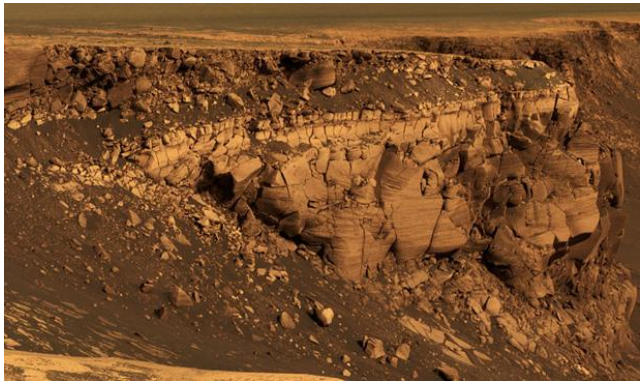
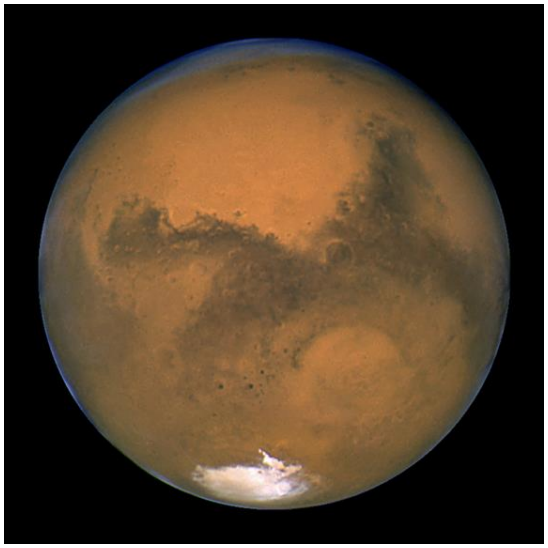


NWA7533 , The CI-Mars Hypothesis and Mars Age Paradox



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LPSC March 18 2014

Basic Thesis

- CI meteorites are unique
  - 100% water altered
  - No evidence of hypervelocity impact
  - 2% organic matter
- Oxygen Isotopes match Mars meteorites
- NWA 7533 O isotopes indistinguishable from CI
- NWA7533 contains CI material
- ***CI-Mars connection is proven (Brandenburg 1996)***
- ***CI are 4.5Gyr old (12 meteorites) and thus ratio of young/old Mars meteorites ~1 and Mars age paradox is solved***

