Textural evolution of metal and sulphide in H-chondrites: Constraining parent-body structure

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H-chondrites are samples of a single asteroidal parent body which show evidence for variable degrees of heating. The least "metamorphosed" members of the H-chondrite clan (H3) are mixtures of various components, clearly out of chemical and textural equilibrium. While the mineralogical and compositional effects of progressive heating have been studied in the literature, textural equilibration has received far less attention. We have therefore studied the textural characteristics of metal and sulfide in a series of H-chondrites (H4, 5, 6). These results provide constraints on the structure and thermal evolution of the parent body and have implications for the onset of processes leading to core segregation.

We have quantified: i) metal and sulfide proportions as a function of metamorphic grade; ii) the length of metal-sulfide contacts; iii) dihedral angles at silicate-silicate-metal/sulfide contacts; iv) the shape of metal/sulphide grains (circularity); v) the crystal size distribution (CSD) of metal and sulfide grain populations.

Proportions of metal and sulfide are independent of metamorphic grade, but the length of sulfide-metal contacts decreases significantly with increasing grade (metal and sulfide grains separate). Dihedral angles, grain circularity and CSD's for metal grains show little change between H4 and H5, but show significant changes between H5 and H6. These results may be rationalized in terms of textural equilibration and ripening involving diffusion. Published values for the temperature dependent diffusion coefficient of Fe in olivine have been combined with the results of thermal models describing the temperature-time paths at different depths within a parent body 180km in diameter heated internally by Al26. Comparison of the modeled length scales of Fe-diffusion relative to the average separation of metal droplets implies that the H5 samples come from a depth approximately 30km below the surface, in excellent agreement with independent estimates based upon peak metamorphic temperatures and Pb-Pb dating.

U-Th, $\delta^{18}O$ and paleomagnetic dating of a mid-Pleistocene lacustrine sequence: The Amora Formation, Mount Sedom, Israel

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Dating of mid-Pleistocene carbonate sediments may be possible with the ^{230}Th-^{234}U and ^{234}U-^{238}U methods, yet, analytical uncertainties and problems of open system and presence of detrital material and initial Th hamper the dating of samples older than 200-300 kyr. Here, we present a combined approach that utilizes the U and Th isotopes with floating $\delta^{18}O$ stratigraphy and paleomagnetic constraints, and establish a high-resolution chronology of the mid to upper Pleistocene Lake Amora in the Dead Sea basin.

The application of the $\delta^{18}O$ record as a floating chronometer is based on the correlation found between $\delta^{18}O$ values of synchronously deposited upper-Pleistocene and Holocene lake sediments, East Mediterranean foraminifers and Judean Mountain speleothems (Kolodny *et al.*, 2005).

The lacustrine Amora Formation consists of laminated aragonite and detritus, Ca-sulfate minerals, halite and clastic units. The sediments were depsoited in the lacustrine environment of the paleo-Dead Sea basin and were later uplifted and tilted by the rising Sedom diapir, exposing ~330 m of the formation on the eastern flanks of Mt. Sedom.

$\delta^{18}O$ values range between 6.0 and –1.0‰, shifting periodically between glacial and interglacial sequences throughout the sedimentary section, marking corresponding shifts in the global marine records. Paleomagnetic data indicate the entire section was deposited after the 780 ka Matuyama-Brunhes magnetic transition.

Data compilation renders the age of the base of the exposed Amora Fm. to be ~750 to 700 ka BP (MIS 18 to 17), and the age of its capping sediments to be between ~200 and 130 ka BP (MIS 6 and the transition to MIS 5). Climatic-limnologic shifts throughout the sedimentation period are recorded by the lithological, chemical and isotopical properties of the sediments, and are correlated to global and regional events.

Reference

Kolodny Y., Stein M., and Machlus M. (2005) *Geochim. Cosmochim. Acta* **69**, 4045-4060.