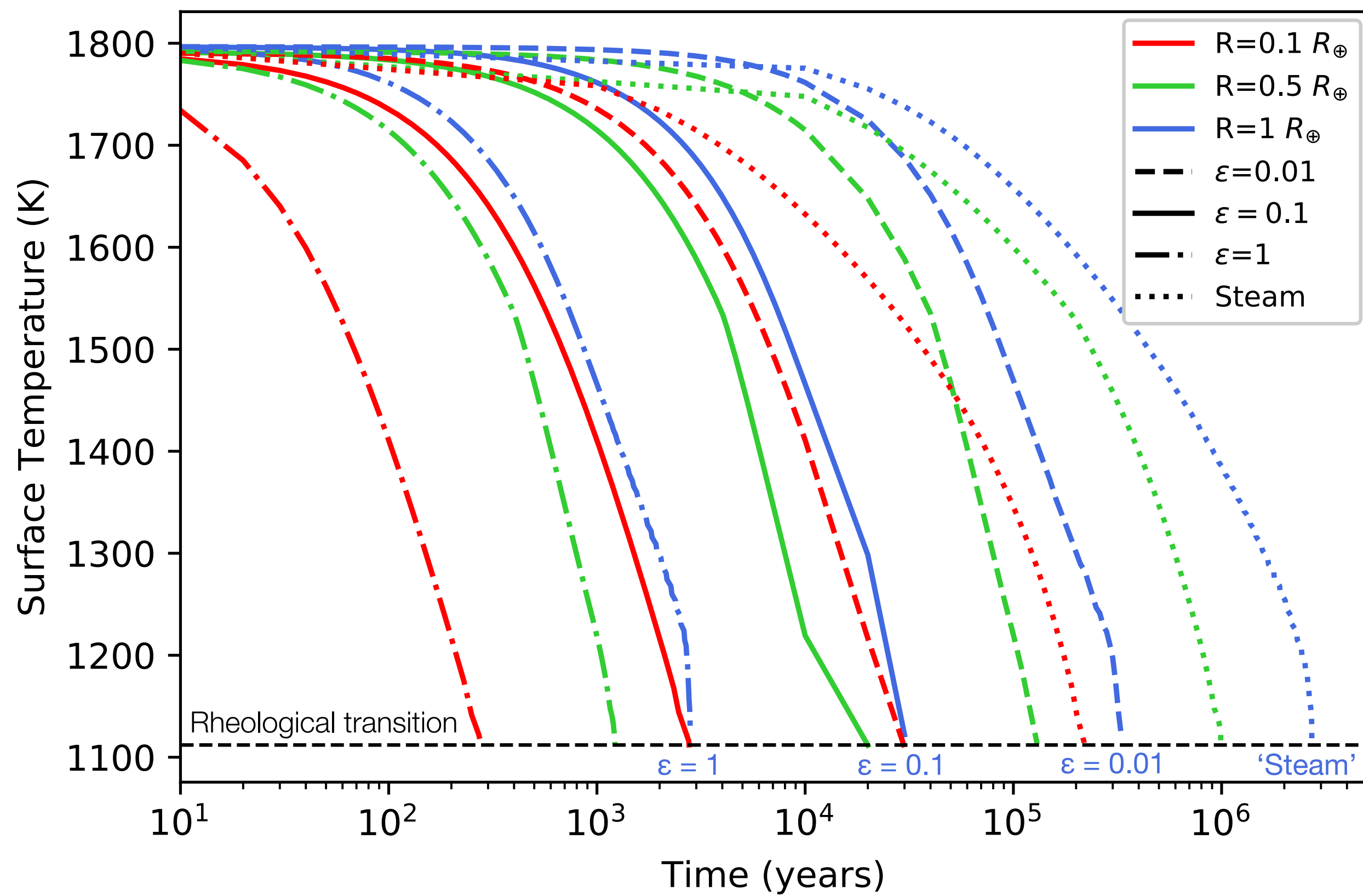
Integrated magma ocean—atmosphere framework



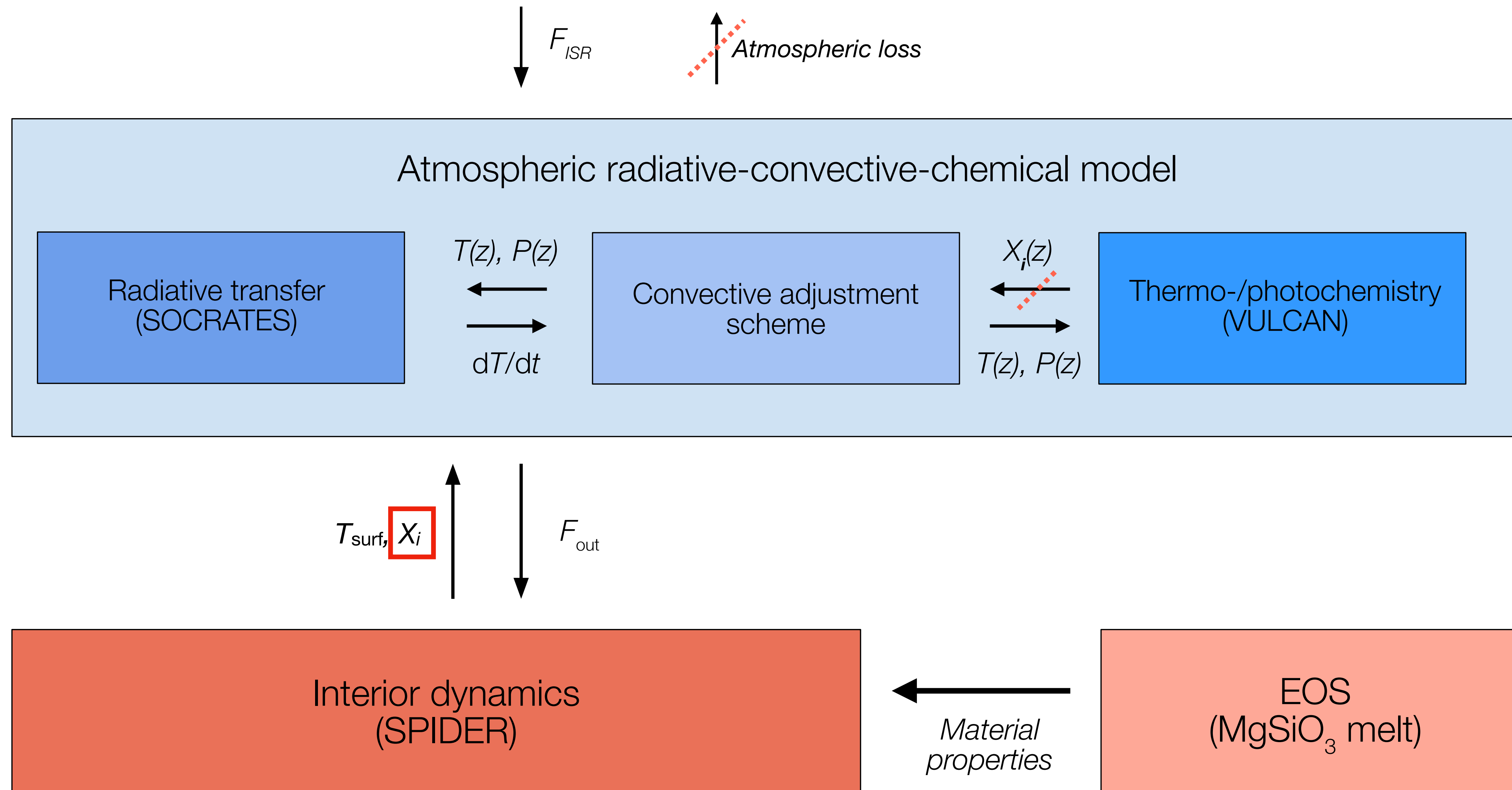
Impact of planet size