# TEGA Update

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# History of TA samples

- **5 samples analyzed fully**
  - **TA4, Baby Bear: Disturbed surface sample taken soon after landing**
  - **TA0, Wicked Witch: sublimation lag from bottom of Snow White trench. It had a small amount of ice with it (~1% or less)**
  - **TA5, Rosy Red: A well documented undisturbed surface sample**
  - **TA7, Burn Alive: A deep sample taken beneath Rosy Red to look for differences as a function of depth.**
  - **TA6, repeat of Rosy Red: No quantitative analysis done yet.**
- **TA1, A "blank" sample: reported on at End of Sol on 10/14. Final quantitative analysis not yet done, but data still look like the blank is a factor of 10 lower than our signal for low-temperature release of $CO_2$ (therefore or signal from the other TAs is not due to terrestrial organics being oxidized by the sample).**

# History of TA samples (cont’d.)

- **TA3 blank: TA3 oven was closed and used as a second blank to support (and perhaps lower) the blank level found on TA1**
  - **Data just arrived a few hours ago.**
  - **EGA sweep voltage shut down in the middle of the run.**
    - **Don’t know why yet.**
    - **Bad thing is we lost data from 150ºC and above, right where it would have started to be useful.**
  - **Data from TA1 are very likely to be good enough on their own.**
- **TA2: Never did get a successful sample acquisition.**

# Interesting observations on carbonate(s)

- **All samples show release of $CO_2$ at low temperature (250ºC to 600ºC)**
  - **This low-temperature $CO_2$ could have been from $FeCO_3$, oxidized Mars organics, or oxidized terrestrial organics.**
    - **Data on TA1 blank suggests we can eliminate terrestrial organics.**
  - **The amount is low, on the order of 0.0x% carbonate (based on $CO_2$ volume)**
- **We see a wide range of the amount of $CO_2$ released at high T**
  - **700ºC to 1000ºC: almost certainly due to CaCO3.**
  - **Two samples (Baby Bear and Wicked Witch) showed little or no high-T release of $CO_2$**
    - **On the order of 0.0x % carbonate**
  - **Rosy Red (1st) had much more $CaCO_3$ (on the order of 5%)**
  - **Rosy Red (2nd) had significant $CO_2$ release, but not quantified yet.**
  - **Burn Alive has some intermediate amount of $CaCO_3$, but it is also not yet quantified.**
- **Not clear why such a big difference (it is almost certainly interesting)**

# CO2 Isotope Ratios

- **We have a new way to analyze the released gases now that we understand the nature of their release pattern.**
  - **We collect all of the gases in a certain temperature range and release them for analysis all at once.**
  - **We record the pressure of the gases released as a function of time to know the temperatures of release.**
  - **The total pressure is a good measure of the amount of gas released.**
  - **This approach allows us to have a much higher signal-to-noise ratio for the isotopes of CO2.**

# Precision of isotope ratios from evolved $CO_2$

- **We have been able to demonstrate excellent precision on our measurement of count-rate ratios**
  - **Conversion to isotope ratios depends on getting high precision on our calibration gas, but we expect that to not be a problem.**
  - **Other sources of systematic error must also be evaluated**
  - **For Burn Alive, we got good data on both the low-T and high-T CO3 release.**
    - **For mass 45 we get ± 1.5 ‰ (requirement is 5 ‰)**
    - **For mass 46 we get ± 1.4 ‰ (requirement is 10 ‰)**
  - **Isotopic ratios could help argue for low-T CO2 being from Mars organics rather than carbonates.**
- **Since the last presentation we have analyzed the calibration gas several times, but have not been able to reduce the data yet.**

# Atmospheric Work

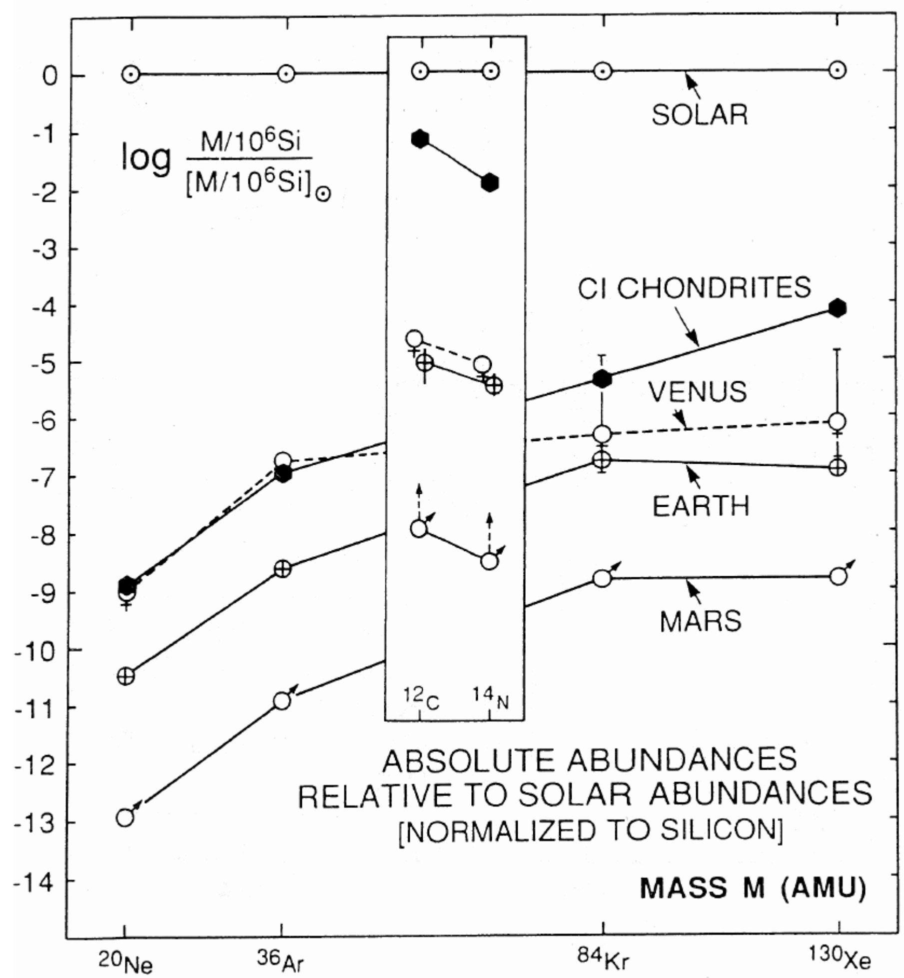
- Nothing new to discuss here. John Hoffman and Paul Niles will have more results to discuss after we do more data reduction.
- Only thing left to do is GEC run (Gas Enrichment Cell)
  - This cell collects gas from the atmosphere and chemically removes the $CO_2$ and $N_2$, which is 98% of the gas.
  - We increase the pressure of noble gases by a factor of up to 50.
    - This increases our sensitivity by a lot

