SHOCK HISTORY OF THE METAL-RICH CB CHONDRITE QUEBRADA CHIMBORAZO (QC) 001.

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Introduction: The Quebrada Chimborazo (QC) 001 meteorite belongs to the rare group of CB chondrites. These metal-rich carbonaceous chondrites show characteristics that sharply distinguish them from other chondrites [1]. Furthermore, they reached higher shock stages (S3–S4) than most other carbonaceous chondrite groups [1–5]. The high-pressure shock history of CB chondrites is of great interest as they seem to resemble the *P-T* conditions of the Earth transition zone, which might help to understand deep Earth processes as well.

The high density contrast between its two main components, metal and silicate, might lead to a heterogeneous *P-T* distribution during shock [6]. Previous studies of shock metamorphism in CB chondrites reveal several high-pressure phases such as wadsleyite, ringwoodite, majorite, majorite-pyrope solid solution, and coesite [1–5], which indicate *P-T* shock conditions of ≥19 GPa and ~2100 K. Up to now, the QC 001 meteorite is one of only two geological samples which contain asimowite, the Fe-analog of wadsleyite [7]. It is likely that asimowite crystallized from a Fe-enriched melt produced by a mixture of partially molten Fe,Ni-metal and silicate at very high temperature > 2000 K and pressure ≥15 GPa [7]. The purpose of this study is to expand the previous knowledge about the *P-T* conditions and their variation during and after the shock event.

Methods: Transmission electron microscopy on focused ion beam (FIB) sections was performed to obtain detailed high-resolution images, element maps and detailed chemical analysis. Furthermore, we use electron structure refinement techniques (ADT [8]) to better characterize the crystal structure of some high-pressure phases.

Results: Several FIB sections from shock melted areas were studied using TEM. One of the studied FIB sections was cut from an 10×10 µm-sized silicate melt droplet within the metal matrix. This melt droplet consists mostly of wadsleyite grains with unusual high Fe-contents ranging from Fa_{30} to Fa_{40} together with ringwoodite (Fa_{50}) and olivine ($Fa_{35–42}$, one grain with Fa_{10}) and a few pyroxenes.

Another FIB section was cut from a 68×110 µm-sized chondrule fragment. It consists of an assemblage of olivine ($Fa_{1.4}$) and low-Ca pyroxene with interstitial garnets. Two compositional trends were observed in the garnets: they either have composition of majorite-pyrope solid solution or a composition similar to the Al-rich diopsides of this meteorite.

Discussion: The dominant phase found in silicate melt droplets is Fe-rich wadsleyite which supports the theory of crystallization during post shock *P-T* release when the pressure and temperature were still high, close to peak conditions. The two types of garnet solid solutions, the Ca,Al-rich and the Mg,Al-rich have been found in the CB chondrite Gujba as well [2]. The chemistry of the pyrope-grossular solid solution is close to the chemistry of the Al-enriched diopsides in QC 001 which are also found in other CB chondrites [9]. Deduced from the chemical composition of the garnets and the resemblance between the Ca,Al-rich garnet and the Al-rich diopsides it is very probable that these garnets represent high-pressure polymorphs. Ca-rich (tetragonal) high-pressure garnets in a meteorite formed by solid state transformation has been described by [10] and the importance of majorite to draw conclusions regarding the *P-T* conditions and cooling rate has been shown by [11]. The results from this study propose peak shock condition of ~15±2 GPa and ~2100±200 K for QC 001.

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