SHOCK METAMORPHISM OF PLAGIOCLASE IN THE XIUYAN CRATER, CHINA.

F. Yin. Department of Geology, Hunan University of Science and Technology, Xiangtan 411201, China. E-mail: fengite@hotmail.com.

Introduction: Plagioclase is the most common rock-forming mineral in the Earth's crust, and it occurs in many terrestrial rocks and meteorites. Shock-induced deformations in plagioclase have been studied in detail, and they are widely used to calibrate shock peak pressures and temperatures in meteorites. Plagioclase displays shock effects of irregular fractures, undulatory extinction, planar deformation features (PDFs), diaplectic glass, maskelynite and melted glass with increasing of shock pressures [1, 2].

The Xiuyan crater is a bowl-shaped simple crater with a diameter of 1800 m and is located in Liaoning Province of 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. The crater is filled by the upper 107 m thick lacustrine sediments and the lower 188 m thick impact breccias [3]. 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. The suevite is composed of fragments of gneiss, granulite, amphibolite, quartz, and feldspar, fine grained matrix, as well as glass inclusions. Gneiss fragments from the impact breccia usually contain quartz and plagioclase.

Results and Discussion: According to shock effects in the quartz grains, gneiss fragments from impact breccias are divided into the weakly shocked gneiss (Quartz planar fractures, shock pressure less than 10 GPa), the moderately shocked gneiss (Quartz PDFs, shock pressure range between 10 and 30 GPa) and the strongly shocked gneiss (Quartz diaplectic glass and Coesite in silica glass, shock pressure above 30 GPa) [4, 5, 6].

Plagioclases in the weakly shocked gneiss basically display irregular fractures and only a few of them show undulatory distinction. In the moderately shocked gneiss, PDFs and diapletic glass are observed in the plagioclase grains. Only one set of PDFs can be found in some moderately shocked plagioclase grains and they are usually oblique to twin lamellae. Several plagioclase crystals have been partially converted to diaplectic glass. In some case, part of the twin lamellae becomes vitrification while the rest part of the crystal remains intact.

In the strongly shocked gneiss, plagioclases are totally molten. They are transformed into vesicular glasses. These vesicular glasses show round outline and flow texture. The diameter of vesicula is 5-20 μm. There are so many vesicula in the plagioclase glass and the volume of vesicula can even take up half of the glass's volume. The quantitative chemical composition analysis shows that some vesicular plagioclase glasses have a little higher content of SiO_2 (75.33 wt.%).

Shock-metamorphic features in plagioclase indicate certain shock pressures as that of quartz. Based on the vesicular glass, the peak pressure of the impact gneiss fragment in the Xiuyan crater is about 45 GPa [2, 5]. The higher SiO_2 content in the vesicular glass is attributed to the silica glass that incorporated into plagioclase melt.

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