MODELING OF CM PARENT BODIES. R. F. Coker[1] and B. A. Cohen[2], [1]Department of Physics, The University of Arizona, Tucson AZ 85721 (rfc@physics.arizona.edu) [2]Department of Planetary Sciences, The University of Arizona, Tucson AZ 85721 (bcohen@lpl.arizona.edu).

We have constructed an asteroid model with the intent of tracking the radial and temporal dependence of temperature and composition throughout a 100-km diameter body, with emphasis on constraining the temperature and duration of a liquid water phase. The asteroid is composed of rock (altered and unaltered), water (ice or liquid), and void spaces. Thermal properties of the materials are composition- and temperature-dependent where appropriate. The initial distribution of materials is uniform, except for a small surface regolith, and can be varied for different calculations. We investigate the effects of formation distance, formation time since solar nebula collapse, hydration reactions, and water, void, and rock content and composition on the evolution of the asteroid.

The numerical scheme we employ to handle the spherically-symmetric heat flow equation is similar to that used by [1]. We also make some of the same assumptions: accretion is rapid, the rock is fully lithified, there are no pressure dependencies of the material properties, and the major heat source is radioactivity. We incorporate a suite of both long- and short-lived radionuclides, the abundances of which we obtained from [2].

Our model differs significantly from [1] in some ways. First, we explicitly add a regolith to the asteroid, which for our purposes is a zone of a few hundred meters where porosity increases and water content decreases dramatically. The impact processes which create such a regolith proceed over the timescale of the solar system, so our constant regolith overestimates its own effects on the evolution of the interior. However, we find that the regolith can act either as a thermal blanket or a thermal sink, depending on the initial setup. Second, we include solar nebula temperature evolution [3] to determine the initial asteroid temperature as well as the surface equilibrium temperature; at 10^7 years after nebula collapse, the nebula dissipates and the surface is assumed to be in thermal equilibrium with the solar flux. This produces a substantial difference between our models, because many material properties are dependent on temperature and the nebula at 3 AU drops to ~20K before it dissipates. Third, we vary the time between nebular collapse and the accretion of the asteroid. This is similar to varying the amount of live ^{26}Al as in [1], but has wider implications because of the solar nebula model discussed above. Fourth, we consider a broad set of alteration reactions and use a finite rate of reaction. This allows us to track effects of mineral alteration on water salinity, pH, and freezing-point depression. The choice of alteration reaction determines the amount of heat released during alteration, and this is found to have a large effect on the duration of liquid water. The choice of reaction also has volumetric consequences; we suggest that examination of altered matrix for expansion textures might constrain the mode of alteration.

Although highly dependent on the choice of alteration reaction, our preliminary results show that the interior of a 100-km-diameter body can reach temperatures high enough to produce liquid water for significant times ($>10^6$ years). Some scenarios allow the complete melting of ice in the deep interior, with a subsequent temperature rise ($T_{max}\approx400$K). We produce a non-uniform distribution where liquid water persists longest in the deepest zones and the regolith never sees conditions appropriate to aqueous alteration. The non-uniform liquid distribution produces a radially-dependent amount of alteration products. It has been suggested [4] that both CI- and CM-type material could be formed by progressively altering the same initial assemblage, perhaps by this kind of parent-body history.

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