Stars: the Early Evolution of the Sun

Our systematic comparison between the Sun and stars very similar to it ("Solar Twins") has led to astonishing results as regards the solar chemical composition. Thus, the Sun is relatively poor in elements that easily condensed in the Proto-planetary Nebula ("refractories") as compared with more volatile elements.

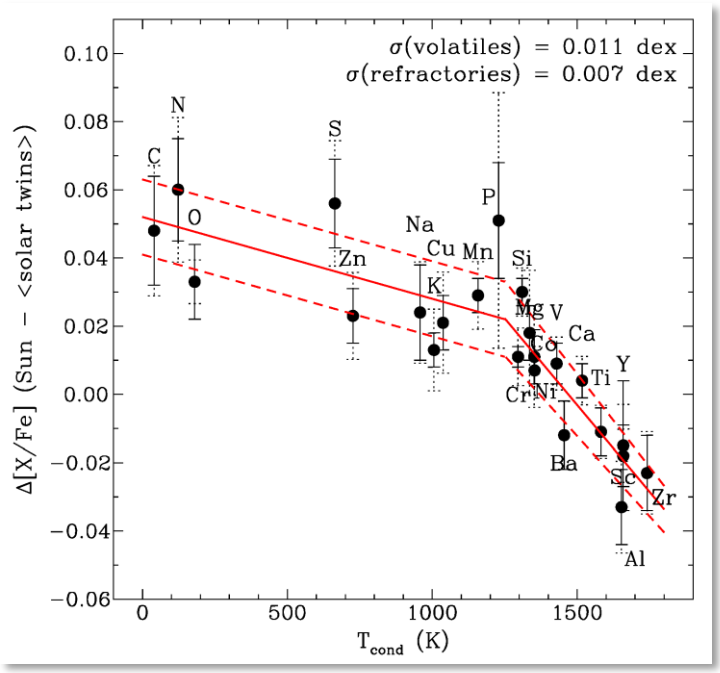

Fig. 1: The difference in mean abundance of different elements for the 11 solar twins of Meléndez et al. (2009), subtracted from the corresponding solar abundance, plotted vs. condensation temperature. Dotted error bars show the estimated error in abundance difference for individual stars, while 1σ errors in mean abundances for all twins are indicated as solid error bars. The red lines are fits to the data, the dashed lines indicating a 1σ deviation in this fit.

Possible explanations?

- Sun seen at special angle. Proven unimportant by SST observations (Kiselman et al. 2011)
- Solar protoplanetary disk cleansed by planetary formation.
  - Long-lived gas disk? (>25 Myr)
    - No observational support
  - Shallow solar convection early? (< 10 Myr)
    - Possible at episodic accretion (Baraff & Chabrier 2010)
- Pre-solar nebula dust-cleansed by bright stars. Some support from composition of one solar twin in M67, which shows solar signature! (Önehag et al. 2011)

Needs more calculation and analysis, comp. with Li, Be, rot. profile, seismology

More observation: M67 twins, planetary connection, T_{eff} dependence.

See Gustafsson et al. (2010) for further discussion.

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