Are There Carbon-rich Extrasolar Planetesimals?

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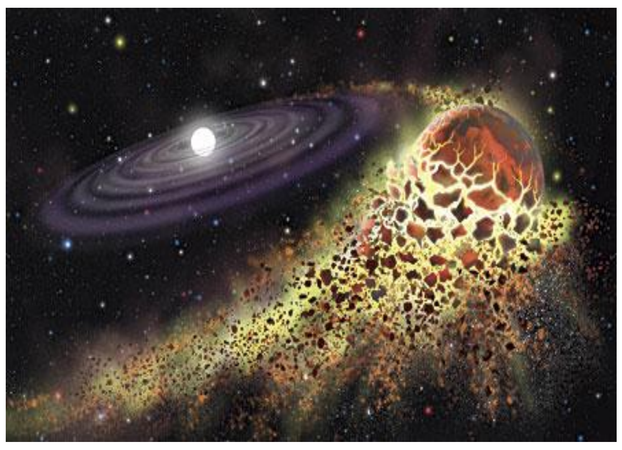
Introduction

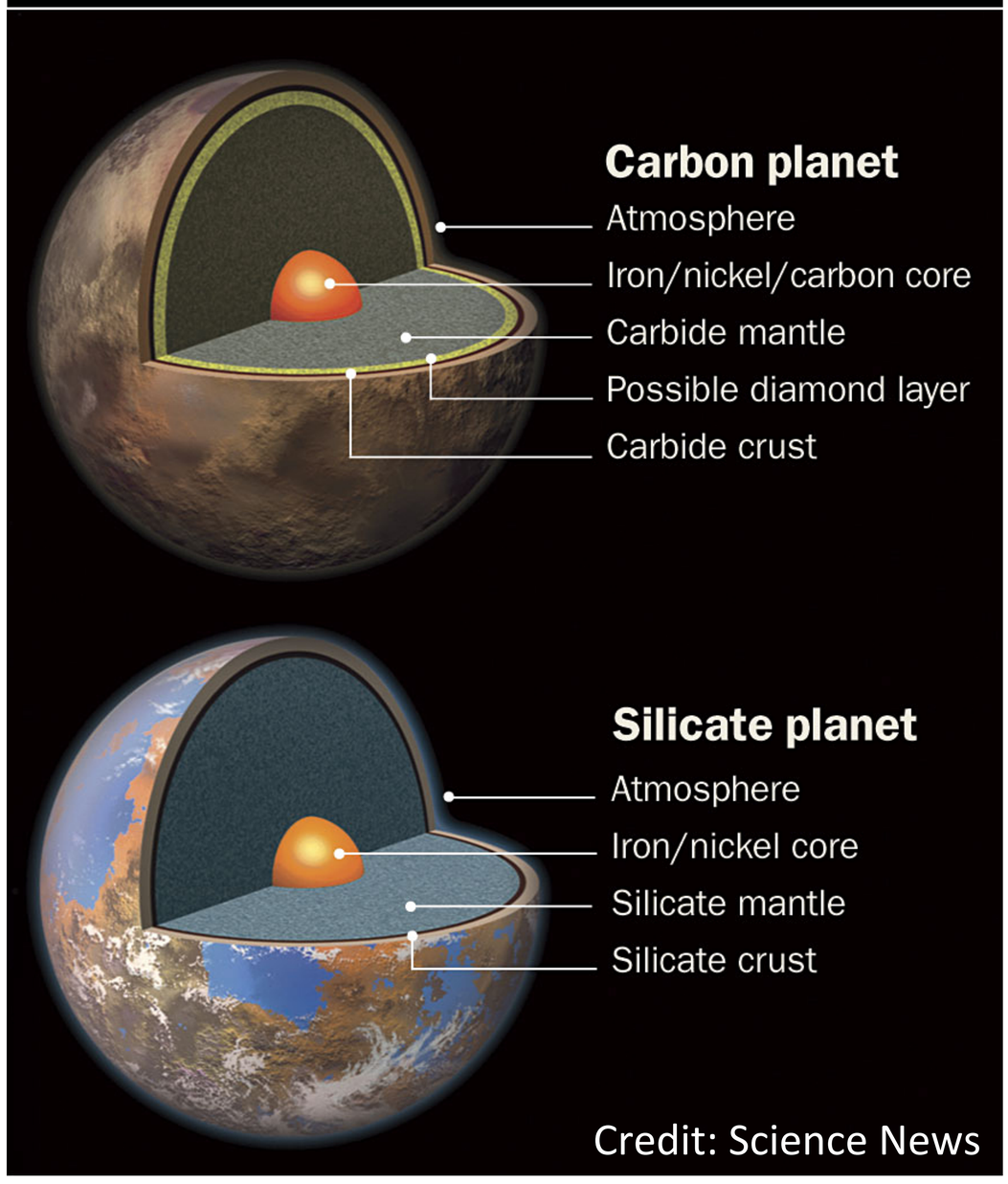
Cosmochemically, carbon is the fourth most abundant element after hydrogen, helium and oxygen. However, it drops to the 10th most abundant element on Earth by mass. Though theoretically predicted, extrasolar carbon planets are nowhere to be found. What about extrasolar planetesimals?

