Interior dynamics of tidally-locked super-Earths: The case of LHS 3844b

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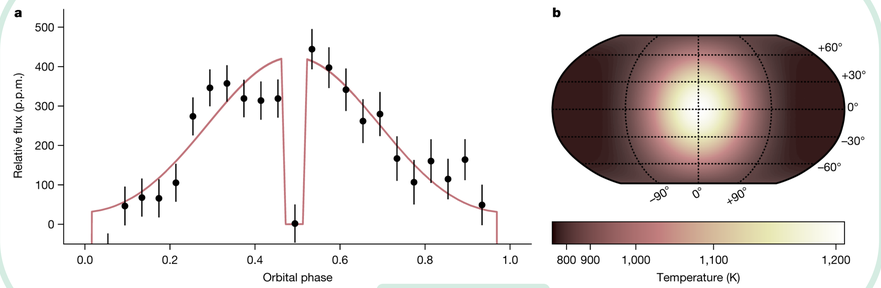
- tidally-locked rocky super-Earths: large surface temperature contrast between day- and nightside
- this surface dichotomy may lead to an interior dichotomy
- super-Earth LHS 3844 b: thermal phase curve measured by Kreidberg et al. 2019 consistent with absence of a thick atmosphere

observed thermal phase curve



Kreidberg et al., 2019

used as a surface boundary condition in our geodynamic simulations of interior flow

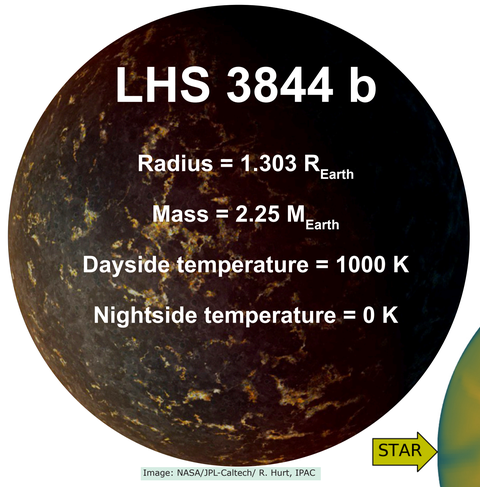
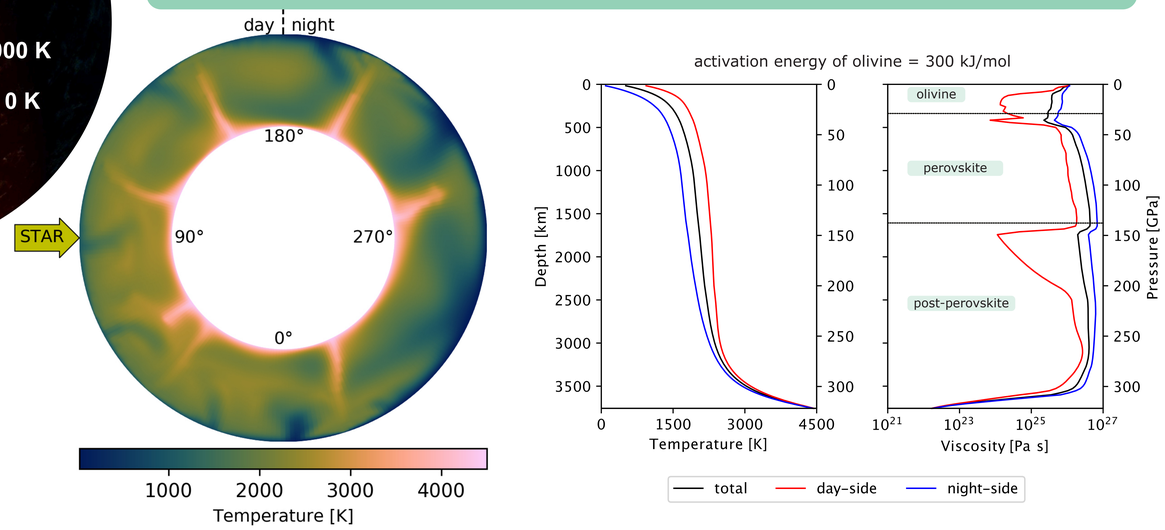


Image: NASA/JPL-Caltech/ R. Hurt, IPAC

The rheology of the lithosphere influences the interior flow of tidally locked planets

