FORMATION PROCESSES OF SHOCKED QUARTZ BY IMPACT METAMORPHSIM.

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1. Introduction

Physical, mineralogical and morphological changes of silica minerals by shock (or impact) metamorphism (i.e. high pressure shock wave effect within a few microseconds [1,2,3]) are discussed in this study.

The purposes of the present study are (1) silica mineral change by shock metamorphism, and (2) application of the formation process to natural impact craters and Cretaceous-Tertiary (K/T) boundary samples.

2. Formation process of silica minerals

Impact metamorphism of silica minerals can be analyzed by (1) volume percentage of shocked quartz vein-type lamellae [4], and (2) change of cell-dimensions and corresponding calculated density.

From the structural data shocked silica minerals, the following formation stages are considered in this study [5,6].

1) Compression stage of shock impact. High pressure type silica minerals of stishovite and coesite are formed during this stage. However, immediately after the compression due to shock impact, the silica phases are transformed to quartz of lower pressure silica type. Thus it is difficult to find high pressure type silica which resulted from compression stage of shock impact. This shock compression process is represented by either C1 or C2 trend in Fig. 1.

2) The initial release stage. Shocked quartz grains with shock lamellae were formed at the release from the compression stage. The difference in volume between stishovite (or coesite) and quartz is the mechanism for generating the vein formation which indicates shock lamellae after expanding in volume. Thus silica mineral formed during this stage of shock process demonstrates a quartz field with relict of higher density (<1 vol.%) from the stishovite (or coesite) fields. This shock release process may be depicted by either an R1 or R2 trend as shown in Fig. 1.

3) The later release of contamination stage. This type of shocked quartz shows a lower density and a decorated planar texture and is formed at the later release of the contamination stage. The planar lamellae are replaced by a fluid solution which is the main cause of the lowing of the measured density of quartz grain at the final stage. It is difficult to clearly differentiate between the formations generated by impact and igneous (i.e. volcanic) process at the later stage.

3. Application of shocked quartz to impact crater and K/T boundary

Relation between crack-vein percentage (i.e. x vol.%) and shock pressure (i.e. y kbar) is expressed by the following equation.

$$y = 9.41 \cdot x - 33.77 \quad (r=0.98)$$

Relation between density deviation $\Delta\rho$ (%) obtained from cell-parameters of quartz grains (i.e. x %) and shock pressure obtained from shock lamellae of Charlevoix crater [7,8] (i.e. y kbar).

$$y = 494.3 \cdot x + 14.8 \quad (r=0.89)$$

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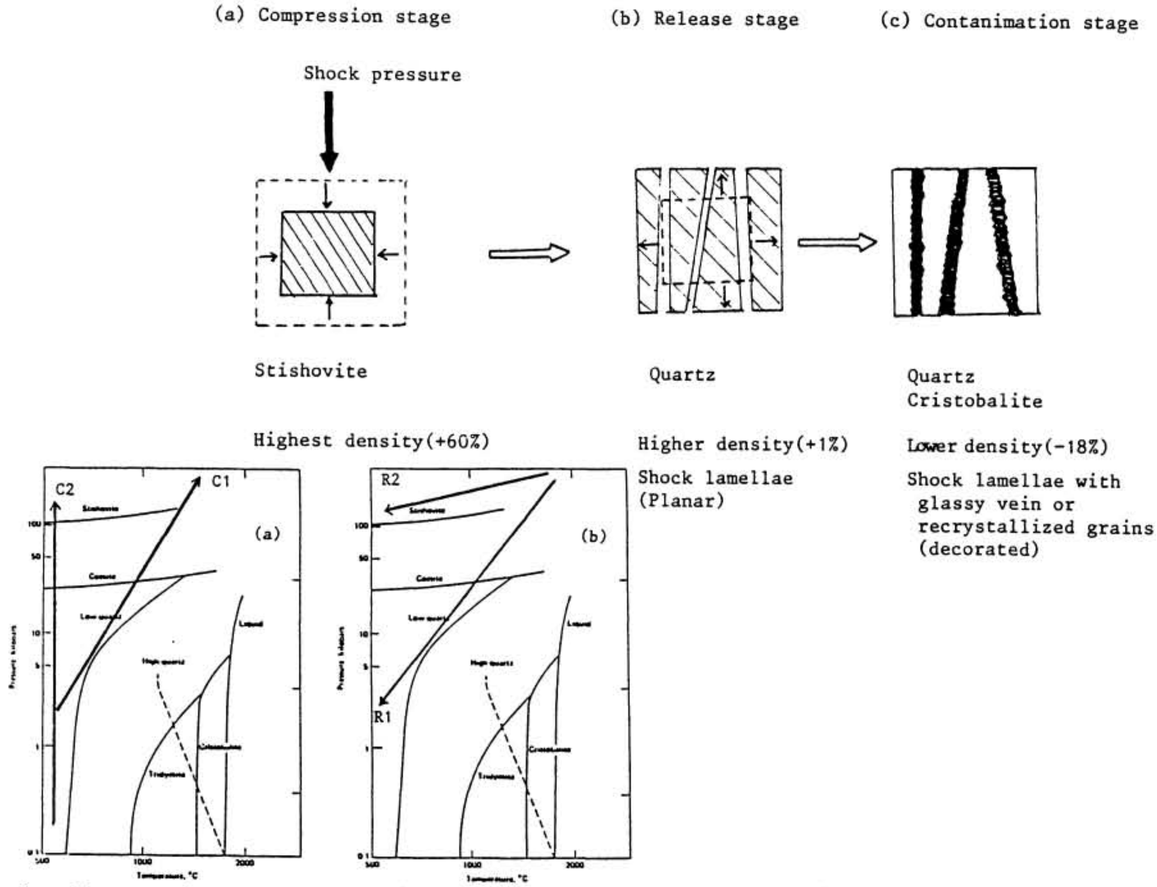

Fig. 1. Formation stages of shoched quartz on shock impact with diagram of pressure and temperature of silica minerals [6,9]. (a) Compression stage (designated as C1 or C2). (b) Release stage after shock impact (designated as R1 orR2). (c) Contamination stage by glassy fluid veins.

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