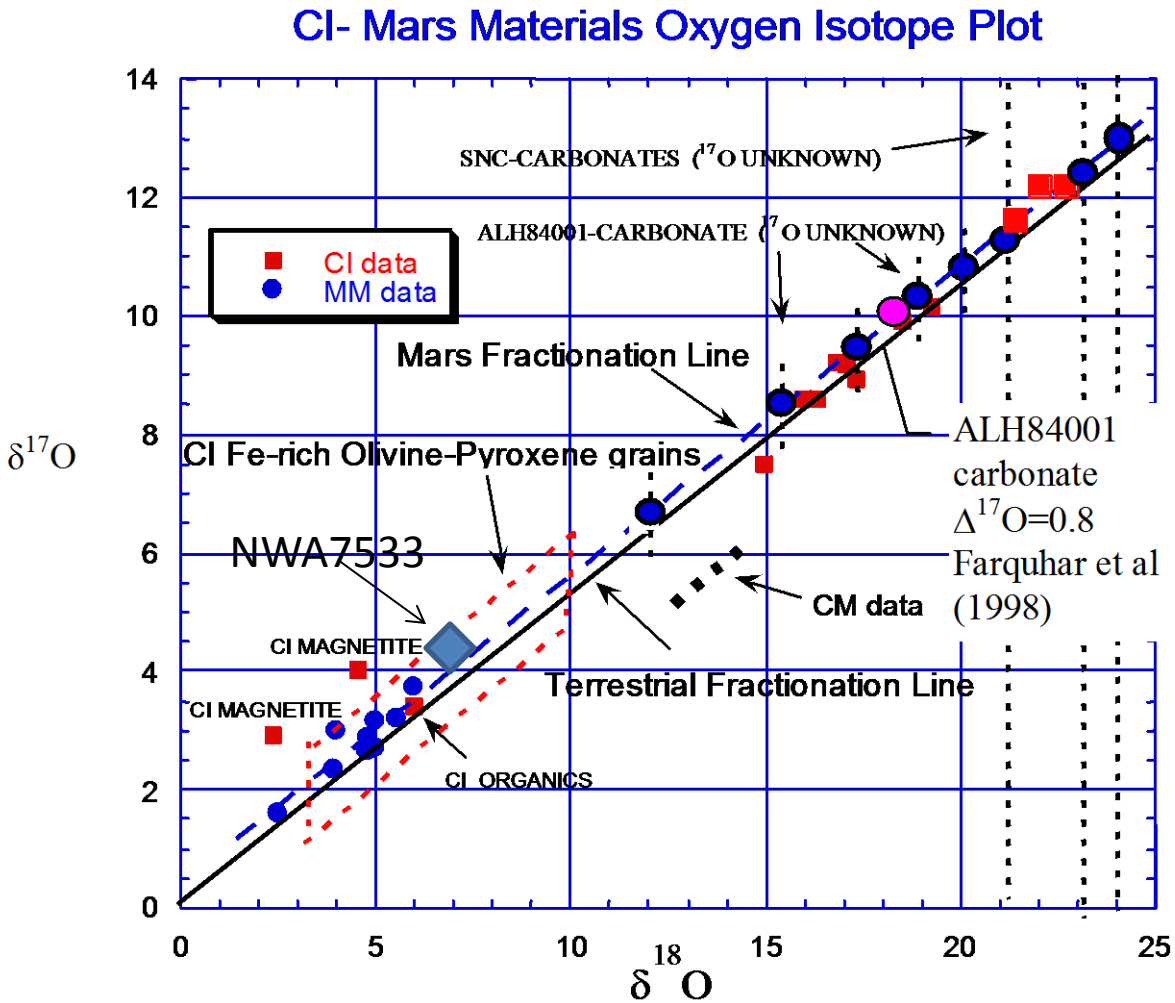
Orguiel and NWA 7533

Both are mixed breccias

Agenda

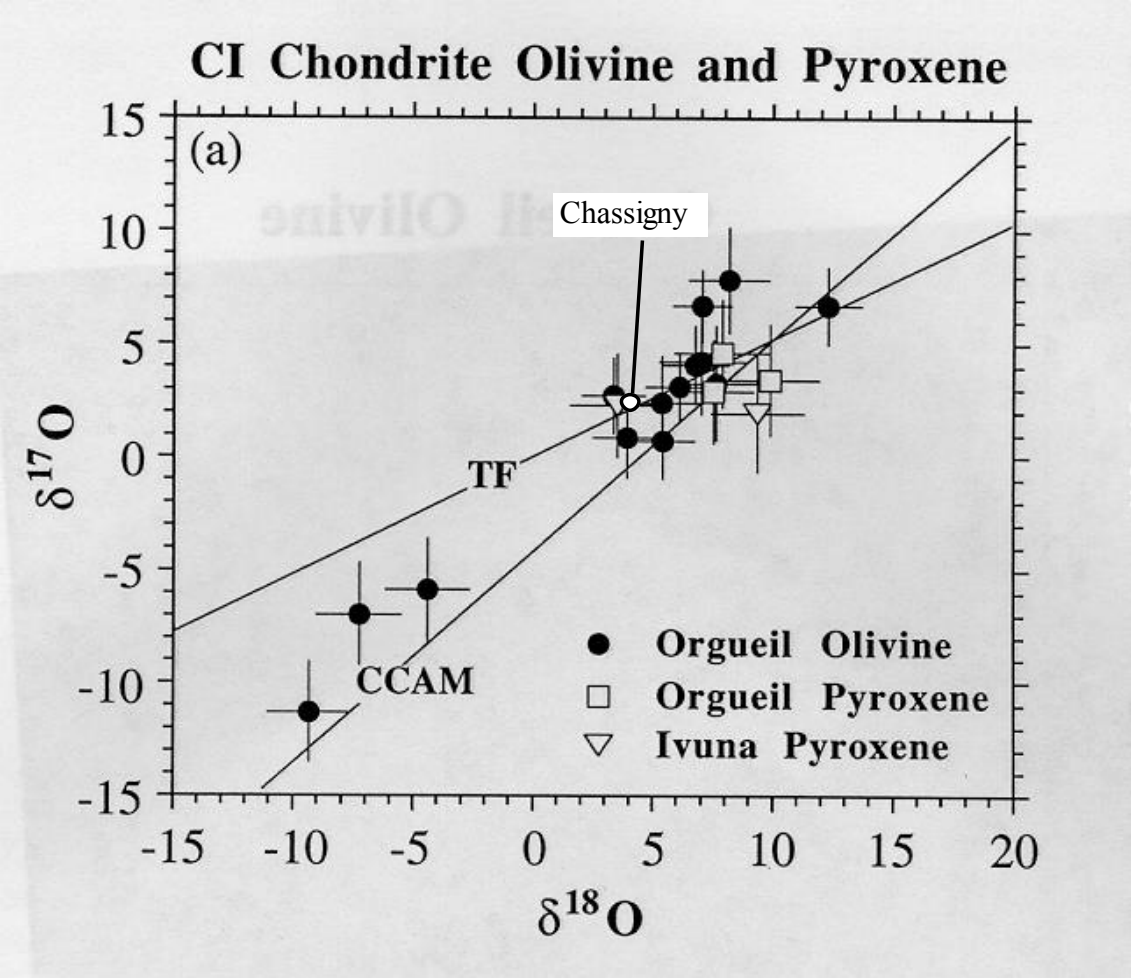
- Comparison of NWA 7533 O isotopes and CI
- Trapped gases in CI versus MM (Mars Meteorites)
- Chemical Comparison CI- MMs
- Morphology Comparisons
- Summary

