

Space Studies of the Earth-Moon System, Planets, and Small Bodies of the Solar System (B)
Planetary Formation: From Dust to Giant Exoplanets (B0.5)

MIGRATION OF ICY PLANETESIMALS TO FORMING TERRESTRIAL PLANETS

Sergei I. Ipatov, siipatov@hotmail.com
Vernadsky Institute and Space Research Institute, Moscow, Russia
Mikhail Ya. Marov, marovmail@yandex.ru
Russian Academy of Science, Russia

Our studies of migration of planetesimals from the feeding zone of Jupiter and Saturn to forming terrestrial planets were based on computer simulations of the orbital evolution of 10^4 planetesimals under the gravitational influence of planets. In series JN, all planets were considered in present orbits with present masses, and in series JS, Uranus and Neptune were excluded. Initial eccentricities and inclinations of planetesimals were 0.3 and 0.15 rad, respectively. Their initial semi-major axes were between 4.5 and 12 AU. Masses of planets moving in the orbits of the terrestrial planets were equal to present masses of the planets in series JS and JN, and were smaller by a factor of 10 in series JS₀₁ and JN₀₁. The obtained results show that the ratio of the fraction of the planetesimals collided with an embryo of the Earth's embryo was about $2 \cdot 10^{-6}$ and $4 \cdot 10^{-7}$ for the mass of the embryo equal to the Earth mass and to 10% of the Earth mass, respectively. We concluded that during the growth of the mass of the Earth's embryo up to a half of the present mass of the Earth, the amount of water delivered to the embryo could be about 30% of all water delivered to the Earth from the feeding zone of Jupiter and Saturn. The total mass of water delivered to the Earth from the feeding zones of the giant planets and beyond these zones could be comparable with the mass of the Earth's oceans. A half of this water could come from the feeding zone of Jupiter and Saturn, and another half from more distant regions. Most of the water that was delivered from the distant regions to the Earth's embryo came when its mass was not small (e.g., was mainly greater than a half of the Earth mass). In series JS, the ratio of the mass of water delivered to a planet to the mass of the planet for the Earth was smaller by a factor of 2, 1.25, and 1.3 than for Mars, Venus and Mercury, respectively. For series JN, the above values of the factor were equal to 3.4, 0.7–0.8. For the growth of the Earth's embryo of mass m by accretion of planetesimals that came from the feeding zone of Jupiter and Saturn, the increase of its mass was proportional to $m^{0.74}$.