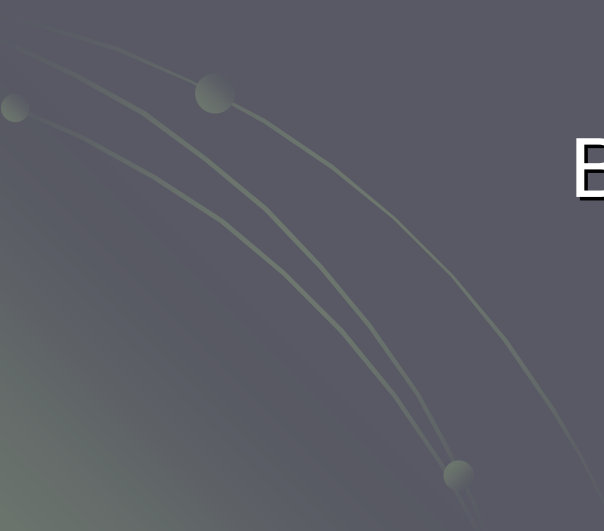


Outgassing of Chondritic Planets: Preliminary Results

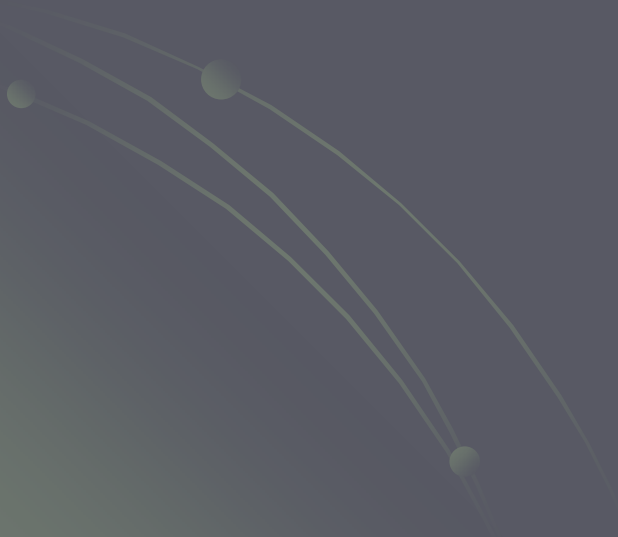
Laura Schaefer
Bruce Fegley, Jr.