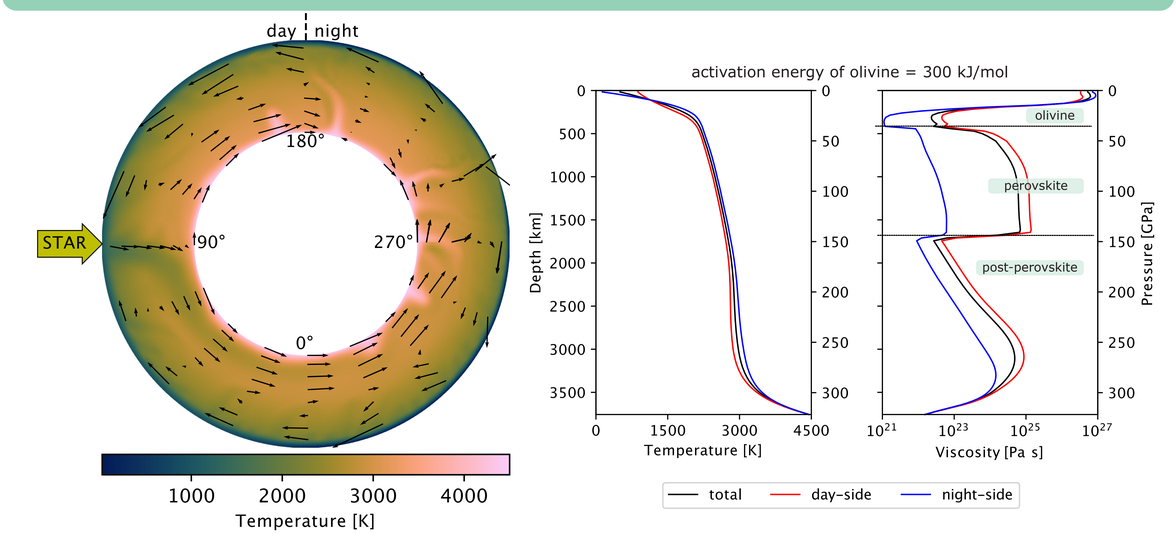
viscosity is temperature and pressure-dependent and plastic yielding is included

low yield stress (30 MPa)



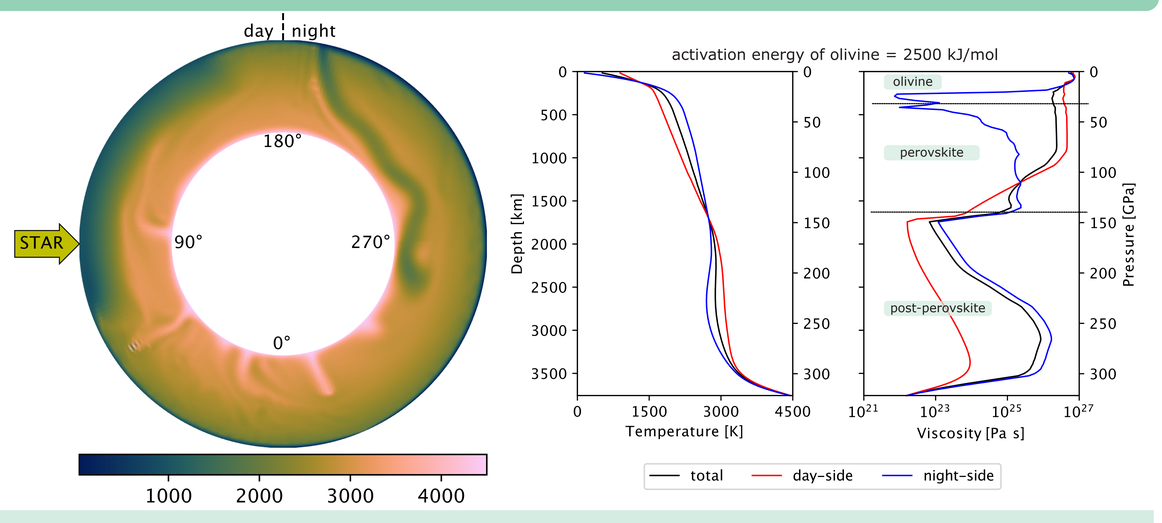
lithosphere is sufficiently unstable to subduct both on the dayside and nightside

high yield stress (300 MPa)



- downwellings prefer dayside and upwellings prefer nightside
- cold material on the nightside does not subduct, but is advected to the dayside where it does subduct

high yield stress (300 MPa) and high olivine activation energy (2500 kJ/mol)



- downwellings preferentially on dayside
- formation of plumes on both sides
- formation of a highly viscous ‘raft’ that rotates around the surface and eventually subducts on the dayside