MICROTEXTURES OF COESITES WITH DIFFERENT OCCURRENCES FROM THE XIUYAN CRATER. F. Yin[1,2], M. Chen[2], [1]Department of Geology, Hunan University of Science and Technology, Xiangtan 411201, China, yinfeng@hnust.cn, [2]Guangdong Provincial Key Laboratory of Mineral Physics and Materials, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China.

Introduction: Coesite, a common high pressure mineral with chemical composition of SiO_2, is widely distributed in metamorphic rocks, meteorites, and impact craters. Coesite was firstly found in Meteor crater by Chao et al. [1] and was explained to be formed via a polymorphic transformation of quartz. So far, coesite had been reported in more than 30 impact craters and were considered as a result of solid-state transformation of amorphous silica [2] or crystallize from silica melt [3]. There are many coesite in silica glasses of the suevite from the Xiuyan crater. Chen et al. [4] proved these coesite crystallized from silica melt based on the morphology and occurrence of coesite. Here, we summarize the further investigations of the microtextures of coesites with different occurrences in the Xiuyan crater.

Sample and Methods: A sample of suevite was collected from the drill cores of Xiuyan crater. Thin sections of the suevite were investigated using a combination of polarized and reflected light optical microscopy to document shock metamorphic features of minerals. And then Raman spectroscopy was used to verify the high pressure phases. We followed these investigations with field-emission scanning electron microscopy (FESEM) and transmission electron microscopy (TEM) to characterize the microtextures of coesite in the suevite.

Results: The suevite consists of fragments of gneiss, amphibolite, silicate glass and fine-grained matrix. Gneiss clasts are strongly shocked and are composed of silica glass, vesicular feldspar glass, and opaque black patches. Most silica glasses keep the same morphology as primary quartz, and some silica glasses display round outline. There are many coesite grains in the silica glasses and they mainly occur in two kinds of occurrence. One is the stringer of coesite that the average width is about 20 μm. The stringer always extends across most or all of the silica glass. The other is the granular coesite with a diameter up to 30 μm that are randomly distributed within the silica glass.. TEM images reveal both stringer and spherulite are indeed polycrystalline aggregates of coesite microcrystal. In the stringer, individual coesite microcrystal ranges from 100 to 500 nm and coesite crystals distribution is denser in the rim than that in the core (Fig. 1). In the spherulite, most coesite microcrystals aggregate and isolated coesite crystals are rare (Fig. 2).

Discussion: Occurrences of coesite assemblages in the silica glass undoubtedly indicate they crystallize from silica melt. Phase diagram for SiO_2 [5] indicates the pressure for coesite crystallization is 4.5-13 GPa.

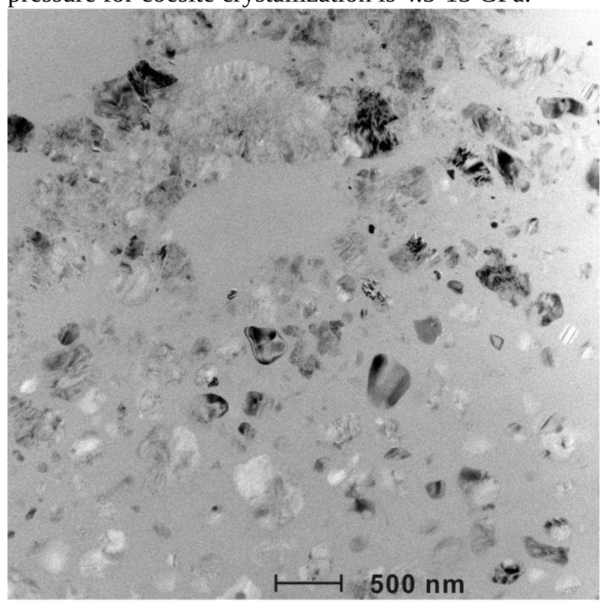

Figure 1: Bright-field TEM image of isolated coesite crystals in the stringer. The top of this image is the rim of stringer and the bottom is the core of stringer.

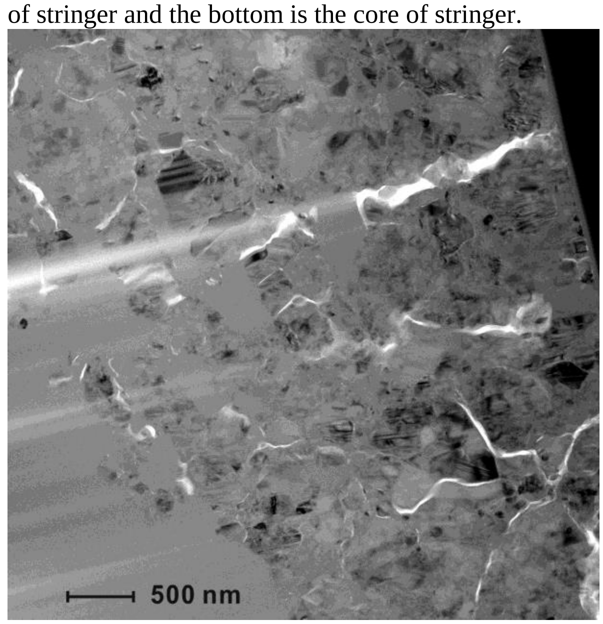

Figure 2: Bright-field TEM image display coesite crystals of the spherulite.

Previous study of this sample by Chen et al. [4] estimated the growth rate of coesite crystallization is 10^{-3} m/s. Fazio et al. [3] observed analogous occurrence of stringer coesite in the Ries crater and they also concluded that the coesite forms through crystallization from silica melt. Both Chen et al. [4] and Fazio et al. [3] considered that the formation of stringer coesite may be related to defects and fractures in primary quartz. TEM images in this study further reveal that there are more coesite crystals in the rim of stringer. This may be due to that coesite began to nucleate at the interface between silica melt and original quartz. Crystals that nucleated along the interfaces between the original minerals and other minerals or shock melt vein matrix have been observed in meteorites [6]. For the granular coesite that randomly distributed in the silica glasses, the occurrence indicates the primary quartz is totally melt and then coesite adopt a homogeneous nucleation from it.

References: [1] Chao E.C.T. et al. (1960) *Science, 132*, 220-222. [2] Stähle V. et al. (2008) *Contrib. Mineral. Petrol., 155,* 457-472. [3] Fazio A. et al. (2017) *Meteoritics & Planet. Sci., 52,* 1437-1448. [4] Chen M. et al. (2010) *Earth & Planet. Sci. Let., 297,* 306-314. [5] Zhang J. et al. (1996) *Phys. Chem. Miner., 23,* 1-10. [6] Ozawa S. et al. (2014) *Sci. Rep., 4,* 5033.

Acknowledgements: Rui Li (IGCAS) and Haiyang Xian and Yiping Yang (GIGCAS) are thanked for helping with making foils by FIB and the TEM analyses, respectively. This work was supported by the National Natural Science Foundation of China (41503062), Guangdong Provincial Key Laboratory of Mineral Physics and Materials (GLMPM-36), and Hunan Provincial Key Laboratory of Shale Gas Resource Utilization (E21819).