LUMINOSITY OUTBURSTS AND THEIR IMPACT ON THE CHEMICAL CONTENT OF THE PROTO-SOLAR NEBULA.

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Introduction: The properties of the first solids imprinted in meteorites and interplanetary dust particles put important constraints on factors that governed the formation of the Solar Nebula, but processes that have caused dust crystallization, chondrules' condensation, melting, and solidification etc. as well as their spread over the Solar System are still debated (e.g. [1]). On the other hand, the formation of a planetary system is apparently accompanied by luminosity outbursts that are probably caused by periods of enhanced accretion [2]. In this contribution we consider these outbursts as one of transient heating sources in the forming planetary systems and analyze their possible contribution to the changes in the disk chemical composition and structure as well as to the evolution of first solids in the vicinity of the young Sun.

Model: We use a parametric disc model around a typical young Solar-type star, described in [3]. A disc has a pre-set surface density radial profile and is illuminated by the radiation field of the central star, whose parameters were derived from [4] models, accretion luminosity corresponding to a specific value of the accretion rate, and interstellar radiation field. A quiescent state of the disc is approximately represented by the accretion rate of $10^{-9}\ M_{\odot}\ \mathrm{yr}^{-1}$, while an outburst corresponds to the accretion rate of $10^{-5}\ M_{\odot}\ \mathrm{yr}^{-1}$. The chemical processes are modeled using an extensive set of chemical species and reactions, which includes both gas-phase and solid-phase processes.

Results: The luminosity outburst severely heats the disk material. While at a quiescent stage, the temperature at 1 au only slightly exceeds 300 K, during the outburst the disk temperature (except for the midplane) exceeds 1000 K up to a distance of about 5 au. At the same time, the disk puffs up due to this heating, which may initiate a material transport at larger scales. We consider possible chemical consequences of the luminosity outburst and indicate gas-phase species that can be used as tracers of outburst-driven changes in other protoplanetary disks. It is shown that some complex organic molecules can be used as tracers of past outburst activity in the protoplanetary disks, marking them as potential sites to look for outburst-related dust processing, like, for example, the crystalline silicate production [5].

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