# Why measure noble gases?

- **There a many, many reasons why knowledge of noble gas abundances is important, but the real question is why measure them with them with Phoenix.**
  - **Viking lander measured some noble gases**
  - **Viking data was good enough that we can have assurances that some gases extracted from SNC meteorites have come from Mars.**
  - **Compositions of gases extracted from meteorites is much better known than what Viking measured or what TEGA could measure.**
- **For some science applications, meteorite data are not suitable.**

# Noble Gas elemental abundances

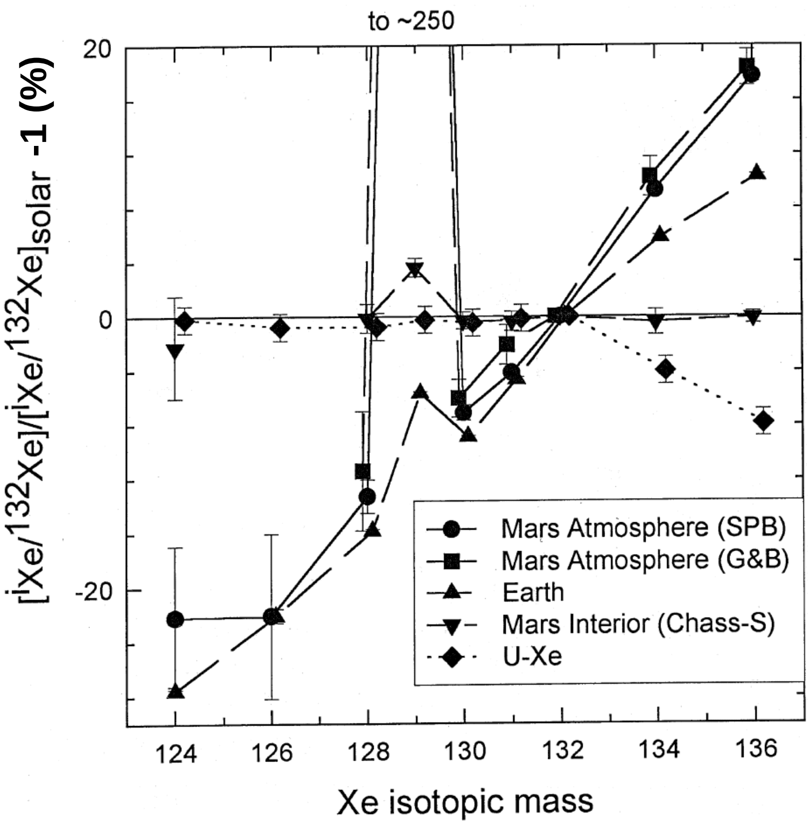
- **Abundances of noble gases in planetary atmospheres are much lower than solar**
  - **Note log axis of 14 decades!**
  - **Mars has had more loss of atmosphere than Earth**
- **Compared to solar, atmospheres favor heavy gases.**
- **Compared to CI chondrites, Ne/Ar/Kr ratios are similar, but Xe is depleted.**
  - **Hunt for “missing” Xe on Earth**
- **Depletion of Xe same on Earth and Mars**
  - **Likely to be not planet specific process**




*Swindle (2002) Rev. Min. Geochem.*

# Xe isotopic abundances

- Xe isotopes are also fractionated relative to solar.
- Mass 134 and 136 due to fission of $^{244}Pu$.
- Very large enrichment at mass 129 is due to decay of $^{129}I$ ($t_{1/2}$ = 16 My)
- Phoenix data would be important for $^{129}Xe$.
  - Viking data very uncertain (factor of a few)
  - Being higher than Earth suggests loss of atmosphere early
- Mass 136 important for fission Xe
  - Why only slightly more fission Xe than on Earth?

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- $^{36}Ar/^{38}Ar$ on Mars is < 4 vs. 5.3 on Earth.
  - Model to explain it is due to solar-wind-induced sputtering
  - Ratio is not well known
    - Viking measurement not very precise (factor of 2)
    - Meteorite measurement has large spallation correction