Summary of
"Chemical composition of the Earth ..."
by Claude Allègre

Objective

- Calculation of bulk composition of the Earth for every element.
  - Many volatiles are also siderophile or chalcophile (buried in the core) and their abundance cannot be estimated directly.
  - Composition of the core - what light elements (S, Si, O)?

Introduction

- Meteorites are the oldest objects in the solar system and the closest to the Sun in chemical composition.
- Where does Earth fall with respect to the meteorites?

Approach

- Carbonaceous chondirtes represent (undifferentiated) condensates of solar nebula.
- Range in composition due to variable proportions of volatiles (condensation at different temperature).

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Allegre, Claude, Gerard Manhes, and Eric Lewin. "Chemical composition of the Earth and the volatility control on planetary genetics." *Earth and Planetary Science Letters* 185 (2001): 49-69.

- CI, CM, CO, CV always straight line, same relative position.
- Ordinary chondrites are often outside of these lines.
- Use constant ratios to normalize more volatile elements.

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- Consider refractory elements, not siderophile nor chalcophile.
- "Primitive" mantle assumed the same as bulk silicate Earth (BSE).
- Earth falls on CC line.
- Fractionation index (volatile, Q_v) and (refractory, Q_r) for each element (Earth relative to CI and CV).

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- From abundance ratios for CV and CI define fractionation factor, K_v, for each element.
- K_v determines if Q_v or Q_r is used to calculate abundance ratios.

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Choose Pt as refractory and Au as volatile.

Results

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The bulk silicate Earth.

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Condensation temperature for the Earth is 1100-1200 K.

Main conclusions

- Minor refinements in K/U, K/Rb, Ba/Rb, Sr/Ba.
- No "excess" O required to explain density deficit of the core.
- Core: Fe=79%, Ni=4.87%, S=1.21% (assumed), Si= $7^{+8.5}_{-4.5}$%, O=5%.
- Lu/Hf is different in the Earth than ordinary chondrite (0.215 instead of 0.172).

Assumptions, questions

- Homogeneous mantle for major elements.
- Binary: refractory or volatile.
- Volatility is independent of speciation or gas composition.
- Are CI and CV analyses accurate enough?

Problems

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Highly volatiles show constant depletion.
Adsorption and/or entrainment process?