SHOCK EFFECTS IN THE METAL-RICH CHONDRITES QUE 94411, HAMMADAH AL HAMRA 237 AND BENCUBBIN.

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We have studied the metal-rich chondrites QUE94411 (QUE), Hammadah al Hamra 237 (HH237) and Bencubbin with an emphasis on the petrographical and mineralogical effects of the shock processing that these meteorite assemblages have undergone.

Iron-nickel metal and chondrule silicates are the main components in these meteorites. These high-temperature components are held together by shock melts consisting of droplets of dendritically intergrown FeNi metal/sulfide embedded in ferrous silicate glass. The silicate glass component of the shock melt is substantially more FeO-rich (FeO: 30 to 40 wt%) than the prevailing chondrule silicates (FeO < 5 wt%).

Fine-grained matrix material, which is a major component in most other chondritic assemblages, is extremely scarce in QUE4411 and HH237; it has not been observed in Bencubbin. This material occurs as rare, hydrated, and fine-grained matrix lumps with major and minor element abundances roughly similar to the ferrous silicate shock melts (and CI). We infer that hydrated, fine-grained material, compositionally similar to these matrix lumps, was originally present between the FeNi metal grains and chondrules, but was preferentially heated by the shock wave and melted.

Other shock-related features in QUE94411, HH237, and Bencubbin include a distinct alignment and occasionally strong plastic deformation of metal and chondrule fragments. However, the existence of chemically zoned and metastable FeNi metal condensates in direct contact with shock melts indicates that the shock did not substantially increase the average temperature of the aggregate. TEM analyses of the FeNi metal droplets embedded in the shock melts show martensitic crystal structures, indicating rapid cooling, essentially quenching, of the shock melts. These findings indicate that the pre-shock temperature of the assemblage was low.

Because porphyritic olivine-pyroxene chondrules are absent in QUE94411, HH237, and Bencubbin, it is difficult to determine the precise shock stage of these meteorites, but the shock was probably relatively light (S2-S3; 5-20 GPa) consistent with a bulk temperature increase of the assemblages of less than 200 ºC. The higher pressures within this range (i.e. 15-20 GPa) are consistent with the findings of shock produced diamonds in Bencubbin [1]

The many mineralogical, petrological and isotopic (e.g. O and N) similarities between Bencubbin, Weatherford, Gujba and QUE/HH237 have been used to argue for a common origin of these meteorites on a single asteroidal parent body [2,3]. The findings of this study, which indicate similar shock processing, lend support to this view.

References:

[1] Mostefaoui *et al*. EPSL **204**, 89-100 (2002)
[2] Weisberg *et al*. MAPS **36**, 401-418 (2001)
[3] Rubin et al. GCA **67**, 3283-3298 (2003)