Clues on the origin of comets from Rosetta and Philae

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The ESA Rosetta mission with US instrument participation successfully completed its two-year primary mission to comet 67P/Churyumov-Gerasimenko in Sep 2016. The Rosetta orbiter and the Philae lander made the most thorough documentation of the physical and chemical properties of a comet nucleus, gas and dust coma, and plasma environment thus far in the history of human spaceflight.

The evolving comet landscape revealed by the cameras, the composition of gas measured by mass spectrometers, the odd shapes and structures of dust aggregates documented by the atomic force microscope, and the interior structure probed by the bistatic radar are as mysterious as the Egyptian hieroglyphs that inspired the name of the spacecraft. Deciphering this ancient message that tells the story of the formation and evolution of the comet, and that provides insight to the Solar System environment in which comets are born and processed, is far from trivial.

I will provide an overview of the observations by Rosetta and Philae that are most relevant for reconstructing the origin of this comet nucleus. I will also sketch one formation scenario that has been proposed to explain the observed properties, that interprets the high porosity, low strength, structural and morphological properties, chemical composition, and apparent lack of aqueous alteration as signatures of an ancient mostly primordial nucleus that has not been substantially processed by heat and collisions since its birth at the dawn of the Solar System. Perceived problems with this interpretation are discussed and the significance of resolving these issues for understanding the early Solar System are described.

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