and (fixed) atmosphere



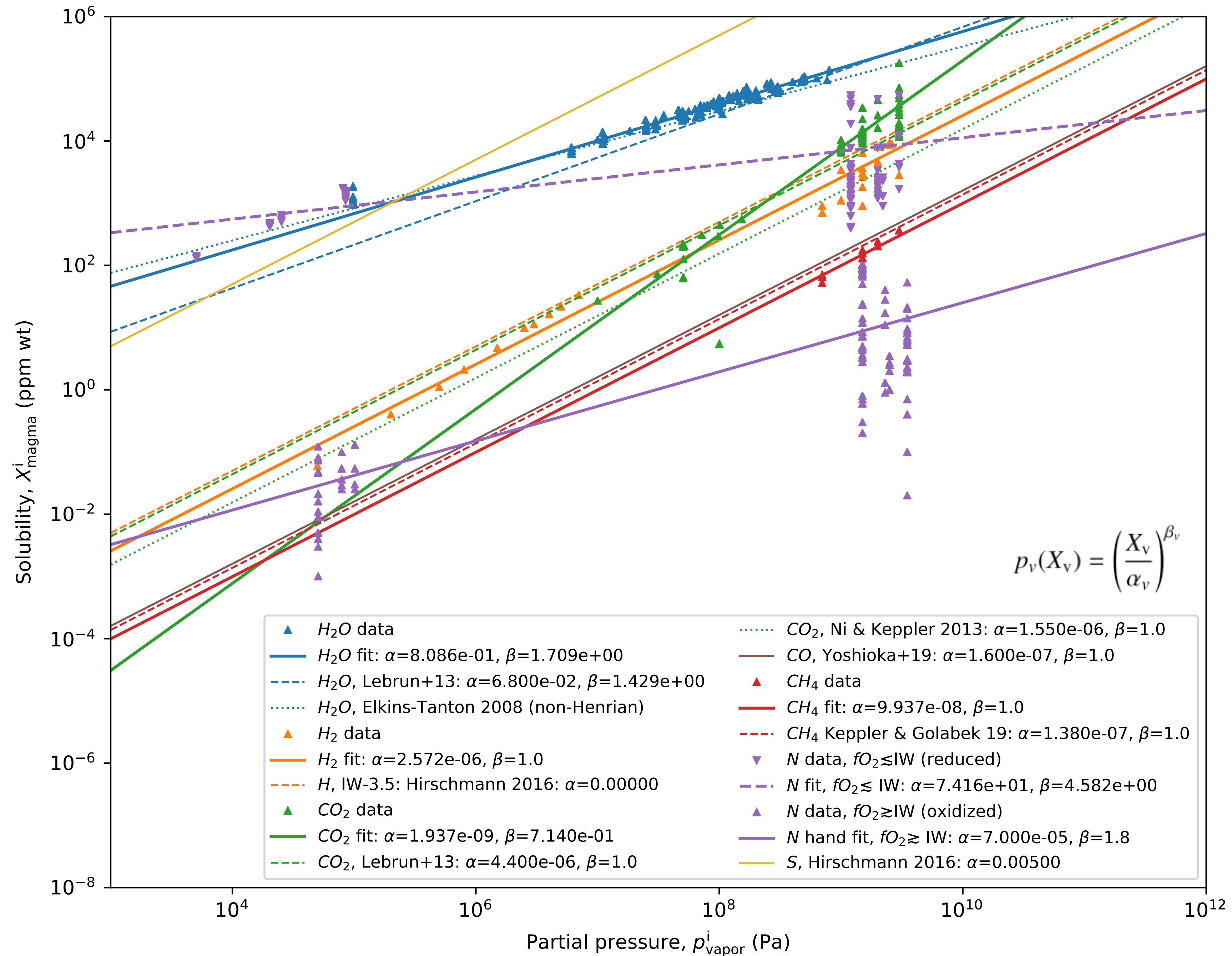
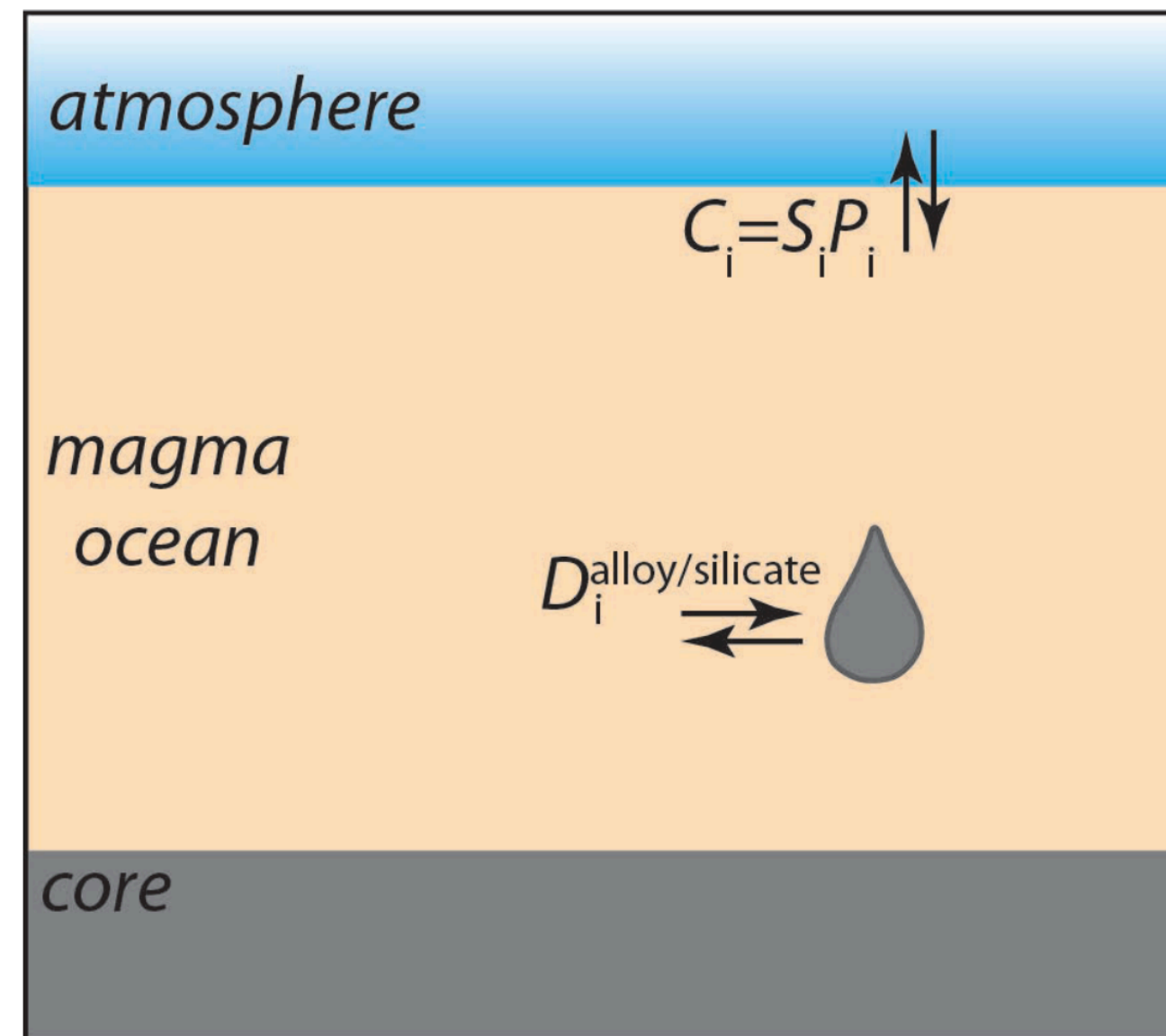
Stellar influence



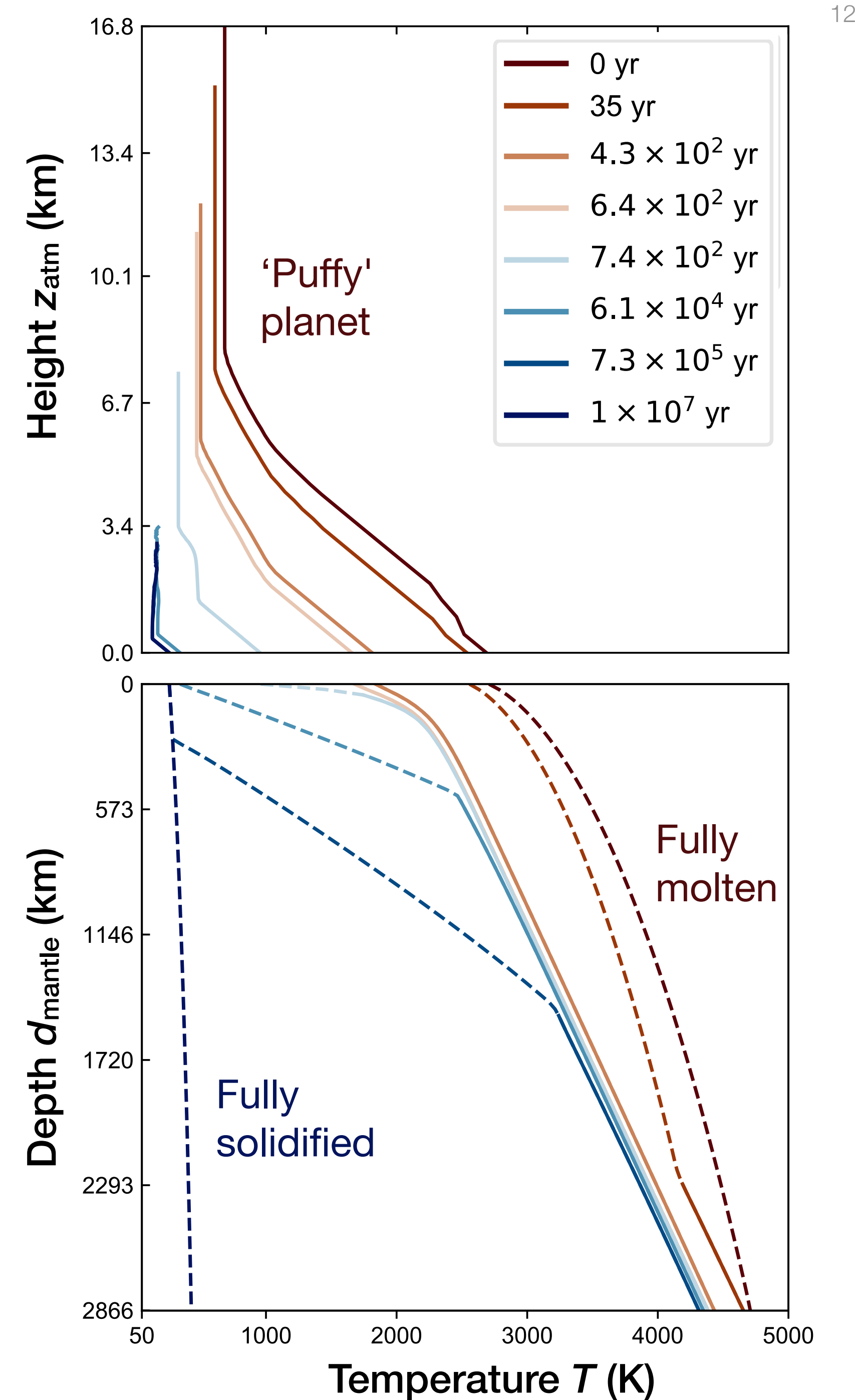