CI –Mars isotopes

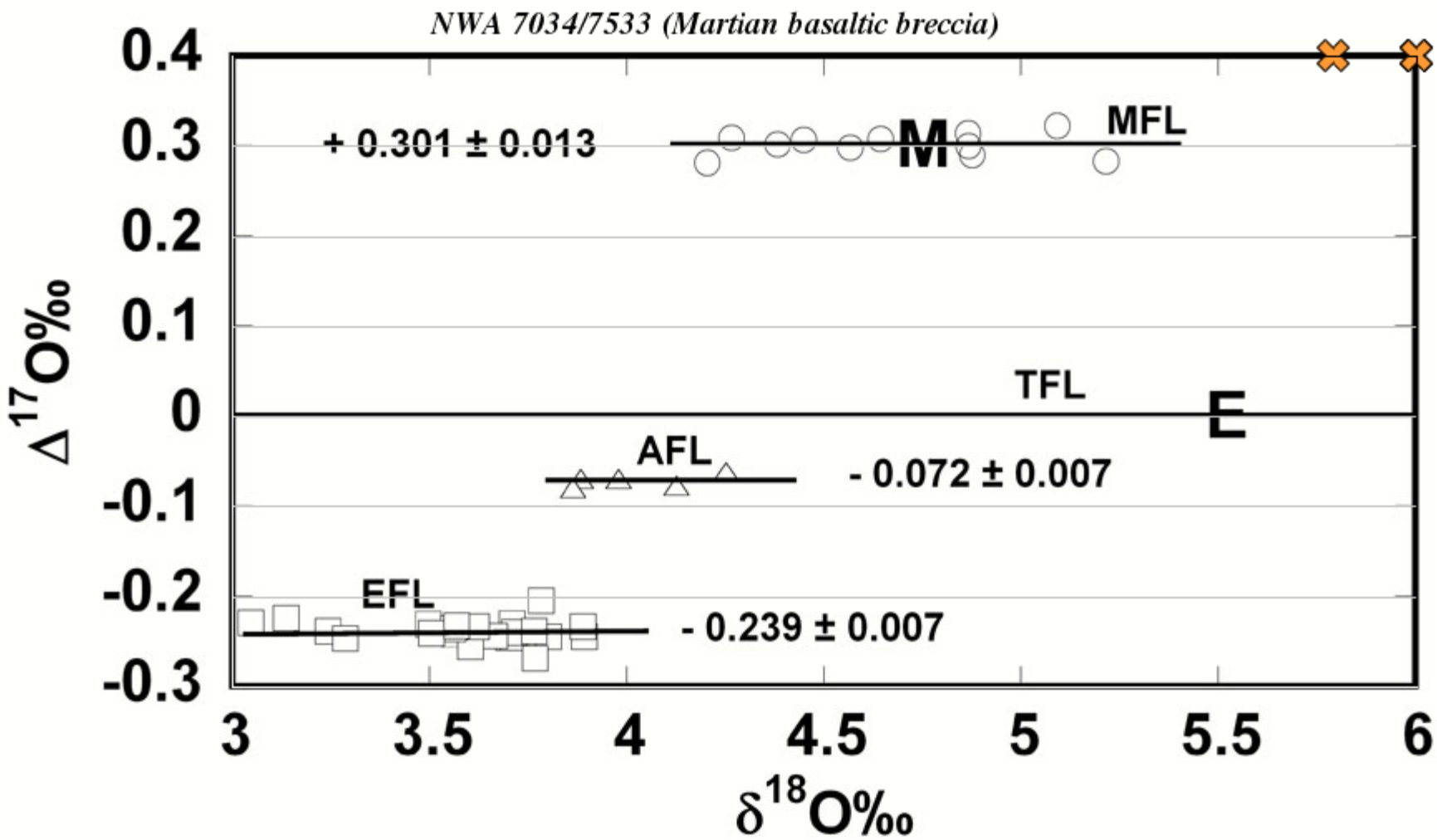


CI and MM O isotopes data is now indistinguishable

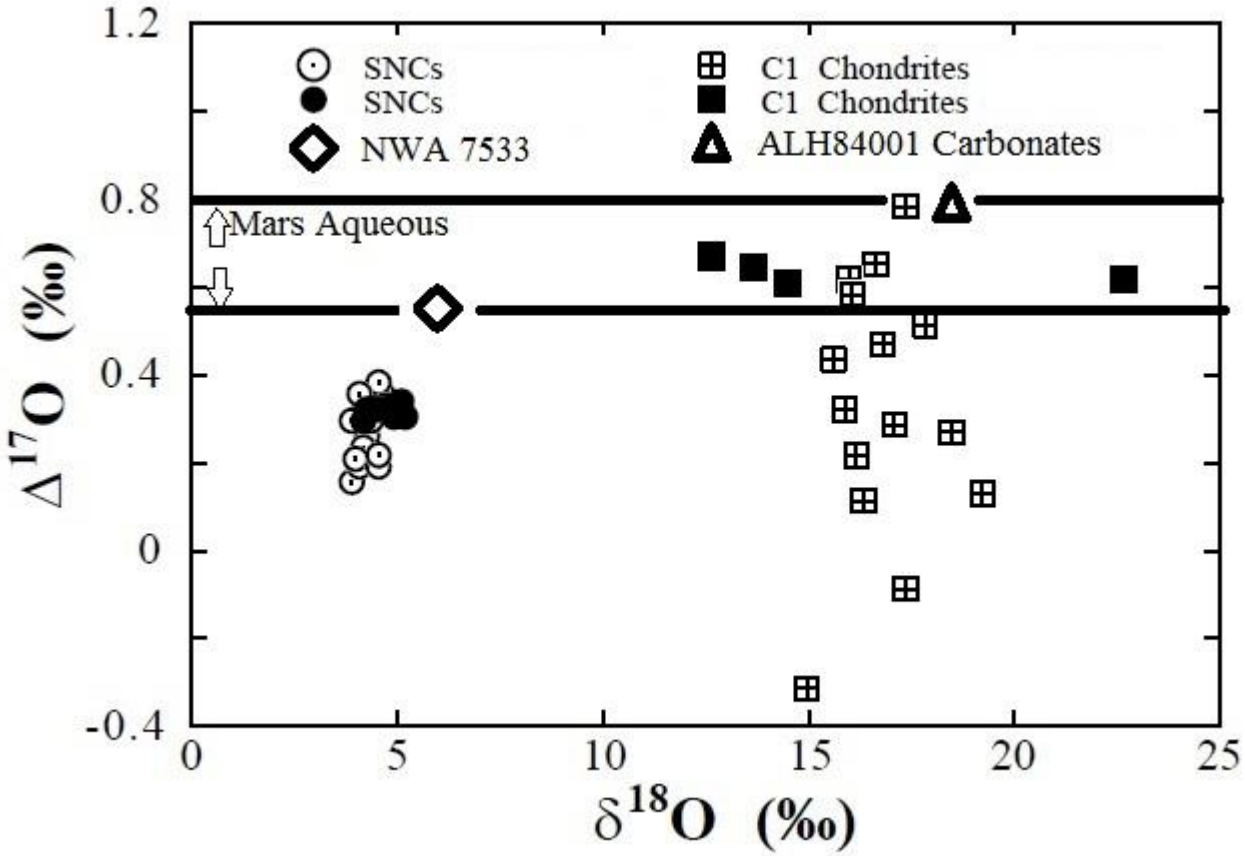
CI anhydrous grains O isotopes consistent with Mars



