Formation and Evolution of Habitable Worlds

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While considerable progress has been made in the past 20 years in understanding the evolution of accretion disks surrounding sun-like stars at radii from 0.03-0.3 AU (dissipating on timescales of 1-10 Ma), as well as older debris disks from 30-300 AU (with ages of 1-10 Ga), we still lack answers to basic questions such as: 1) how long do gas-rich disks survive from 0.3-30 AU?; 2) how do disks transition from primordial accretion to post-accretion debris disks?; and 3) what is the range of typical disk properties as a function of radius and age and how to these properties compare to the inferred history of our own solar system. Answers to these questions constrain theories of gas-giant and terrestrial planet formation, both of which have an impact concerning the habitability of emergent planetary systems. We seek to understand, among the ensemble of terrestrial-like planets that may be out there, how common habitable (and inhabited) worlds are. This depends on how different extraterrestrial life could be from ours and the nature and range of environments in which life could emerge. While little about this is known, there is consensus that research examining the conditions necessary to retain liquid water and create life in extreme environments is important. Key questions are: 1) how do terrestrial planets gain and maintain, or lose, water?; 2) when did the Moon form and what is its role in the emergence of life?; 3) what is the evidence for the oldest life on Earth and under what conditions did it arise?; 4) how does a planet's impact history bear on early habitability?; and 5) is atmosphere and biosphere co-evolution an inevitable consequence of life?