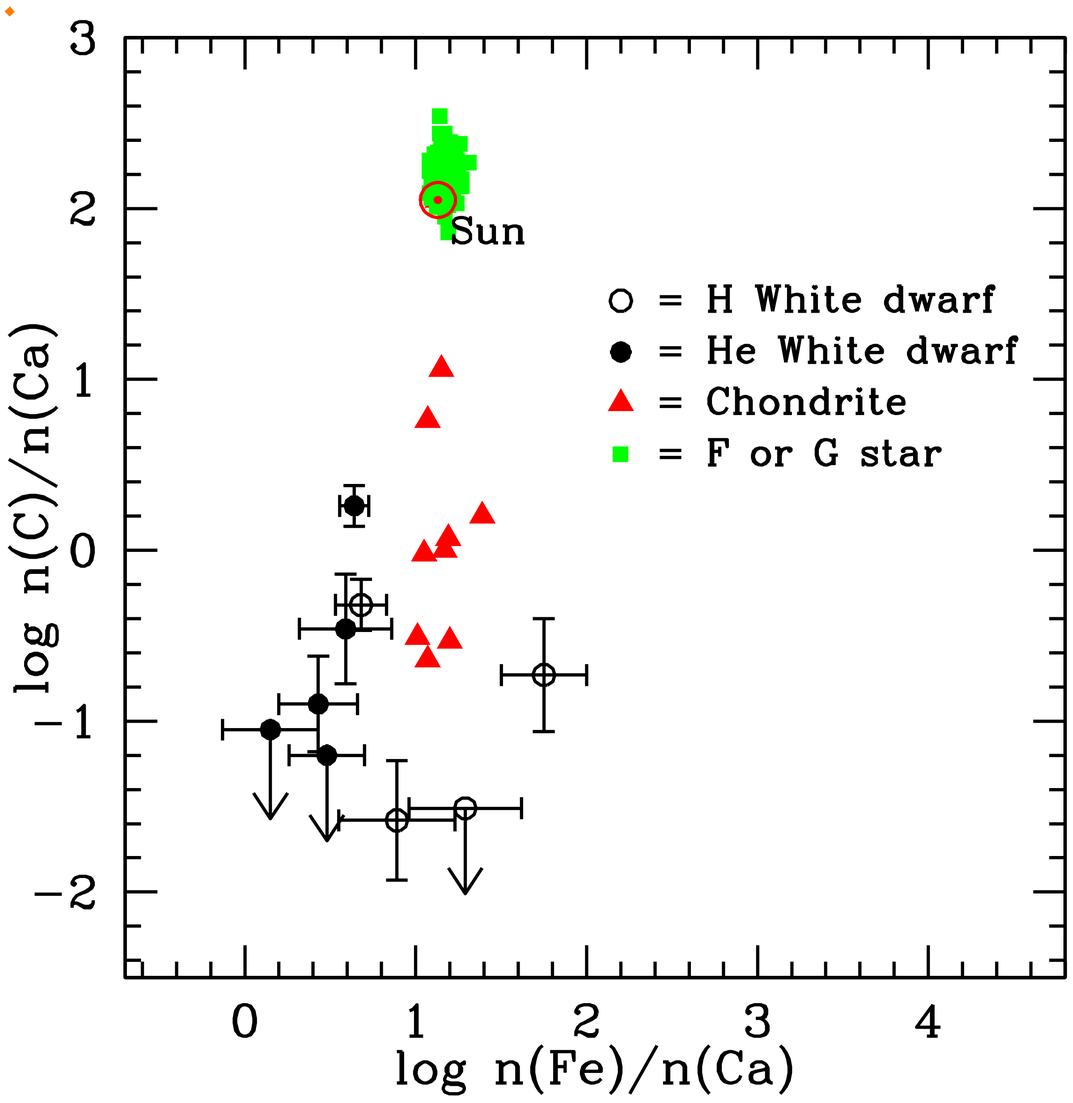


Evidence is strong that ~25% of white dwarfs are accreting from tidally disrupted extrasolar asteroids; this material pollutes the otherwise *pristine* atmosphere of the white dwarf.

Studying externally-polluted white dwarfs provides invaluable data about the bulk composition of extrasolar planetesimals.

Internal Structure Model





Logarithm of the relative numbers of iron and carbon scaled to calcium for nine externally-polluted white dwarfs where the elemental abundances have accurately estimated error bars. The circles represent the values for white dwarfs while red triangles represent the values for different chondrites. The green squares represent the abundances for 178 local F and G stars. (Jura & Young, Ann. Rev. Earth Planet. Sci. 42, submitted [2014]).

Even in the most carbon-rich meteorites, CI chondrites, the carbon abundance is depleted by a factor of 10 compared to the solar abundance.

The carbon deficiency is also evident among extrasolar planetesimals. This shows that solid planetesimals are not simply accumulations of interstellar grains. Additional processing is required to reproduce the abundance pattern observed in extrasolar planetesimals.

So far, there is no evidence for carbon-rich extrasolar planetesimals!