Formation conditions and evolution of comets as derived from experimental results compared to Rosetta's measurements

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Rosetta spacecraft at the comet 67P/ChuryumovGerasimenko delivered most important scientific data on comets. Laboratory studies are essential to evaluate comets' formation conditions, and their evolution and also to interpret the received data from Rosetta. Direct measurements together with laboratory experiments help improve our understanding the nucleus interior structure and composition, the surface covered with cracks and craters and also the volatiles in the coma formed along the orbit around the Sun.
The findings of our laboratory experiments can set the formation temperature by the trapping mechanism of gases in amorphous ice as compared to new direct measurements by the Rosetta spacecraft on Comet 67P/C-G. The measured noble gases Ar, Kr and Xe, without Ne, together with the N2 measurements set the grains formation temperature at 30 K (Rubin et al., 2015). By comparing the experimental results of trapping gases and their relative ratios in the amorphous ice with ROSINA mass spectrometer measurements we can appreciate the gas composition in the comet formation region and the implications for the origin of the volatiles on the solar system (Owen and Bar-Nun, 2000).
The observed outbursts, forming deep pits (Mousis, et al., 2015), on the nucleus surface can be also explained by the gas released from ice during the heating process.
More experiments are needed to interpret ROSINA's measurements and also to understand the differences among comets, such as D/H ratios (Altwegg et al., 2015) and thermal conductivity (Bar-Nun and Laufer, 2003). Laboratory studies are essential also for planning a future sample return mission or deep nuclei excavation.

The author acknowledges support from the Israel Ministry of Science, Technology and Space through the Israel Space Agency.

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