SHOCKED AMPHIBOLE AT THE XIUYAN CRATER, CHINA.

F. Yin[1], M. Chen[2]. [1]Department of Geology, Hunan University of Science and Technology, Xiangtan 411201, China. E-mail: fengite@hotmail.com. [2]Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China. E-mail: mchen@gig.ac.cn.

Introduction: Although amphiboles occur in many terrestrial metamorphic and igneous rocks, they are rare in meteorites. The information about shocked amphiboles comes mainly from the amphibole-bearing rocks of terrestrial impact craters [1, 2] and shock loading experiments [3].

The Xiuyan crater is a simple crater 1.8 km in diameter in northeastern China. The crystalline basement rocks of the crater is made up of the early Proterozoic metamorphic rocks composed of granulite, amphibolite, gneiss, tremolite marble, and marble. A drilling hole in the center of the crater revealed that the crater is filled by the upper 107 m thick lacustrine sediments and the lower 188 m thick impact breccias [4]. The impact breccia unit is loosely consolidated and consists mainly of lithic impact breccias and some suevites. The lithic impact breccia is composed of gneiss, granulite, amphibolite, and marble fragments up to 30 cm in size, and mainly occurs in the depth interval of 107–260 m. The suevite mainly occurs in the depth interval from 260 to 295 m. The suevite is composed of fragments of gneiss, granulite, amphibolite, quartz, and feldspar, fine grained matrix, as well as glass inclusions [5]. Gneiss fragments with different degrees of shock metamorphism can be found in the drill cores.

Results and Discussion: Amphiboles in the weakly shocked gneiss (shock pressure less than 10 GPa) basically remain intact. The Raman spectrum of weakly shocked amphibole displays peaks at 223, 667, ~1,033, and 3,671 or 3,696 cm^{-1}. Amphiboles in the moderately shocked gneiss (shock pressure range between 35 and 45 GPa) show strong deformation, reduced optical interference color, and partial loss of OH^-. Raman spectroscopic analyses of the moderately shocked amphiboles also display the Raman peaks at 223, 671, and 3,672 or 3,662–3,676 cm^{-1}. However, the intensity of the Raman band of OH^- from the moderately shocked amphiboles becomes much weaker than that from the weakly shocked amphiboles.

In the strongly shocked gneiss (shock pressure above 50 GPa), amphiboles occur as irregular patches among silica glass and vesicular feldspar glass. These patches are opaque under transmitted light of the optical microscope, and no amphibole crystals or fragments can be found in the patches. Under reflected light of the optical microscope and on the backscattered electron image, these patches display a number of dendritic diopside and pigeonite microcrystals with lengths and widths of 5–80 μm and 1–10 μm, respectively. The formation of dendritic pyroxenes shows nearly complete loss of water in the amphibole melt at shock-induced high temperature above 1,500 ^oC. The occurrence of both diopside and pigeonite dendrites crystallized in the same amphibole melt shows inhomogenous melt composition and rapid cooling of the melt.

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