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TBD (*THE ROLE OF ICE COMPOSITIONS AND MORPHOLOGY FOR SNOWLINES THE C/N/O RATIOS IN ACTIVE DISKS*)

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ABSTRACT

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1. INTRODUCTION

Background info. Importance of volatiles in disks and planetary atmospheres, detections of snowlines in disks, C/O ratios etc. State again the importance of radial drift and gas accretion on the snowlines location, and that a systematic study of the combination of these two particular effects across the disk has not been done before. Then transition to the fact that we provide such a systematic study in Paper I and in this paper: here we enhance the model of Paper I by making three additions: (1) we add N and CH4 in the static chemistry model, (2) we explore how different abundances of CH4 and of the N main carriers (N2 and NH3) affect the C/O and N/O ratios, and (3) we explore how different binding energies of CO, N2 and (perhaps) CH4 affect the snowline locations.

2. MODEL REVIEW

Review the four disk models, desorption model, relevant timescales. Summarize the findings of Paper I, i.e. particles of certain sizes desorb instantaneously and at a fixed particle size dependent location. Probably split into 2 subsections.

3. VOLATILE ABUNDANCES AND BINDING ENERGIES: EFFECT ON C/O AND N/O RATIOS IN A STATIC DISK

3.1. *Nitrogen and CH4*

Discuss that nitrogen is abundant in the solar system and should be abundant in disks as well, but that its dominant form is largely unknown. Discuss that the main carrier of nitrogen is N2, but some fraction of it can be NH3 as well. Present and motivate the choices that we make for NH3 abundances. Along the same lines, discuss CH4, and the choices that we make for CH4 abundances.

3.2. *Volatile Desorption Energies*

State that desorption energies for H2O and CO2 are well constrained experimentally, and that the CO2 binding energy is only weakly dependent on whether it's pure CO2 or combined with H2O, but that is not the case for CO, N2 (and perhaps CH4 and NH3?). Briefly discuss CO-CO, N2-N2, CO-H2O and N2-H2O (and perhaps the same for CH4 and NH3 if we find literature on that) experimental results for binding energies, and motivate the choices that we make.

3.3. *Results for C/O and N/O in a Static Disk*

For each of them (C/O and N/O), show a 3-panel plot as follows: each panel has a specific CH4/NH3 abundance (top: none, middle: median abundance, bottom: maximum abundance); for a given panel, have multiple curves for C/O or N/O, depending on the choice of binding energies, so that it's clear visually how the binding energy changes the snowline location. Discuss how different abundances and binding energies affect snowline locations and C/O or N/O ratios.

4. RESULTS

4.1. *N2, NH3 and CH4 Snowline Locations*

One multipanel 3x3 (or 3x2) rainbow plot similar to the snowline plots from Paper I, for one choice for the binding energies (perhaps the largest ones, since we want a limit on how far in we can push the snowlines?). Rows: snowlines as a function or particle size for passive, active and (maybe) steady-state disk. Columns: N2, NH3 and CH4. Not entirely certain how necessary these plots/subsection actually are, since it is exactly the same qualitatively as in Paper I...

4.2. *C/O and N/O Ratios*

For each of them (C/O and N/O) show a 3x3 multipanel plot similar to the C/O plot from Paper I, for the same choice of binding energies as in the previous subsection. Columns: C/O or N/O in passive, active and steady-state disk. Rows: No CH4/NH3, median CH4/NH3, maximum CH4/NH3. Again, not sure if we need/want this for all disk choices, at least in the case of C/O since we already have that in Paper I. For N/O, quantify how the snowline location changes from a static disk due to drift and gas accretion.

5. DISCUSSION

Discuss how entrapment of volatiles by H2O affects volatile abundances and C/O ratios. More TBD.

6. SUMMARY

Maybe we can include the summary in the discussion section?

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