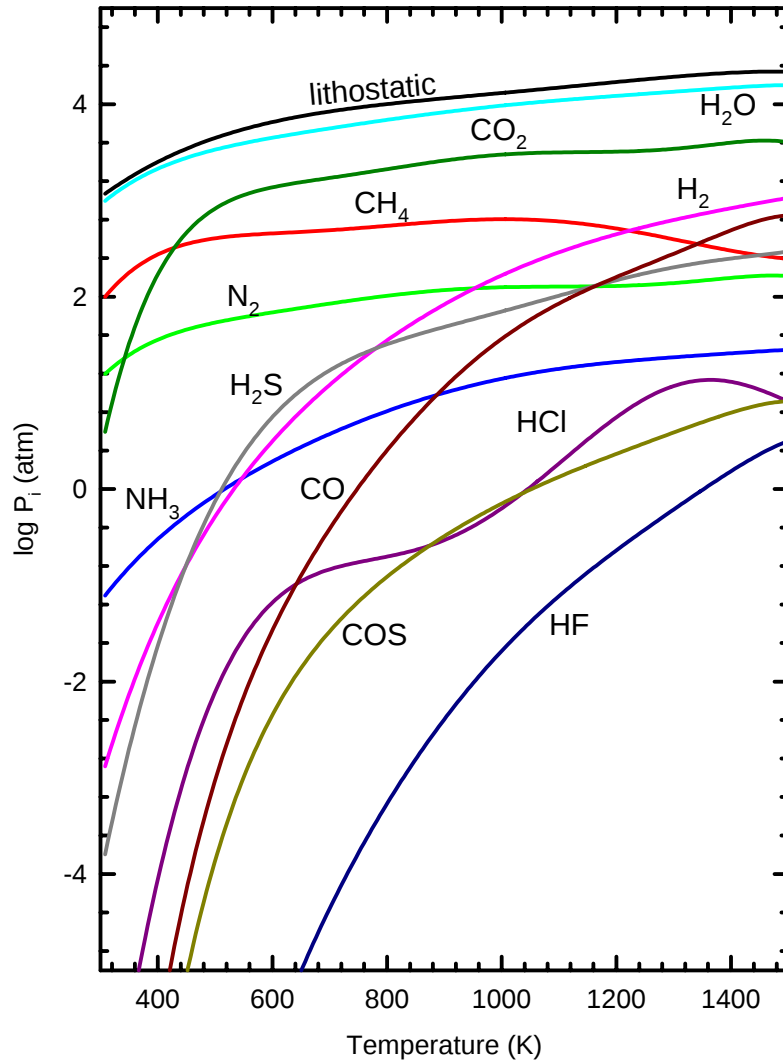
Preliminary Calculations

- Assumptions:
 - planetary body of homogeneous meteoritic composition
 - terrestrial T/P profile for upper layers (~70 km)
- Divide interior into layers ~3 km thick
- Calculate initial gas composition for each layer (21 layers)
- Prior calculations by Bukvic (1979) M.S. thesis, MIT

Gas Compositions



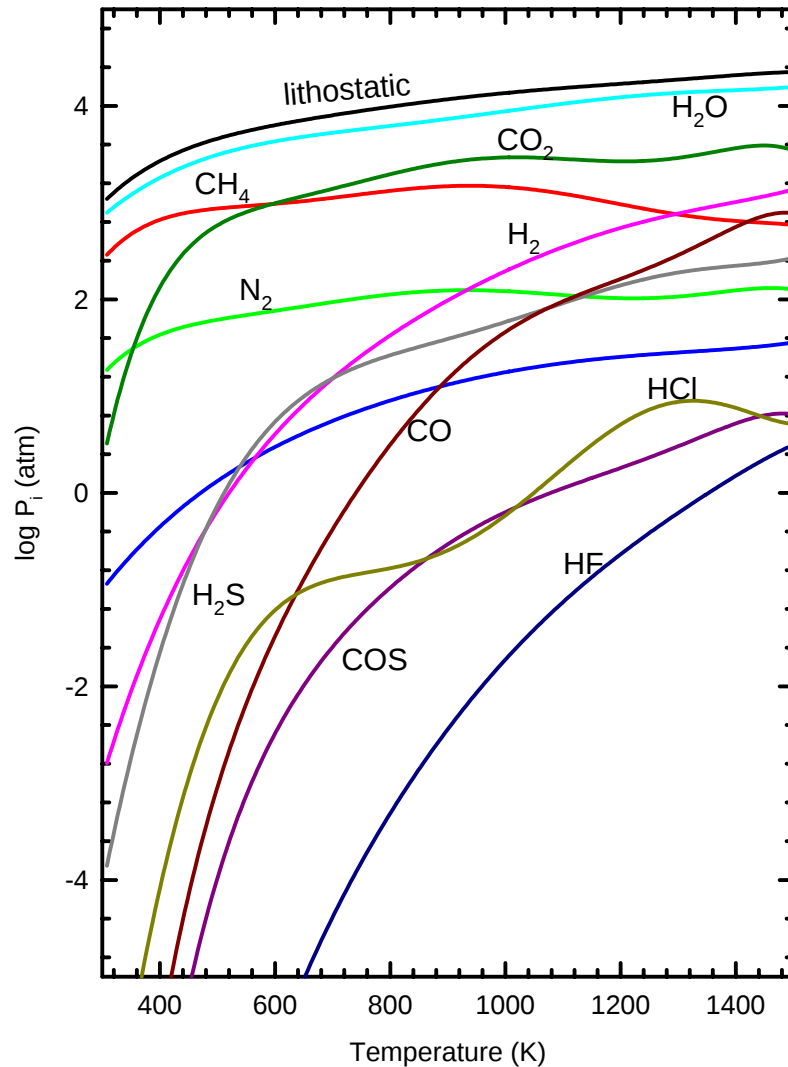
Outgassing of an average CI chondrite



CI Chondrite

- Average CI chondrite from Lodders (2003) ApJ
- Major gases are H_2O , CO_2 , CH_4 , H_2 (higher T)
- $N_2 > NH_3$
- $H_2S > OCS, SO_2$
- Gas composition is more oxidized in deeper layers (at higher T & P)
 - $\log fO_2 = -65$ at 3 km
 - $\log fO_2 = -9$ at 63 km