NWA 7533 O Isotopes



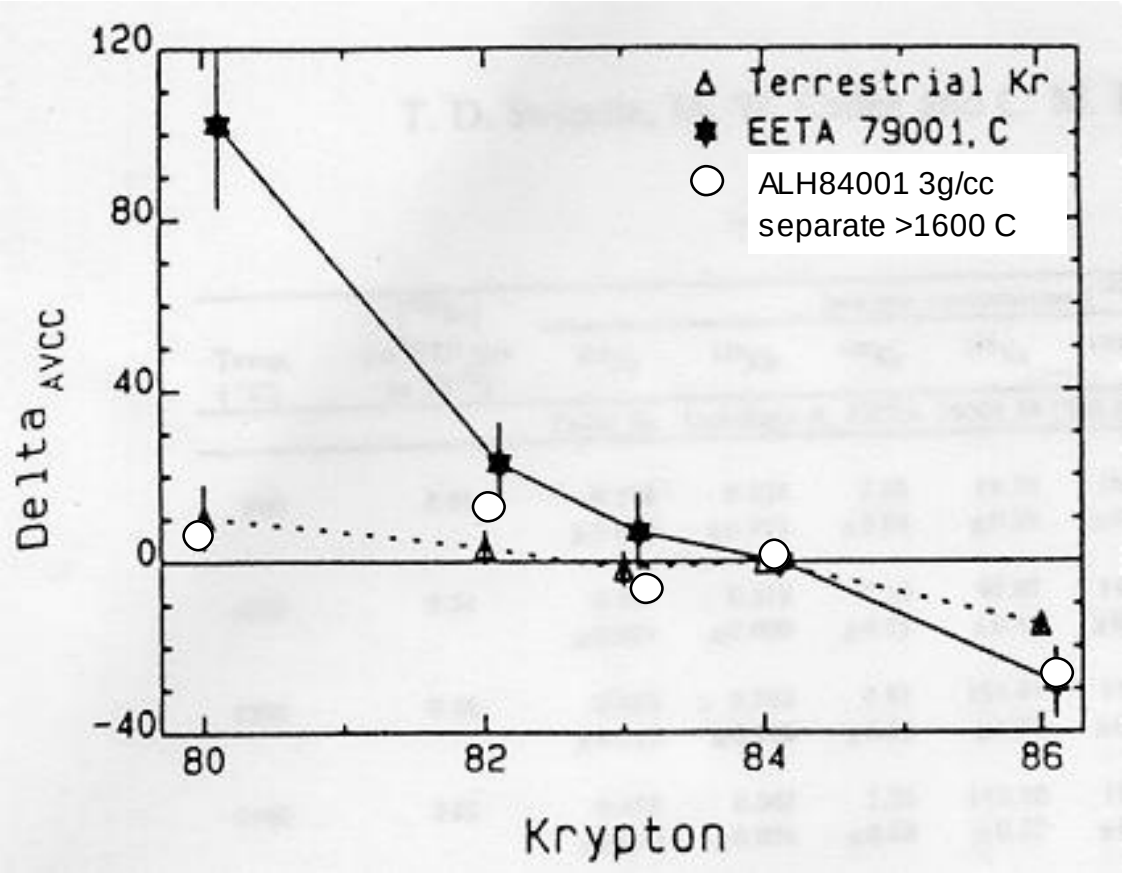
NWA 7533 and CI O Isotopes



Mars O reservoirs

- Mars has no plate tectonics
- Mars lithosphere and hydrosphere are out of equilibrium as far as $^{17}\Delta$ Oxygen isotopes
- Hydrosphere has higher $^{17}\Delta$ Oxygen than Lithosphere

