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The meteoritic evidence for disk transport

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Astronomical observations and examination of returned samples from comet Wild 2 point to extensive radial transport in protoplanetary disks. Most of this evidence is for transport of material outwards. However, there should also have been inward transport. It has been suggested, for instance, that the oxidation state and O isotopic composition of the inner Solar System was dramatically modified by the transport of ice that formed in the outer Solar System.

The meteoritic evidence for transport is more equivocal. For instance, the different chondrite groups have distinct CAI and chondrule populations, in terms of abundance, and physical and chemical properties. Naively, one might expect dust in a vigorously transporting disk to be well mixed. In the case of chondrules, it could be that they formed shortly before the formation of their host chondrites, so there was little time for mixing. This is not an option for CAIs. Most chondrites do contain similar organic and presolar grain components in their matrices. These same components are also present in IDPs, which may come from comets. Whether these primitive components are present as the result of transport of material from the outer Solar System after CAI/chondrule formation, or simply represent inner Solar System material that was not processed by chondrule or CAI formation is unclear. Ice that formed in the outer Solar System should be D-rich, a prediction that seems to have been confirmed by D/H measurements of three comets. The water responsible for aqueous alteration in carbonaceous and ordinary chondrites is generally thought to have accreted as ice and is not D-rich, suggesting that it did not form in the outer Solar System. Whether this is consistent with models for transport of ice and O isotopes in the disk needs to be addressed.

Keywords: meteorite, transport, organics, presolar grains, water