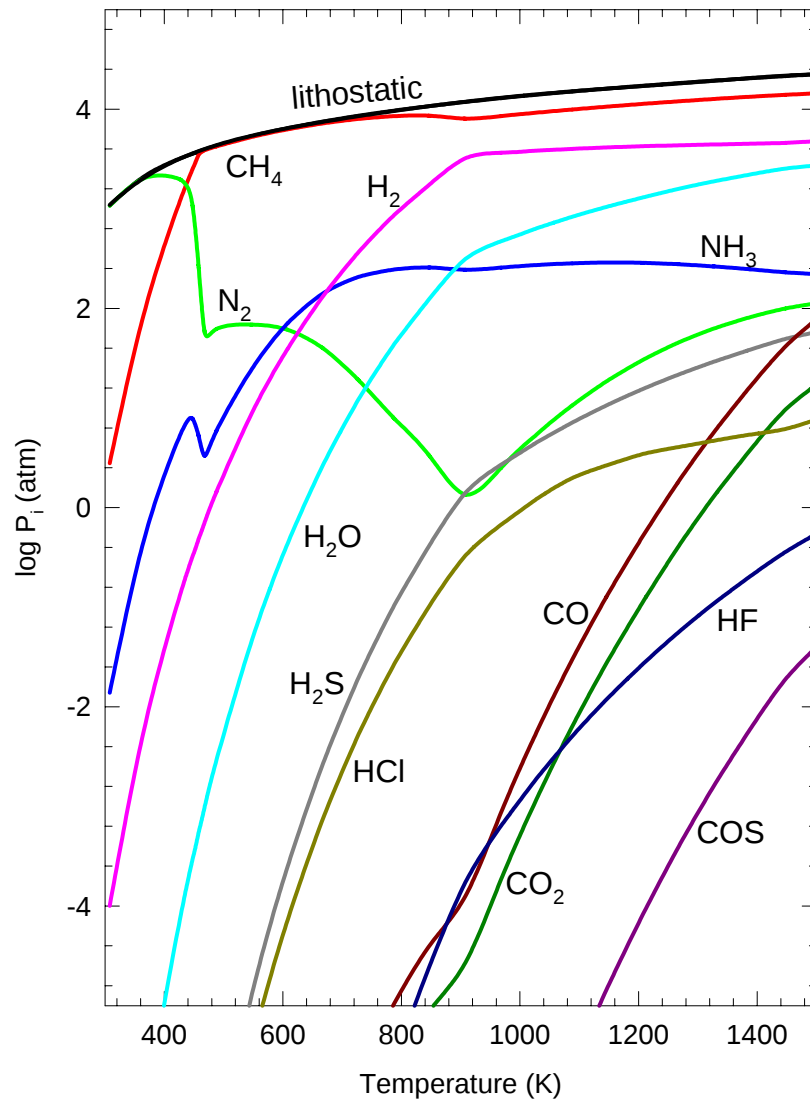
Outgassing of an average CM chondrite



CM Chondrite

- Average CM chondrite from Lodders & Fegley (1998)
- CM chondrites have less H,C,N than CI chondrites
- Major gases are similar to CI chondrites
- Slightly less oxidized than CI chondrite