Nobel Gases



ALH84001 trapped gases match CI

CI vs MM Trapped Gases

Among the Kr and Xe isotopes (Swindle et al. 1986)have identified what appears to be a highly fractionated AVCC component in Shergotites (Swindle et al. 1986) and Drake et al. (1991) more recently has identified in MM trapped gases two mixing lines in the space of $^{86}Kr/^{132}Xe$ and $^{129}Xe/^{132}Xe$ abundance ratios. Both mixing lines have the data from Chassigny as an endpoint, indicating that it represents an important trapped gas component in these isotopes. The data from Chassigny, $^{86}Kr/^{132}Xe$= 1.14 and $^{129}Xe/^{132}Xe$ =1.03. compares very favorably with data taken from Eugster et al. (1967) which gives $^{86}Kr/^{132}Xe$ = .98 and $^{129}Xe/^{132}Xe$ = 1.05 for Orgueil indicating that the CI and the MM

CI vs MM Trapped Gases

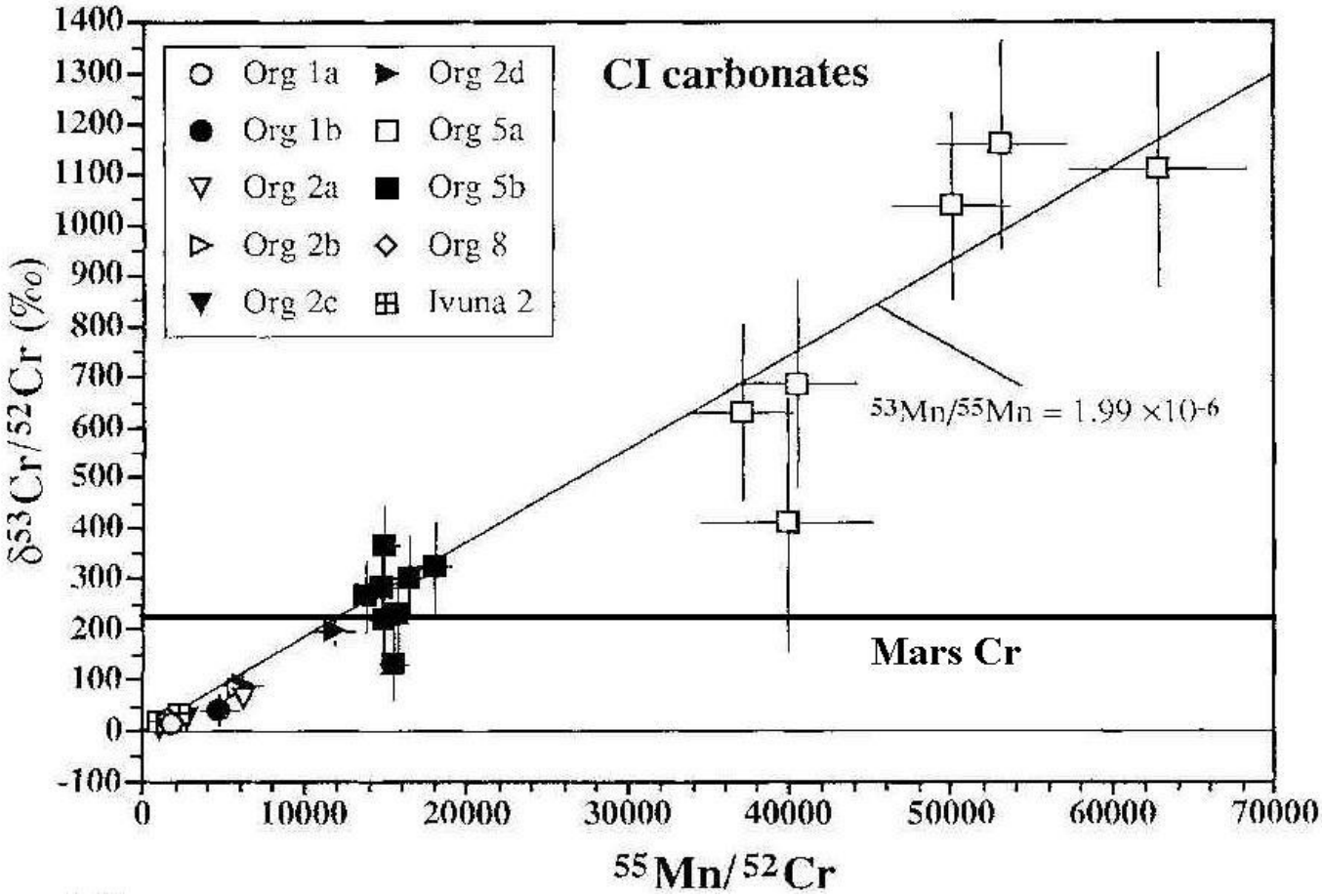
Trapped nitrogen , released from the organic portion of the Orgueil meteorite, gives a $\delta^{15}N_{air}$ = +43 (Pillinger 1984) whereas nitrogen from EETA79001 glasses ranges from +90 < δ $\delta\ ^{15}N_{air}$ < +225 (McSween 1985). Since Mars atmosphere is believed to have undergone fractionation in time and the CI are primordial in age , this slightly fractionated nitrogen in CI's is consistent with primordial Martian atmosphere.

