THE SOURCE OF WATER MOLECULES IN THE VICINITY OF THE MOON. *T. Földi [1], Sz. Bérczi [2],*
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ABSTRACT

We suggest three continuous sources for the lunar water molecules: 1) from the small ice meteorite collisions to the lunar surface, 2) from terrestrial and solar hydrogen, which reaches Moon in the periodical lunar crossings of the Earth's magnetic and radiation tail, 3) from atomic H with energy higher then 1525 K in the vicinity of the Moon, which reduces the metallic oxides [1] on the surface and produces water molecules by this reduction.

INTRODUCTION

Since Lunar Prospector discovered water sources in the lunar polar regions the question of water and its possible accumulation became challenging. The existence of water implies the question of the ratio of sporadic influx of water (ice) versus the continuous transport of water (molecules). Although we shortly touch the possibility of ice meteorites as water sources, we believe in the main role of the second possibility, the continuous influx of nanoparticle sized water containing components.

1. FROM ICE METEORITE IMPACT

In the case of ice meteorite impact, (which was not observed yet, only suggested), the impacting body is mixing and sublimating with the target materials, and cosmic concentrations of additive materials (i.e. NH_3 component) can survive only perhaps in the conditions of Antarctica [2], [3], [4]. As compared terrestrial and lunar conditions the atmospheric pressure difference (10 to minus 15 atm) implies the escaping of all impacted water on the Moon. Because we believe in the accumulation of the slow continuous process for the water we study the two other possibilities in details.

2. FROM EARTH'S TAIL TO THE MOON

It was found in electron-tube industry that water molecules may retain one negative electric charge. (Tungsram Factory, in 1935, Bródy and Palócz [5].) On the inner surface of the electron tube, in hypervacuum, a monomolecular water molecule layer was found. This molecular water layer was negatively charged while the glass surface wall was positively charged. Later, Israel [6] found that the negatively charged water molecules have very longer lifetime, do not recombine, This lifetime is an order of magnitudes longer, then that of the small positive ions. Such charged water molecules can survive the cosmic travel time from the Earth upper atmosphere to the surface of the Moon.

During full Moon the magnetic and radiation belts of the Earth sweep over the Moon. For the ionized and charged particles the "wall" of terrestrial magnetosphere tail behaves as a tube with reflecting walls. Together with ionized particles the water molecules, which have one negative electric charge (adhered to the water molecule) are also reflected on this tube wall. Therefore the charged water molecules do not escape from the tube but they travel till the Moon in the magnetic tail. The reflecting force from the wall is: v X B (where v is velocity, B is magnetic induction) the electrostatic accelerating force is e X E (where e is the electron charge unit, E is electric field strength in V/m) the acceleration by E is F_E Electric Force per molecular mass.

Let us follow the way of one water molecule in the terrestrial upper atmosphere. Because of the Brown motion neutral water molecular particles may get enough velocity to escape, if these particles get one electron which adhere them, then it will be transported to the magnetotail and remain inside the wall.

Reaching the lunar surface the negatively charged water particle meets the positively charged (from UV radiation, [7]) dust particles. With charged dust particles water molecule forms a complex coagulated particle. At the same time, in the near vicinity of the lunar surface there exist a space charge of electron cloud, which recharge and so neutralize the coagulated particle. But this coagulated particle will not remain neutral for a long time, but it becomes charged again by the space charge of electron cloud. This periodic charging up and discharge 1) enlarges the coagulated particle, and 2) levitates the particle which will be the object of a transporting mechanism which moves it toward the lunar pole [7]. The step by step drag by the solar radiation pressure toward the poles, where agglutinated particles become discharged, results in their fall-down, and accumulate on the surface [7].

3. BY REDUCTION OF LUNAR SURFACE ROCKS

The solar flux consists mainly of two components: photons and protons. The photon flux emits electrons from the lunar surface soil. Because of the electron emission of the lunar surface it become positively charged. Because of this field charge of the lunar surface the overwhelming majority of the protons from the solar wind will deviate the surface.

The very small part of the protons, before deviation, recombines in the electron cloud above the

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surface and forms neutral hydrogen atoms, (while emits photon). During recombination these neutral hydrogen particles preserve their energy of motion, because the mass of the proton is greater (with 3 orders of magnitude) then that of the electrons. These neutral hydrogen atoms impact to the surface and they will reduce the crystals of the surface rocks (Fig. 1.) (Because of the average energy of protons is 0.5 eV which corresponds to cca. 5000 K temperature this reduction can be modeled with a vacuum owen of these parameters.)

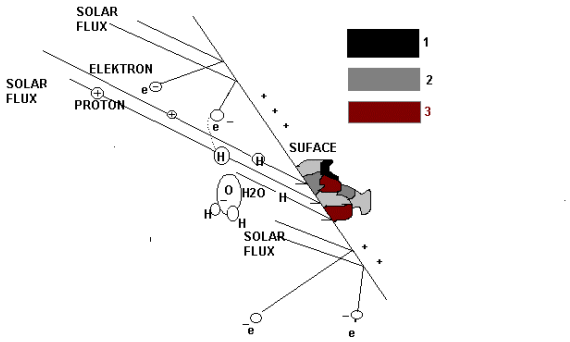

Fig. 1. Cartoon of those protons which become hydrogen by recombination and which reduce lunar surface crystals and produce molecular OH^- and H_2O. Along the lunar surface there is a cloud of electrons which, after reduction, contribute the coagulation of the OH^- and H_2O molecules with levitating dust particles. (1 dark gray: intensely reduced mineral grain, 2. middle reduced mineral grain, 3. less reduced grain.)

On terrestrial conditions reduction by H atoms means liberation of OH^- and H_2O molecules.
But the reduction in lunar (almost vacuum) conditions means two effects to be taken into consideration, because the reduction proceeds on molecular level, slowly and randomly, and therefore it does not influence the crystal structure of the crystallite.

As a consequence of this randomness 1) the crystallite becomes "vesicular" in molecular level (it can be described by a fractal dimension). Because of this "molecular vesicularity" the blackness of the surface increases considerably. (Other consequence of "molecular vesicularity" is that for the electrons the emission energy increases.)

2) The second consequence is that the produced OH^- and H_2O molecular units will stay longer above the emitting surface (because of the increased surface produced by "molecular vesicularity"). If these molecules remain longer in the vicinity of the lunar surface the probability of a plus electron absorption increases and the velocity of the OH^- and H_2O particles will not reach the escaping velocity.

As a final consequence of these two effects the OH^- and H_2O molecules will levitate (Fig. 1.) above the lunar surface (some millimeters above the surface). Now step in to the picture the charged dust particles [7], which, by chance, can meet with these levitating OH^- and H_2O particles, they can coagulate with each other and they can grow up larger and larger, and they also drift slowly toward the poles (see [7]).

SUMMARY

We studied three possible sources of the lunar water molecules. We did not find possible that ice meteorites may transport considerable water to the Moon. But we studied two other processes. One is caused by the Moon's periodic crossing of the terrestrial magnetic tail. Rising water molecules from the Earth's atmosphere may get a negative charge, and so electromagnetic forces transport it to the lunar surface.
We studied the way of reduction which may produce water molecules on site of the lunar surface, from solar protons, recombining to atomic H, which then reduces metal oxides of the surface minerals.

Water molecules from these two sources will agglutinate electrostatically with the levitating charged dust particles. These coagulated particles periodically charge up and discharge, attract other H_2O molecules, and by the drag of solar wind pressure these composite agglutinated molecules move toward the poles where they are discharged, fall down and accumulate on the surface [7].

The most probable source of the lunar water are these two mechanisms.

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