Origin and chemical composition of the inner solar system

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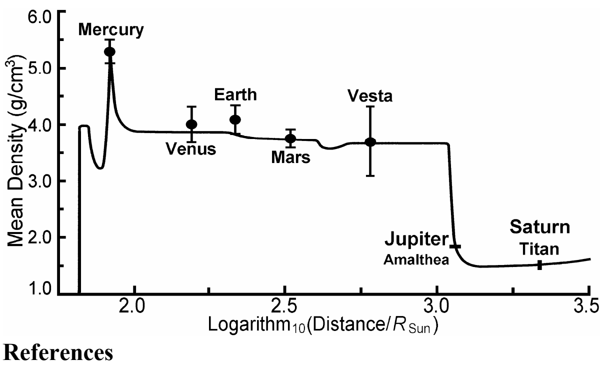
The well-defined gradation of uncompressed mean densities of inner planets with mean orbital radius R_n (n = 0,1,2,..) attests to a well-defined gradient of mean temperature T_n and pressure p_n in the nebula gas. This inference is supported by differences in chemical makeup such as the increase in Fe oxidization between Mercury and Mars, the dryness of Venus' atmosphere and likely existence of FeS in the cores of Earth and Mars. A strong case can thus be made that (i) each body formed from materials close to its current location and (ii) that there was no widespread orbital mixing of condensate material during accretion [1]. This situation finds an explanation within the Modern Laplacian theory of Solar System origin (MLT) [2–3]. In this scenario, planetary systems condense from a concentric family of orbiting gas rings. These rings are shed by the contracting protosolar cloud in order to rid excess spin angular momentum during gravitational contraction. It is proposed that strong supersonic turbulent convection causes discrete shedding of gas rings [4]. The temperature T_n and mean orbit pressure p_n of each gas ring (n = 0,1,2,..) vary with mean orbital distance R_n according as $T_n \sim 1/[R_n]^{0.9}$ and $p_n \sim 1/[R_n]^{3.9}$. Mercury formed at 1628 K and consists mostly of Fe-Ni-Cr alloy (mass fraction: 0.671) and gehlenite (0.190). For Venus (910 K), the condensate contains metal alloy (0.313) and MgO-SiO_2 (0.589). (Fe-Ni)S (0.107) and tremolite (0.094) first appear at Earth's orbit (673 K). FeO, as fayalite (0.192), forms at Mars' (454 K). H_2O ice first condenses at Jupiter's orbit (158 K). Titan formed in a solar orbit, prior to capture by Saturn [3]. Below is a plot of condensate mean density versus distance R_n.



References

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