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Abstract:

Understanding the concept of habitability is clearly related to an evolutionary knowledge of the particular planet-in-question. However, additional indications so-called "systemic aspects" of the planetary system as a whole governs a particular planet's claim on habitability. In this paper we focus on such systemic aspects and discuss their relevance to the formation of an "Earth-like" habitable planet. This contribution summarizes our results obtained by lunar sample work and numerical models within the framework of the Research Alliance "Planetary Evolution and Life". We consider various scenarios which simulate the dynamical evolution of the Solar System and discuss the consequences for the likelihood of forming an Earth-like world orbiting another star. Our model approach is constrained by observations of the modern Solar System and the knowledge of its history. Results suggest that on the one hand the long-term presence of terrestrial planets is jeopardized due to gravitational interactions if giant planets are present. On the other hand the habitability of inner rocky planets may be supported in those planetary systems hosting giant planets.

Gravitational interactions within a complex multiple-body structure including giant planets may supply terrestrial planets with materials which formed in the colder region of the proto-planetary disk. During these processes, water, the prime requisite for habitability, is delivered to the inner system. This may occur either during the main accretion phase of terrestrial planets or via impacts during a post-accretion bombardment. Results for both processes are summarized and discussed with reference to the lunar crater record.

Starting from a scenario involving migration of the giant planets this contribution discusses the delivery of water to Earth, the modification of atmospheres by impacts in a planetary system context and the likelihood of the existence of extrasolar Earth-like habitable worlds.