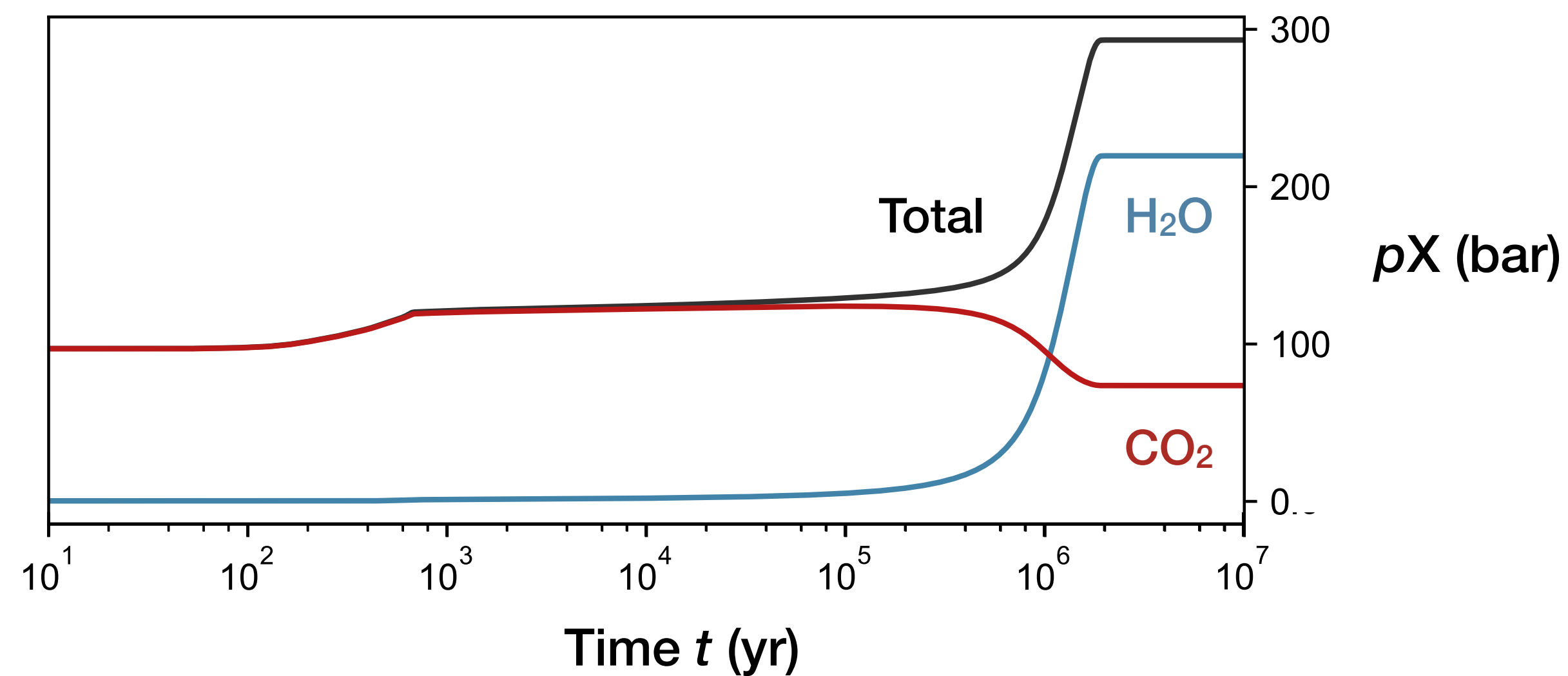
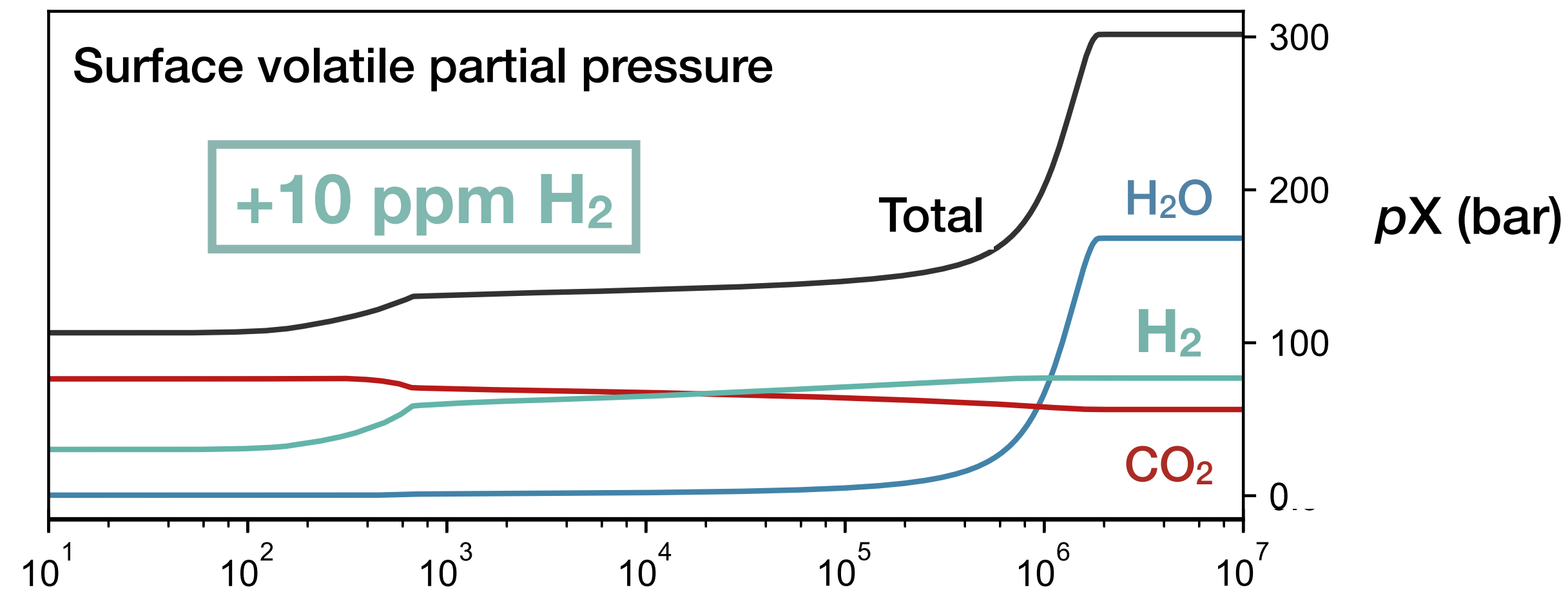
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