The early evolution of our solar system and of nascent planetary systems: hints for the origin of comets?

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What can we learn from the highly successful Rosetta mission to comet 67P/Churyumov-Gerasimenko about the origin of comets? In this talk, selected research results on nascent planetary systems and the early solar system will be presented in order to help answering that question. Young stellar objects (YSOs) can form only in cold and dense regions of the interstellar medium (ISM), protected by dust against the radiation of nearby stars. They are classified into classes 0, I - III, according to the index of their spectral energy distribution in the visual and infrared wavelength regions. The evolutionary stages (models) corresponding to the observed classes and their duration will be presented. Comets contain highly volatile ices like CO ice. Only dust inherited from the interstellar molecular cloud that gave birth to the YSO can shield the environment of comet formation against radiation from the star and other stars and provide the low temperature needed to form comets. This, and other important aspects of modelling of YSOs and their disks, like the chemistry induced by cosmic rays and UV radiation in the dark environment will be discussed in the first part of the talk. There is evidence from undifferentiated meteorites (chondrites) containig calcium-aluminum-rich inclusions and chondrules that, besides of the cold regions needed to form comets, high temperature areas existed in the early solar system. End products of radioactive decay of short-lived radionuclides (SLR) like 26Mg, produced from 26Al with a half life of 0.73 Myr, were found in chondrites. 26Al and other SLRs must have been implemented by stellar winds from a high-mass star, most likely from a supernova, in the very early times of the solar system, most probably already during stage 0 of YSO evolution. The ISM exists in different phases. At present, our solar system is surrounded by the hot, fully ionized phase. Clearly, the solar system must have formed in the cold molecular phase of the ISM, but we must face the possibility that the solar system evolved close to a so-called photoionization interface, i.e. in a transition region between the hot ionized and cold molecular phases of the ISM. The second part of the talk will be devoted to this fact and its possible infuence on comet formation. At the end I will briefy discuss what the presented research results may, in my opinion, imply for comet formation and for particular properties of comet 67P/Churyumov-Gerasimenko found during the Rosetta mission.