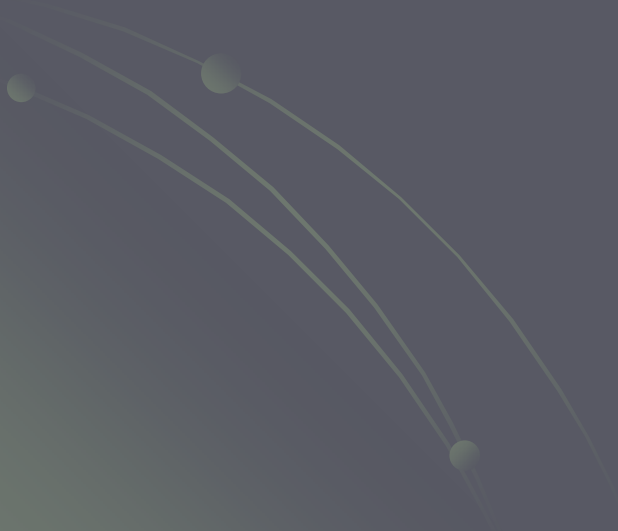
Outgassing of an average L chondrite

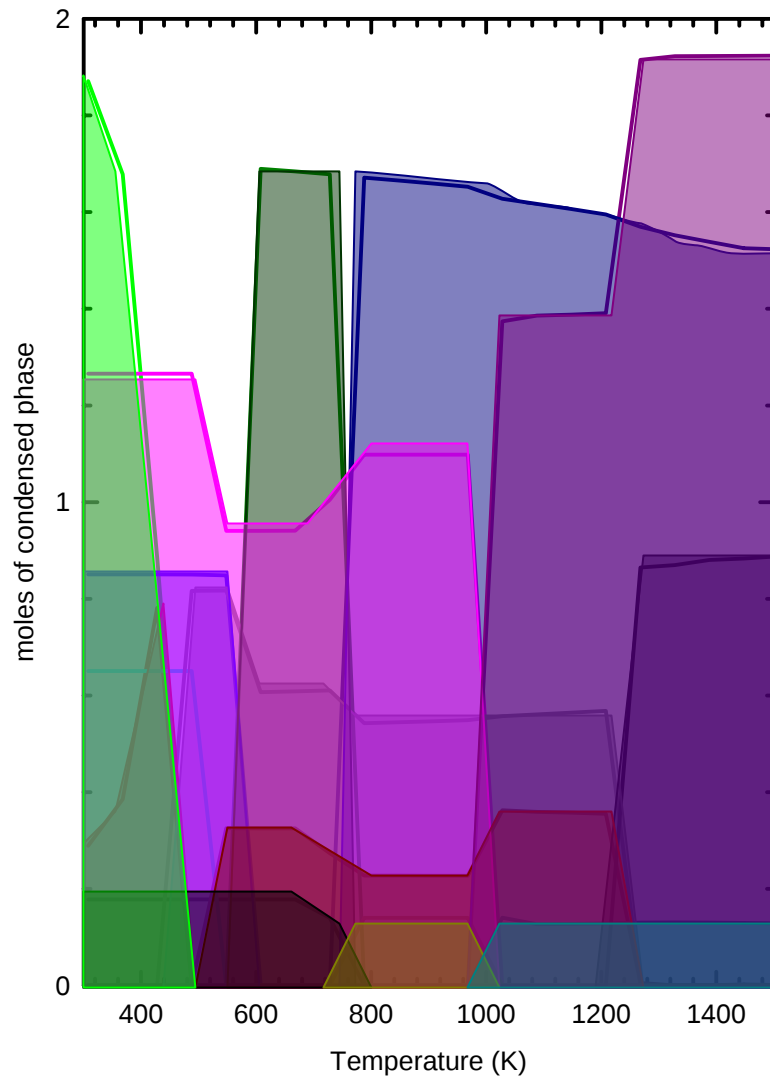


L Chondrite

- Average L chondrite (falls) from Jarosewich (1990)
- Ordinary chondrites (H, L, LL) are H,C,N poor relative to carbonaceous chondrites
- Major gas is CH_4
- Gas is much more reducing than carbonaceous chondrites
 - $\log f\text{O}_2 \sim -88$ at 3 km
 - $\log f\text{O}_2 \sim -12$ at 63 km

