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Is planetary resurfacing a key factor for outgassing and gas speciation on rocky planets?

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Accurate measurements of a planet's mass, radius and age (provided for example by the PLATO mission and follow-up measurements) together with compositional constraints from the stellar spectrum can help us to deduce potential evolutionary pathways that rocky planets can evolve along, and allow us to predict the range of likely atmospheric properties that can then be compared to observations.

However, for the evolution of composition and mass of an atmosphere, a large degeneracy exists due to several planetary and exterior factors and processes, making it very difficult to link the interior (and hence outgassing processes) of a planet to its atmosphere. The community therefore thrives now to identify the key factors that impact an atmosphere, and that may lead to distinguishable traces in planetary, secondary outgassed atmospheres. Such key factors are for example the planetary mass (impacting atmospheric erosion processes) or surface temperature (impacting atmospheric chemistry, weathering and interior-atmosphere interactions).

Here we investigate the signature that a planet evolving into plate tectonics leaves in its atmophere due to its impact on volcanic outgassing fluxes and volatile releases to the atmosphere - leading possibly to distinguishable sets of atmospheric compositions for stagnant-lid planets and plate tectonics planets. These preliminary findings will need to be further investigated with coupled atmosphere-interior models including various feedback mechanisms such as condensation and weathering as well as atmospheric escape to space.