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TITLE: Internal Sources for Water on Earth

ABSTRACT BODY:

Abstract Body: Rocky planets are built through a series of highly energetic accretionary impacts. The accreting bodies are thought to carry small amounts of water to the growing planet, but it is debated whether the planet can retain this water through the accretionary process, or if water needs to be added largely after the planet is complete and cooled. Most of the relatively few measurements of deuterium to hydrogen in cometary water do not match Earth's water, though the single example of 103P/Hartley 2 is a good match (Mumma and Charnley, 2011; Hartogh et al., 2011). Alexander et al. (2012) point out, however, that organic materials in comets have far higher D/H than does their water, so in bulk no comet matches Earth's D/H ratio, not even comet Hartley.

Meteorites provide evidence that the material that built planets had small but sufficient amounts of water, and analysis of its isotopic composition demonstrates that water from rocky material, and not comets, provided water to the Earth (Alexander et al., 2012). This current evidence that Earth's water came from rocky asteroidal material does not solve the question of whether this material was the accreting material that built the planet, or if it was added later.

Mission data from the Moon and Mercury demonstrates that those bodies are not completely devoid of volatiles (McCubbin et al., 2010; Saal et al., 2008; Peplowski et al., 2011). The Moon, in particular, has small amounts of internal water that survived its energetic origins (Hauri et al., 2011). Thus, the giant accretionary impacts that build planets do not completely dry them, and the water from their initial building blocks can be retained.

If volatiles are delivered and partly retained during accretion, then the initial habitability of a young planet may be set by degassing of a magma ocean. Models predict that cooling can result in liquid water oceans within ten or tens of millions of years (Abe and Matsui, 1986; Elkins-Tanton, 2011). Thus, rocky planets in solar systems similarly composed to our own have a good chance of forming with water oceans, and of being habitable, at least for some period of time.

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