Protosolar jets and their implications for processing in the solar nebula

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The meteoritic record indicates that the early solar nebula was characterised by transient, high temperature episodes. Evidence for this includes the high temperatures required to melt, evaporate, and condense the elements comprising CAIs and chondrules, and the often rapid cooling rates suggested by preservation of glass, for example, in chondrules.

Many thermal models invoke high-temperature processing close to the proto-Sun because that is where high temperatures are readily available. But it is not clear that if thermal processing occurred in this vicinity whether rapid cooling can be achieved as well.

Protostellar winds provide an astrophysical scenario for rapid changes in both temperature and thermal gradient. They are commonly observed in star-forming regions and and are thought to be an integral part of the star-forming process. Magneto-centrifugally accelerated disk winds offer the prospect of thermal processing well in to the accretion disk [1, 2].

In this scenario, solid clumps may be entrained in the disk wind and effectively levitate relative to a highly accelerated disk wind. The less refractory elements evaporate from the clumps causing refractory residues. The ambient gas in the accretion disk will also be affected by this process. Initially a gas of solar oxygen isotope composition will be apparent because the local mix of CO and nebula water will maintain solar abundances [3,4]. But as the temperature increases and evaporation of lithophile elements occurs, the oxygen composition of the solids will be favoured and it will be closer to planetary composition.

The episodic nature of jets and winds can quickly change both the thermal regime, but also the oxygen isotope composition of the nebula gas.

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