This CI-MM hypothesis supported strongly by the discover of an end member nitrogen component in ALH84001, (Murty and Mohapatra 1997) which has of $\delta\ ^{15}N_{air}$ = +46 and thus matches that in the CI almost exactly. They also found a pattern of Xe isotopes that seems to be AVCC, they also found a Kr component in ALH84001 that has an isotopic signature of AVCC Kr

CI vs MM Trapped Gases

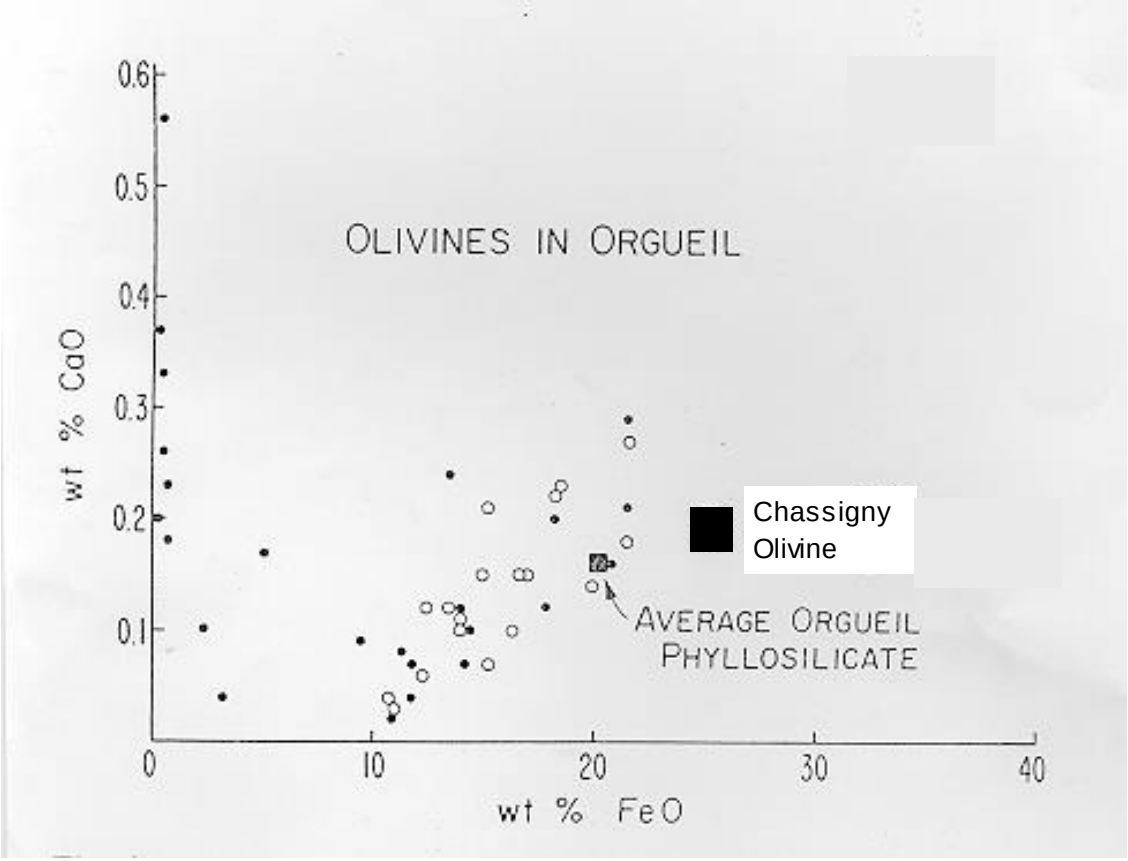
In the lighter isotopes, gases trapped in Orgueil organic residues released above 900C , give average, $^{20}Ne/^{22}Ne$ = 8.5 and $^{38}Ar/^{36}Ar$= 0.19 (Frick and Monoit 1977) These can be compared with values obtained the martian meteorite LEW 88516 released at 1600C which are : $^{20}Ne/^{22}Ne$ =0.92, $^{38}Ar/^{36}Ar$ =0.56, (Treiman et al. 1994). Corresponding values fro Sherggotite lithologies are in ranges 1< $^{20}Ne/^{22}Ne$ < 10 and .19 < $^{38}Ar/^{36}Ar$ <1.0 (Bogard et al. 1984). Atmospheric values for Mars Argon is $^{38}Ar/^{36}Ar$=0.18

Chromium Isotopes



CI materials match Mars Chromium signature

Chemical Comparisons



- Olivine and Pyroxene grains in CI follow unique Ca-Fe mixing line shared by Chassigny

