THE IMPORTANCE OF EXTRATERRESTRIAL ICES IN ASTROCHEMICAL AND PREBIOTIC EVOLUTION

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Introduction: Interstellar ices (H_2O, CO, CO_2, CH_3OH, NH_3, CH_4, etc.) are widely observed in the mid-infrared range around protostellar objects [1], from which planets, but also debris such as comets and asteroids may ultimately form. In the laboratory, experiments simulating the energetic (UV photons, cosmic rays) and thermal evolution of ice analogues lead, after warming the sample up to room temperature, to the formation of a water-soluble semi-refractory organic residue (see Fig.1). These residues have been studied thanks to numerous analytical techniques over the last thirty years, allowing their partial physical and chemical characterisation [2] and showing that they contain a wide variety of organic molecules, some of them of potential prebiotic interest, such as amino and di-amino acids [3]. They may then be considered as analogues of pre-cometary and/or meteoritic organic matter, in particular the soluble part (SOM) although a precise astrophysical scenario is still debated.

The MICMOC experiment: We will present general results on our MICMOC experiment concerning the evolution of ices toward organics, with the detection of numerous amino acids but also our recent analyses in which we have detected aldehydes and sugars for the first time in these organic residues produced from initial simple ices [4]. In addition, enantiomeric excesses in some amino acids have also been reported in the same experiments using UV Circularly Polarized Light on the SOLEIL synchrotron [5]. We will briefly discuss the potential implication of these results for prebiotic chemistry, within an astrophysical scenario that emphasizes the central role of extraterrestrial ice photo/thermo-chemistry as a ubiquitous phenomenon in protostellar media and protoplanetary disks environments.

Conclusions: As will be presented, the organic residue obtained from the VUV photo/thermos-chemistry of only three simple molecules (H_2O, CH_3OH, NH_3) known to be abundant in ices in molecular clouds do present an extremely large and complex variety of organic molecular composition. Among this complexity, molecules of possible prebiotic interest such as amino acids and sugars are indeed present. However, the route to an efficient prebiotic chemistry in a primitive Earth-like environment remains far from understood. A discussion on the next set of possible experiments will be briefly presented here.

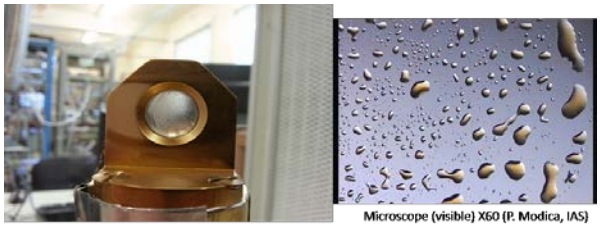

Figure 1; Room temperature of the organic residue (left) and a microscope image (x60) of it (right)

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