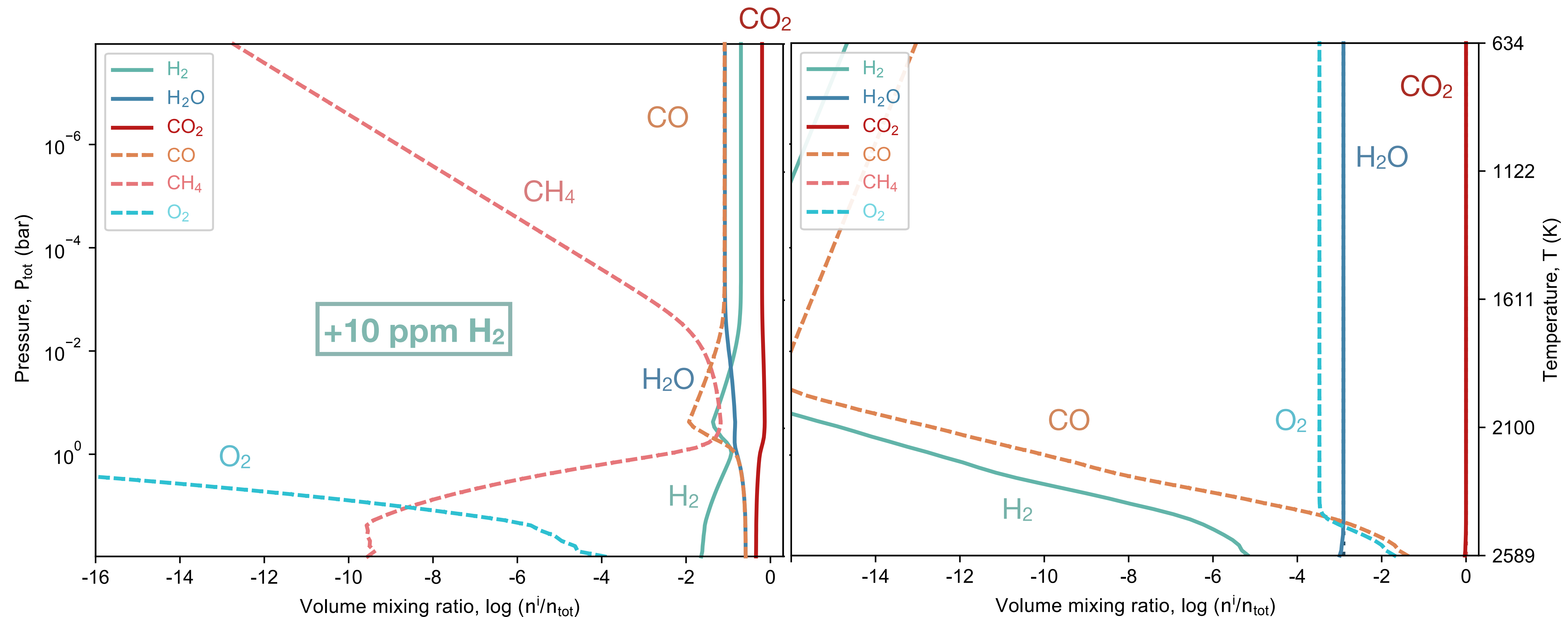
Outgassing/ ingassing



Outgassing/ingassing history

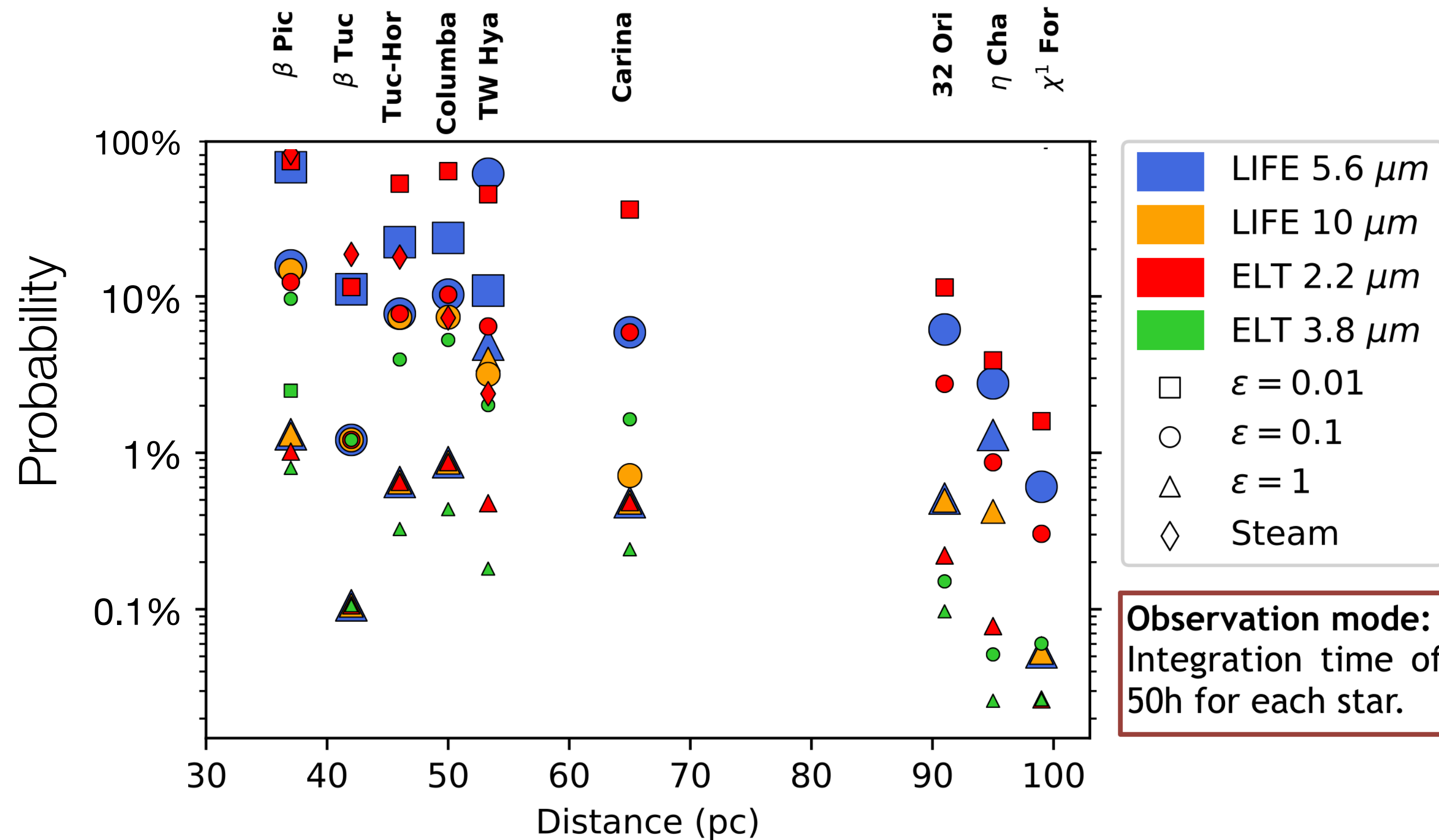


