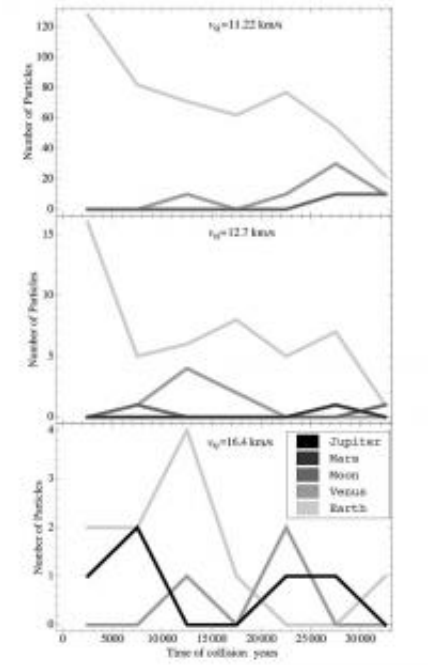
Simulation shows how Earth may have seeded life on other planets

August 23 2011, by Lisa Zyga



Out of 10,242 simulated particles ejected from Earth, these figures show the number of particles that collide with nearby planets at three different ejection velocities, and the collision times. In the top panel, the values corresponding to collisions with Venus and the Moon are 10 times the actual values, which are too small to be plotted. Image credit: M. Reyes-Ruiz, et al.

(PhysOrg.com) -- When comets and asteroids impact Earth, we're usually most concerned with how the impact events have affected life here. But scientists have pointed out that these impact events can eject pieces of Earth's crust containing biological organisms into space, and if

ejected at the right velocities from the right location on Earth, the ejected material could collide with another planet and seed life elsewhere in the Solar System. By using new simulations to analyze the dynamics of these ejected particles, and by tripling the number of particles compared with previous studies to improve the statistics, researchers have found that particles could not only reach Venus, the Moon, and Mars, but for the first time they show that particles from Earth could also reach Jupiter.

Mauricio Reyes-Ruiz at the Universidad Nacional Autonoma de Mexico and coauthors have posted their study on the collision probabilities of particles ejected from Earth with other nearby planets at arXiv.org.

In addition to showing that particles ejected from Earth could reach Jupiter, their simulations also showed that the number of particles ejected from Earth that collide with Mars is two orders of magnitude greater than previous studies have found. The researchers explain that both results have astrobiological significance, especially due to the evidence for life-sustaining environments on early Mars and on Jupiter's moons Europa and Ganymede.

In their simulations, the researchers analyzed 10,242 particles with a minimum ejection velocity of 11.2 km/s (which is required to escape Earth's orbit). Different impact events throughout Earth's history have ejected particles with a wide range of velocities, with the maximum determined by the speed of the impactor as it hits Earth. The researchers followed the simulated ejected particles for 30,000 years, which is the maximum estimated survival time for biological material in space.

Calculations have shown that an ejection velocity of 11.62 km/s is needed to reach Mars and 14.28 km/s to reach the orbit of Jupiter. While particles with ejection velocities of around 11.2 km/s have the highest chance of falling back to Earth, particles with ejection velocities of

greater than 16.4 km/s typically get launched entirely out of the Solar System. Since these particles spend a very short amount of time in the inner Solar System, their collision probability with other planets is negligible.

The results of the simulation also showed that the probability of particles ejected from Earth colliding with other planets depends on the particular place on Earth from where the particles are ejected. Particles ejected from Earth's leading face along its direction of motion, which are statistically more likely, have a higher probability of colliding with Mars and Jupiter, while particles ejected from the trailing face are more likely to impact Venus.

The researchers note that, overall, the probability of particles ejected from Earth colliding with another planet is very small. Further studies will be needed to investigate the velocity distribution of the ejected particles, along with simulations that use a greater number of ejected particles to estimate collision rates that have greater statistical significance.

More information: M. Reyes-Ruiz, et al. "Dynamics of escaping Earth ejecta and their collision probability with different Solar System bodies." arXiv:1108.3375v1 [astro-ph.EP]

via: Physics ArXiv Blog