ASSESSING TERRESTRIAL DUST WITHIN ICE CORES AS A PROXY FOR DUST TRAPPED IN THE POLAR LAYERED DEPOSITS OF MARS.

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The Polar Layered Deposits (PLDs) of Mars: Layered deposits of ice and dust cover the Martian poles. PLDs have been mapped with unprecedented accuracy by optical, topographic and radar techniques from orbiter missions, revealing a stratigraphy thought to be linked with changes in the orbital parameters of Mars [1, and references therein]. Thus, PLDs constitute a record of the past climate of the planet. During the last decades, many efforts have been made to correlate these layers with the orbital evolution of the planet [e.g. 2, 3, 4].

Fig 1: North polar layered deposits (NPLD) as seen by HiRISE [5].

Dust in Terrestrial Ice Cores: At the same time, ice sheets on Earth reflect glacial-interglacial climate changes and temperature variations in sequences of high and low dust concentrations [6]. The accessibility of terrestrial ice allows for in-situ measurements of the dust trapped within the ice. For instance, the study of ice cores from Greenland and Antarctica has shown that production, transport and deposition of dust on Earth is influenced by climatic changes on glacial-interglacial scales: temperature variations during glacial periods account for up to 90% of the dust variability, whereas dust and temperature are not correlated during interglacial periods [7]. Such studies are essential inputs to the study of dust and climate coupling on Earth; we know now that dust is a key element in the climatic system of Earth that both affects and responds to climate change [8,9]

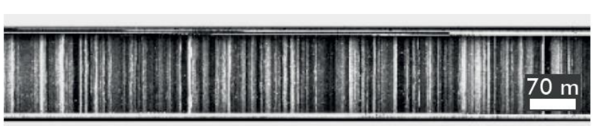

Fig 2: Scan image from a Greenlandic glacial ice core. Bright layers reveal the presence of dust, while black layers are pure ice. Image extracted from [10].

Focus on the Size and Shape of the Dust: On Earth, the study of dust particles informs of the atmospheric transport, the storminess, the conditions in the local source regions, etc. The isotopic composition of the particles reveals the origin of the dust, the size distribution is used to distinguish local or remote dust sources, or tephra layers [11]. The size of particles trapped in the ice informs as well about the atmospheric transport; for instance, the altitude at which dust is transported or the patterns in the wind needed to deliver it [8]. The shape of the particles influences their radiative interaction and settling behaviour. [12]

Furthermore, the size and shape of dust have shown to be crucial in modelling the reflectance from ice and dust mixtures [13]. By understanding the patterns in size and shape of the particles that get trapped in terrestrial ice, we can make assumptions on the size and shape of the particles trapped on Mars, which will eventually allow us to link deposition models [2] to brightness measurements of the PLD [3].

Introducing a Collaboration Between Mars and Earth Scientists: The Martian community can vastly profit from the studies that our terrestrial counterpart conducts on the ice core archives of dust. Indeed, the similarity between the questions addressed by the terrestrial and planetary communities is striking, yet no many links have been established between these communities.

We present an on-going collaboration at the University of Copenhagen between Martian and terrestrial ice and dust scientists. We will first give an overview of the dust and climate coupling on Earth as an exercise of comparative planetology. Then, we will show results of particle size measurements retrieved from a melting campaign conducted in Copenhagen with continuous flow analysis (CFA) and discuss the repercussion and viability of extrapolation to the dust trapped at the Martian PLDs.

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