A new chemical model of meteoric ablation

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It has become apparent from observations of meteor trails and the background metal atom layers in the upper mesosphere and lower thermosphere that the constituent meteoric elements – Si, O, Fe, Mg, Na, K, Ca etc. – ablate with very different efficiencies and at different altitudes. This effect, termed differential ablation, also influences the production of electrons through the impact ionization which occurs when meteoric elements collide with air molecules at hyperthermal velocities. The rate of electron production then controls the size of the "head echo" observed by incoherent scatter radars. This paper will describe a new meteoric ablation model that includes a full treatment of the thermodynamics and kinetics of the evaporation of the meteoric constituents. We will use the model to explore: multiple-lidar observations of meteor trails; the substantial depletion of the Group 2 elements (Mg and Ca) relative to the Group 1 elements (Na and K) in the upper mesosphere; and the dependence of the meteor head echo on particle size and velocity.