Depletions of Elements from the Gas Phase: A Guide on Dust Compositions

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Ultraviolet spectra of stars recorded by orbiting observatories since the 1970's have revealed absorption features produced by atoms in their favored ionization stages in the neutral ISM of our Galaxy. Most elements show abundances relative to hydrogen that are below their values in stars, indicating their removal by condensation into solid form. The relative amounts of these depletions vary from one location to the next, and different elements show varying degrees of depletion. In a study of abundances along 243 different sight lines reported in more than 100 papers, Jenkins (2009) characterized the systematic patterns for the depletions of 17 different elements, and these results in turn were used to help us understand the compositions of dust grains. Since the conclusions are based on differential depletions along different sight lines, they are insensitive to errors in the adopted values for the total element abundances. Some of the more remarkable conclusions to emerge from this study are that (1) oxygen depletions in the denser gas regions (but not as dense as the interiors of molecular clouds) are stronger than what we can expect from just the formation of silicates and metallic oxides, and (2) the chemically inert element krypton shows some evidence for weak depletion, perhaps as a result of physisorption the dust grain surfaces or trapping within water clathrates.