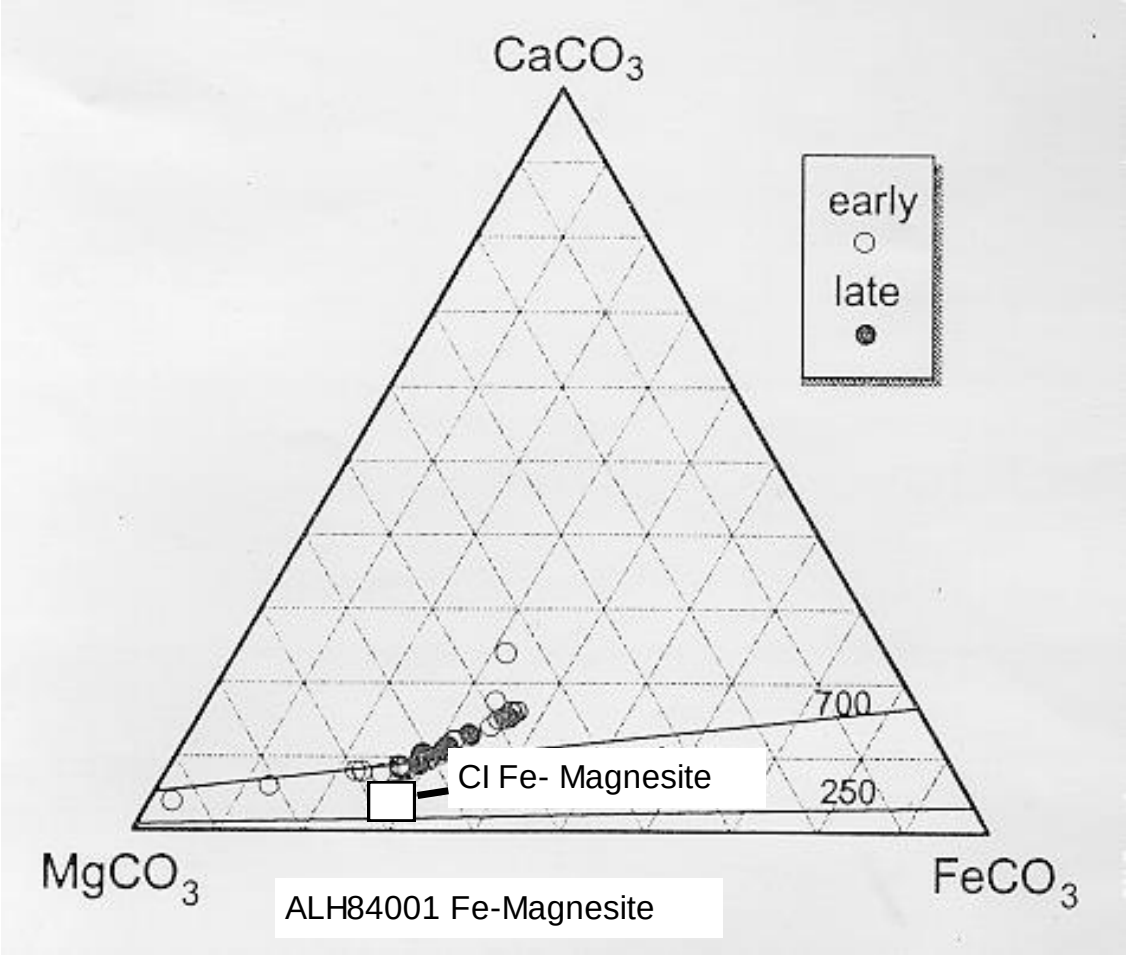
Intermediate Meteorite Morphologies Thermally altered CI

- CI parent body could create strong heating

- Beligica 7904, Yamato-86029, 82162, 86720

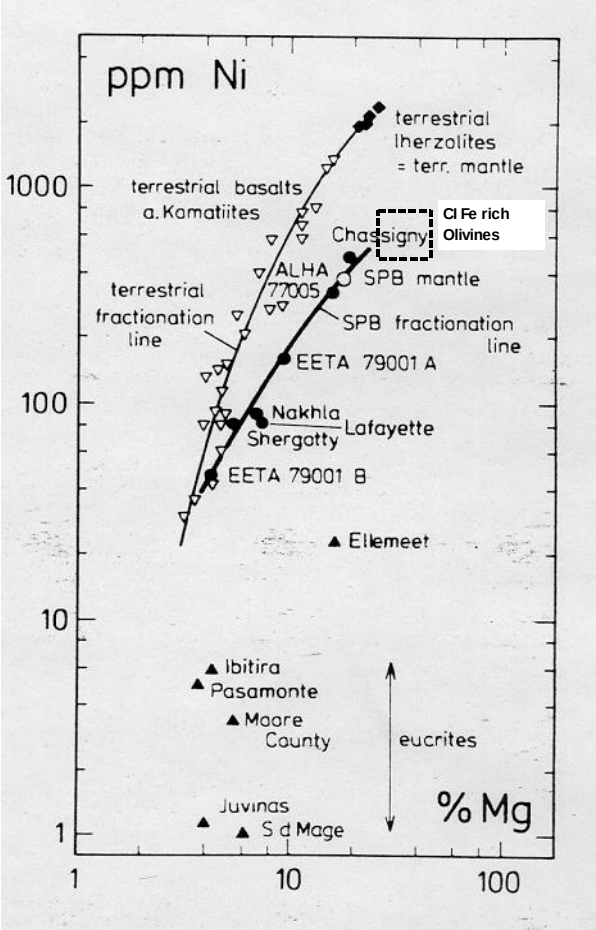
are thermally metamorphosized CI (by O isotopes) that share a fine grained Olivine rich matrix with NWA7533 and its sisters.

