A TEM INVESTIGATION OF FORMATION PROCESS OF COESITE FROM THE XIUYAN IMPACT CRATER.

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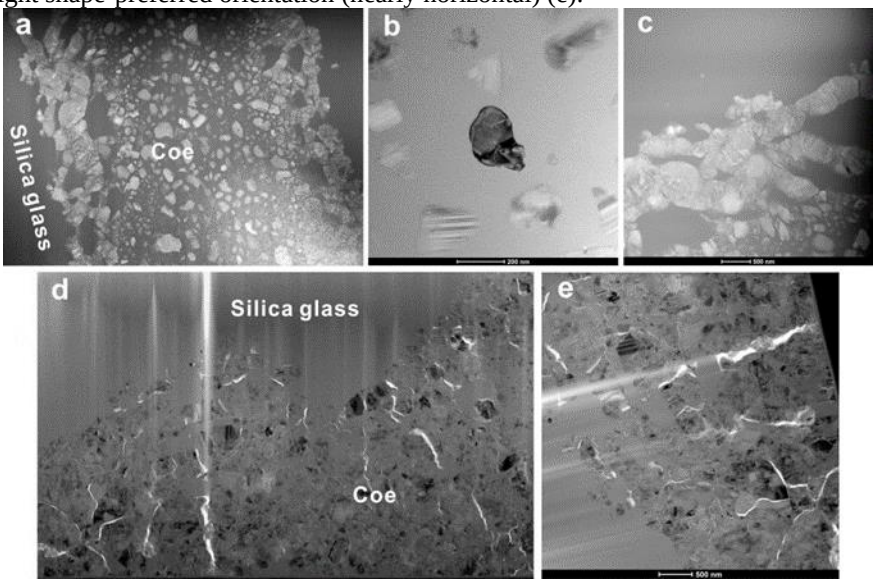
Introduction: Coesite is widely distributed in metamorphic rocks, meteorites, and impact craters. It was firstly found in Meteor crater by Chao et al. [1] and was explained to be formed via a polymorphic transformation of quartz. Coesite had been reported in more than 30 impact craters and is considered to be a result of solid-state transformation of amorphous silica [2] or crystallize from silica melt [3]. Coesite is common 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.

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 material. Most of the silica glasses have the same morphology as primary quartz, and some silica glass fragments are rounded. Coesite grains embedded in the silica glasses occur in stringer and granular morphologies.

The stringer coesites are polycrystalline aggregates of coesite nanocrystals (a). Coesite crystals along the edge are large, fractured and deformed (c), whereas coesite crystals in the center are small, randomly distributed single crystals (b).The granular coesite are polycrystalline aggregates of coesite nanocrystals (d). Most crystals display twinning and a slight shape-preferred orientation (nearly horizontal) (e).



Disscussion: The vesicular feldspar glass and silica glass in the gneiss clast indicate the shock pressure is > 45 GPa [5]. The two occurrences of coesite are from one gneiss clast in the shock breccia, and therefore both of them definitely underwent the same shock pressure. Similar stringer coesites have been observed in Ries crater. Fazio et al. [3] concluded that the coesite crystallites at the rim and at the core of stringer formed by heterogeneous nuclea-tion and homogeneous nucleation from silica melt, respectively. In this study, TEM images reveal that the micro-textures of granular coesites are same as the coesite aggregates at the rim of stringer, e.g. fractured and a slight preferred orientation of the crystals. This suggests that they formed by heterogeneous nucleation on the edge of a silica melt. The randomly distributed coesite in the core of stringer formed by homogeneous nucleation from silica melt. Coesite crystallized at 4.5-13 GPa during pressure release [6].

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