Earliest atmospheric chemistry

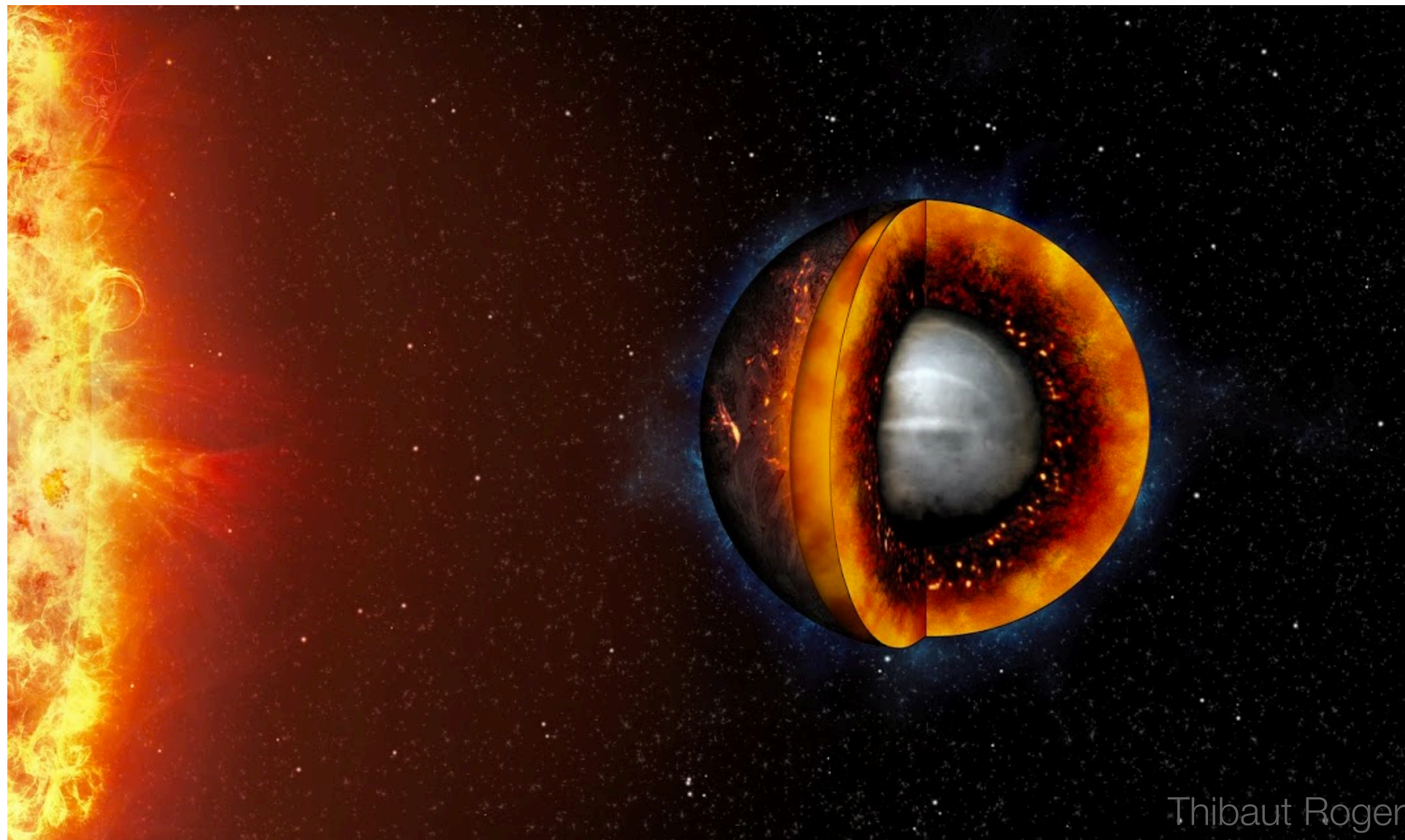


Directly image magma ocean planets?

Probability of detecting magma ocean planet
with future direct imaging facilities



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- Magma ocean-atmosphere coupling shapes earliest atmospheric and upper mantle (geo-)chemistry
 - ➡ Barrier from planet formation to early planetary evolution
 - ➡ Crucially defines volatile fractionation and atmospheric chemistry
 - ➡ Stationary + runaway MO planets may reveal diversity of rocky planetary atmospheres
- Connect w/ space missions and laboratory studies