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Delivery of organics to Mars through asteroid and comet impacts

K. Frantseva (1,2), M. Mueller (2,1), F.F.S. van der Tak (1,2), I.L. ten Kate (3) and S. Greenstreet (4,5)
(1) SRON Netherlands Institute for Space Research, Groningen, The Netherlands, (2) Kapteyn Astronomical Institute, University of Groningen, The Netherlands, (3) Department of Earth Sciences, Utrecht University, The Netherlands, (4) Las Cumbres Observatory, CA, USA, (5) University of California at Santa Barbara, CA, USA (k.frantseva@sron.nl)

Abstract

The recent discovery of methane in the Mars atmosphere and organic molecules in drill samples taken by Curiosity is surprising, as photodissociation and photodegradation would destroy most organics within hours. While burying in the subsurface will increase the lifetime, it is clear that organics must have been delivered in geologically recent times, presumably by impacts of asteroids, comets, and/or interplanetary dust particles (IDPs).

The IDP-borne organic flux on Mars was estimated to be 1.2×10^6 kg/yr by Flynn (1996) [**?**]. We calculate for the first time the flux from asteroids and comets.

We have performed numerical gravity simulations of impact rates on Mars within the past few Myr. We use the N-body integrator RMVS/Swifter to propagate the Sun and the eight planets from their current positions. Separately, we add comets and asteroids to the simulations as massless test particles, based on their current orbital distributions. In our asteroid simulations we focus on organic-rich (C-class), basing ourselves on the dynamical model by Greenstreet et al. (2012) [**?**] and on the measured distribution of taxonomic types across the Main Asteroid Belt. For the comets we assume a constant organic fraction.

We estimate the global carbon flux on Mars from cometary impacts to be $\sim 0.01 \times 10^6$ kg/yr within an order of magnitude, asteroid impacts deliver $\sim 0.042 \times 10^6$ kg/yr. Also, we find that organics from asteroids and comets will dominate over IDP-borne organics at distances up to 100 km from the crater center.

References

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