Implantation of Ionized Solar Nebular Hydrogen in Minerals

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Our proposal: **Nominally anhydrous minerals (NAMs) in the S-type asteroids and ordinary chondrite falls (LL5 Chelyabinsk and L6 Benenitra) are hydrated with 200–1000 ppm weight water (39–55 ppm of equivalent hydrogen) [1, 2]. However, the mechanism(s) by which water can get into the structure of these early-formed silicate minerals in the nebula is still controversial. We propose that implantation of H^+ ions in the hot and rarified environment in the early sun's history is responsible for introducing hydrogen into the NAMs. As indicated in Fig. 1, ionized H^+ ions in the solar nebular gas get implanted into the top surface area of the early-formed silicate grain (Process 1). A concentration gradient in the implanted area of the silicate grain drives the recombination of the implanted H with other hydrogen atoms and leads to their outward diffusion (Process 2). Additionally, the inward diffusion of the projectile hydrogen occurs efficiently and causes a redistribution of hydrogen in the silicate grain (Process 3).**

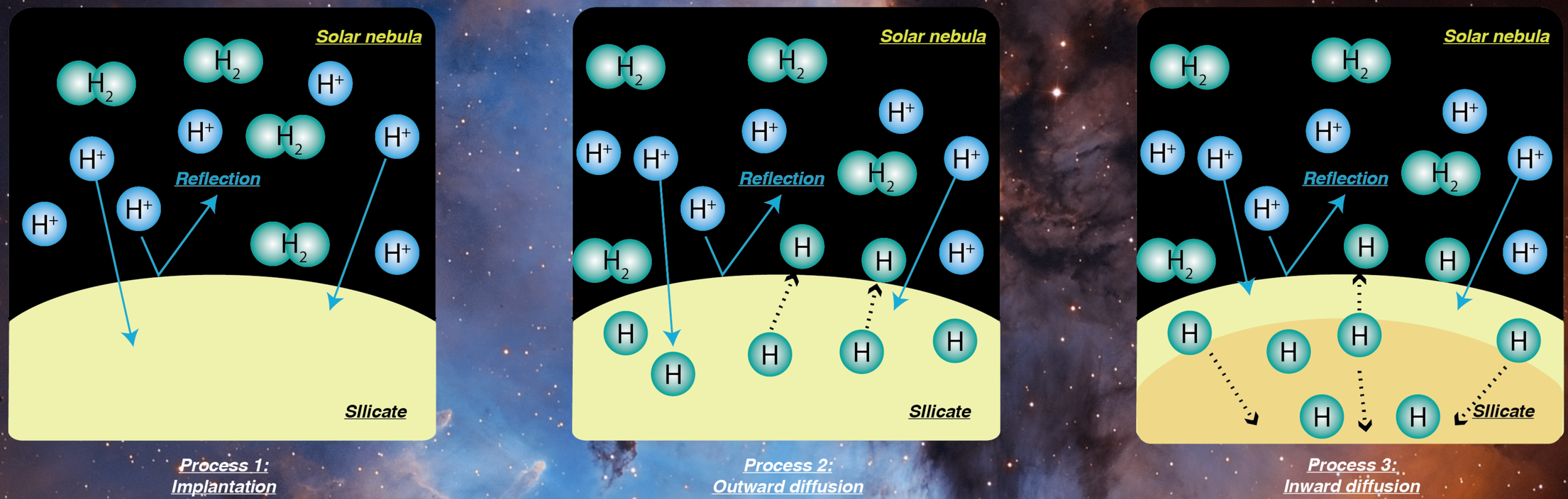

Fig. 1. A schematic showing the proton implantation-diffusion processes occurring in silicate minerals.

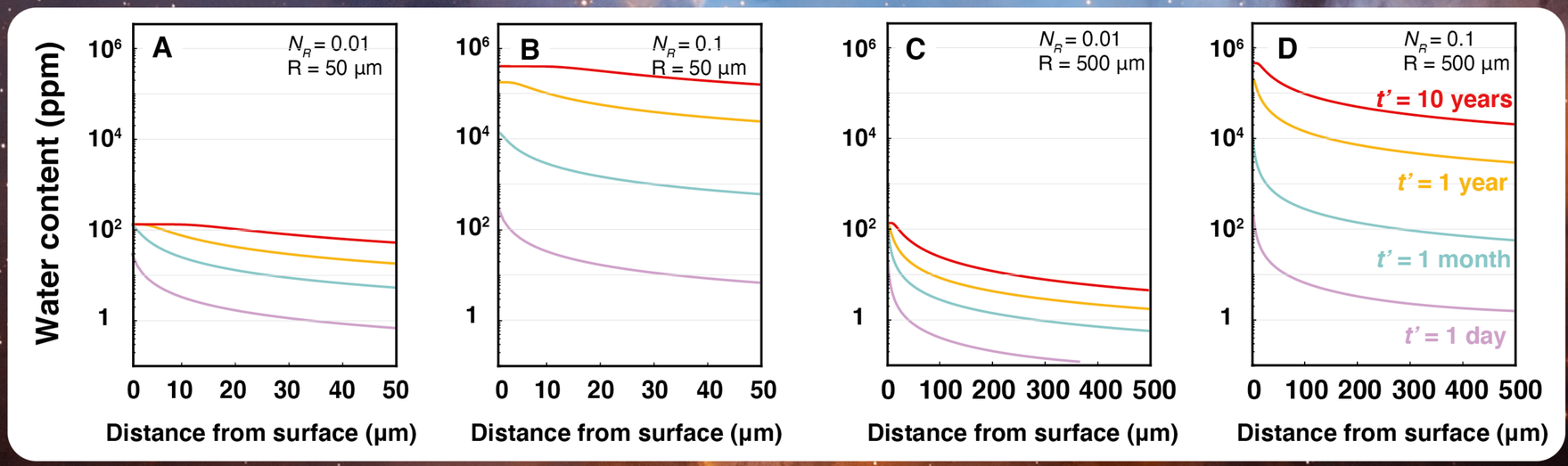

Fig. 2. Simulated concentration profiles of water in the interior of the silicates with radius (R) of 50 μm and 500 μm via solar proton implantation with retention coefficients (N_R) of 0.01 and 0.1.

Conclusions: **Implantation of H^+ ions in the early solar nebula can account for the incorporation of water in the early formed NAMs, and can transform the water contents in early-formed solids.**

References: [1] Jin Z. and Bose M. (2018) LPS XLIX, Abstract, #1670. [2] Jin Z. and Bose M. (2020) LPS LI, Abstract, #1470.

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