Origin and Evolution of Planetary Atmospheres: Impact on Habitability

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The origin and evolution of the atmospheres of early Venus, Earth, Mars and terrestrial exoplanets will be discussed [1]. A focus will be given to the origin and escape of protoatmospheres and further evolution of secondary atmospheres during a planet's history. It will be shown that the formation age of a terrestrial planet, its mass and size, as well as the lifetime in the EUV-saturated early phase of its host star play a significant role if a terrestrial planet can evolve to an Earth-like habitat. It will also be shown that more massive planets such as super-Earths in orbits within the habitable zone of their host stars might have problems to lose nebular- or catastrophically outgassed initial protoatmospheres. In such a case these planets could end up as mini-Neptunes, or as water worlds with CO_2 and hydrogen- or abiotic oxygen-rich upper atmospheres. If an atmosphere of a terrestrial planet evolves to an N_2-rich atmosphere too early in its evolutionary lifetime, the atmosphere may be lost by thermal and nonthermal atmospheric escape processes. Various examples will be shown which indicate that the evolution to Earth-analogue habitats is a very complex endeavor.

References

[1] H. Lammer, Origin and evolution of planetary atmospheres: Implications for habitability, Springer Briefs in Astronomy, Springer Publishing House, Heidelberg / New York (2012)