Chemical Comparisons



- Ferroan Carbonates in CI match those in ALH84001

Chemical Comparisons

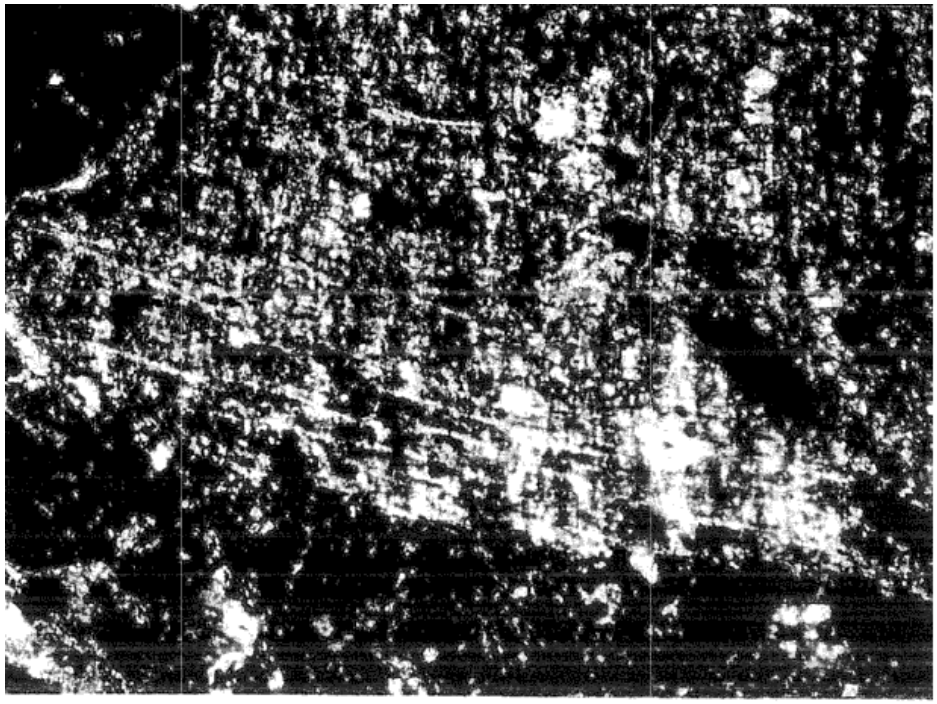


- CI Olivine grains are Ni rich

Morphology

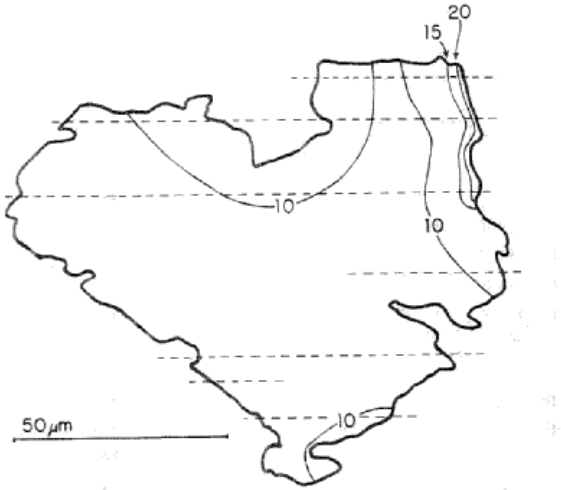
- CI are unique in that they have no evidence of hypervelocity impact (Kerridge and Bunch 1979)
- They contain solar-flare tracked olivine grains, so they were regolith material
- They have to have formed under an atmosphere to suppress hypervelocity impacts
- Thus they must have come from a large body with high gravity and an atmosphere-not a small body like an asteroid or comet- a large body like Mars

Morphology



Lamellar Structure of Clay clasts in CI consistent with formation in strong gravity field

Unique “Embayed” Olivine Grains in the CI



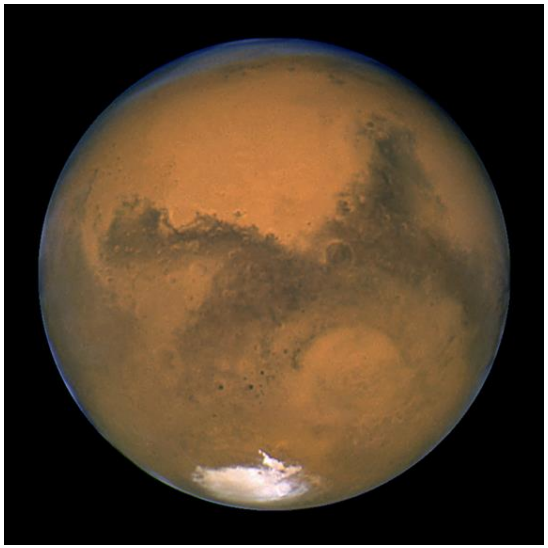
Embayments into Fe-Ca rich (low melting) regions may mark thermal ablation while falling through and atmosphere on the Parent Body (Figure from Kerridge and MacDougall 1976)

Summary and Discussion

- With the discovery of ancient and primitive meteorite NWA7533 and its sisters CI and MM data is indistinguishable
- ***CI are 4.5Gyr old (12 meteorites) and thus ratio of young/old Mars meteorites ~1 and Mars age paradox is solved***
- ***Unique Absence of hypervelocity impacts means they formed under an atmosphere on Mars***

- CI are 4.5 Billion years old and are 2% organic matter showing early Mars was warm-wet and rich in organics
- ***Life findings in ALH84001 and other Mars meteorites are strongly supported***

Thus, We Are Not Alone



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