CONTROL ID: 2243228

TITLE: Uncovering the Chemistry of Earth-like Planets

ABSTRACT BODY:

Abstract Body: We propose to use the evidence from our solar system to understand exoplanets, and in particular, to predict their surface chemistry and thereby the possibility of life. An Earth-like planet, born from the same nebula as its host star, is composed primarily of silicate rocks and an iron-nickel metal core, and depleted in volatile content in a systematic manner. The more volatile (easier to vaporize or dissociate into gas form) an element is in an Earth-like planet, the more depleted the element is compared to its host star. After depletion, an Earth-like planet would go through the process of core formation due to heat from radioactive decay and collisions. Core formation depletes a planet's rocky mantle of siderophile (iron-loving) elements, in addition to the volatile depletion. After that, Earth-like planets likely accrete some volatile-rich materials, called "late veneer". The late veneer could be essential to the origins of life on Earth and Earth-like planets, as it also delivers the volatiles such as nitrogen, sulfur, carbon and water to the planet's surface, which are crucial for life to occur. Here we build an integrative model of Earth-like planets from the bottom up. Thus the chemical compositions of Earth-like planets could be inferred from their mass-radius relations and their host stars' elemental abundances, and the origins of volatile contents (especially water) on their surfaces could be understood, and thereby shed light on the origins of life on them. This elemental abundance model could be applied to other rocky exoplanets in exoplanet systems.

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