

Origin of Earth's Water

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The formation of the terrestrial planets of our solar system and the origin of Earth's water are among the most intriguing problems of planetary astronomy. Models of terrestrial planet formation have been successful to produce planets in the range of Venus and Earth. However, they have failed to produce Mars and Mercury analogs. To account for the water contents of these planets, comets have long been considered as the most likely source of the delivery of water. However, elemental and isotopic arguments suggest a very small contribution from these objects. While other sources such as a local adsorption of water vapor onto dust grains in the primordial nebula and delivery through planetesimals and planetary embryos provide potential pathways to account for the water content of Earth, no sole source of water provides a satisfactory explanation. The giant planets, especially Jupiter and Saturn play a crucial role in this process and are the main determinants of the final size, composition, and dynamical state of terrestrial bodies. We have developed a compound model of terrestrial planet formation that is capable of forming Mars, and incorporates both the principal endogenous and exogenous sources of water. Our model includes a new and sophisticated treatment of the collisions of planetesimals, which can account for the increase in the iron/silicate ratio from Mars to Mercury, and ensures the delivery of sufficient amount of water to Earth in agreement with geological evidence. Comets are also considered in the final analysis, as it is likely that at least some of Earth's water has cometary origin. I will present our new model and discuss the implications of its results.