Solid Phases

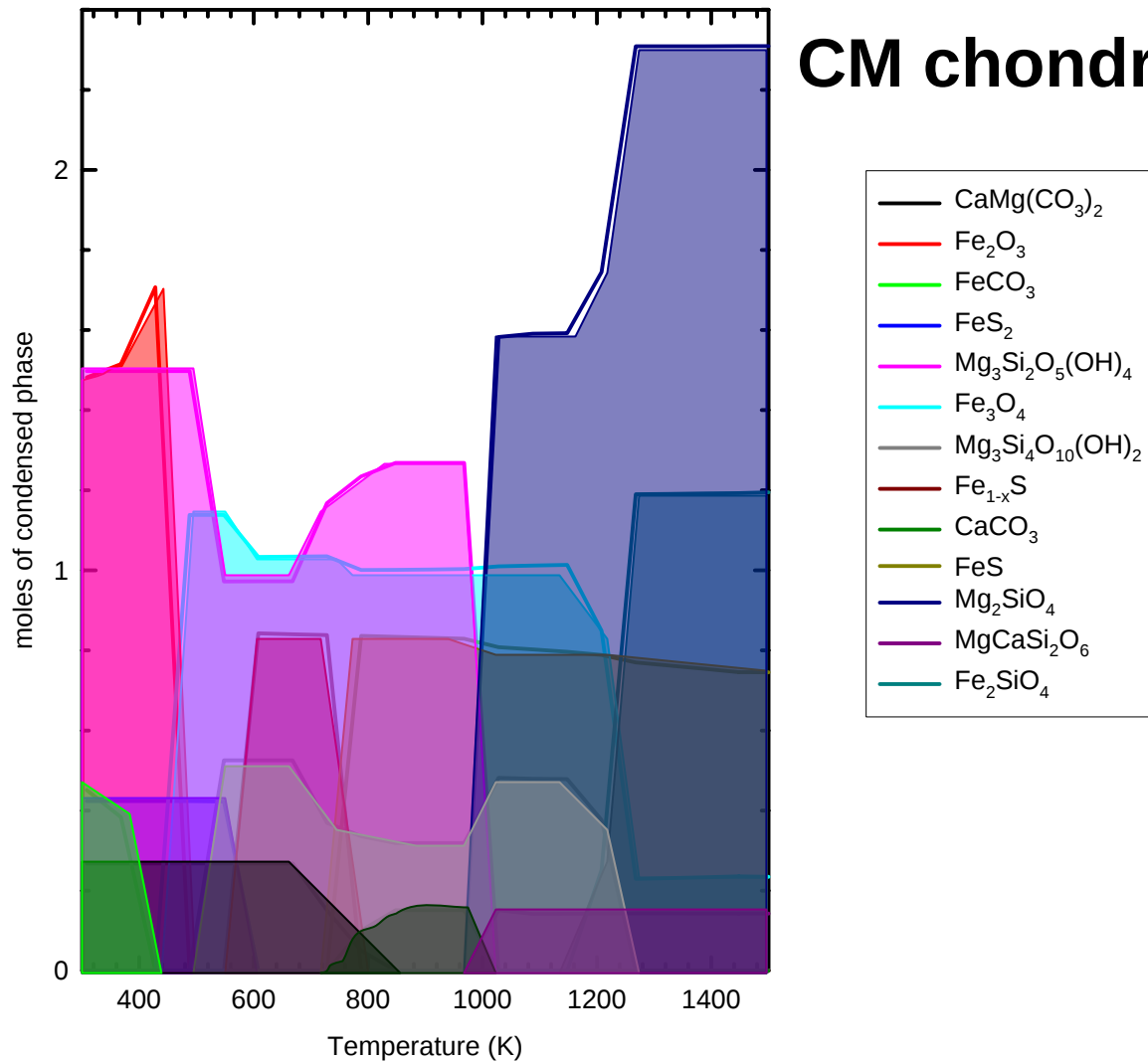




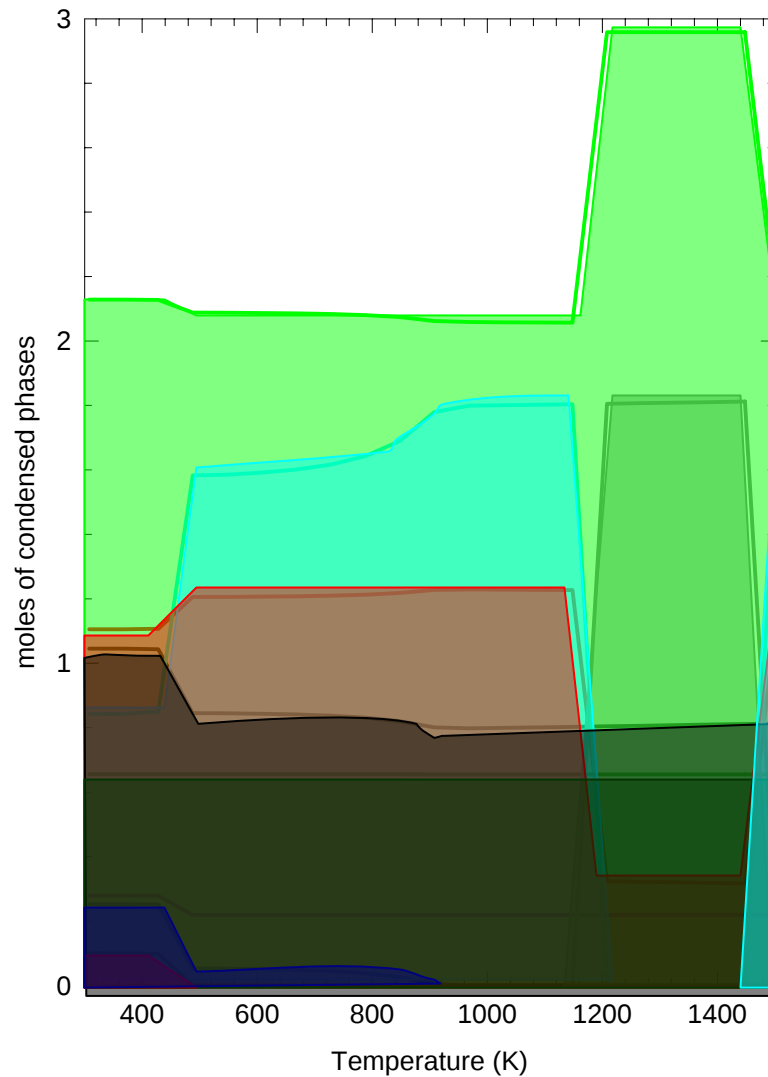
CI chondrite

- Also condensed:
 - Ca₅(PO₄)₃F
 - Ca₅(PO₄)₃OH
 - KAl₃Si₃O₁₀(OH)₂
 - NaAlSi₃O₈
 - NaCl
 - CaAl₂Si₂O₈
 - KAlSi₃O₈
 - FeSiO₃
 - Ni metal

CM chondrite



- Also condensed:
 - Ca₅(PO₄)₃F
 - Ca₅(PO₄)₃OH
 - KAl₃Si₃O₁₀(OH)₂
 - NaAlSi₃O₈
 - NaCl
 - CaAl₂Si₂O₈
 - KAlSi₃O₈
 - Ni metal
 - SiO₂ (quartz)
 - C (graphite)



L chondrite

- No carbonates
 - Graphite is a proxy for carbonaceous goo
- Fe (m) condensed
- Also condensed:
 - $\text{Ca}_5(\text{PO}_4)_3\text{F}$
 - $\text{Ca}_5(\text{PO}_4)_3\text{OH}$
 - $\text{CaAl}_2\text{Si}_2\text{O}_8$
 - $\text{NaAlSi}_3\text{O}_8$
 - NaCl
 - KAlSi_3O_8

Future Work

- Use other meteoritic compositions (i.e., enstatite chondrites, achondrites, etc.)
- Study evolution of gas composition as gas is emitted into higher layers
- Study evolution of mineralogy as gas evolves and is removed
- Do same computations for a proto-Io type planet