

HIGH PRESSURE PHASES IN IMPACTITES OF THE ZHAMANSHIN CRATER/USSR. D.D.Badyukov. Vernadsky Institute of Geochemistry and Analytical Chemistry, USSR Academy of Science, Moscow.

It has been suggested that most rock-forming minerals can be modified in the solid state by shock wave compression (1,2). Recent data suggest a more complicated mechanism of high pressure phase transitions: crystallization of the phases from impact melt under shock compression (3,4). In order to investigate the problem we looked for high density in impactites of the Zhamanshin crater. The crater was formed in a two-layer target consisting of clays, marls, quartzites, chlorite-epidote-quartz slates and so forth (5). The specimens were collected from the inside part of the crater ring bank. The high density phases were yielded from the samples of impactites by dissolution in hydrofluoric acid. Minerals were identified by optical and X-ray diffraction methods. Mineral and chemical compositions of the investigated samples are shown in table 1. According to the optical microscopy observations corundum, spinel and kyanite could be formed from the melt but it should be noted that this is very difficult to establish exactly because of the sub-micron sizes of crystallites. Investigation of the shock metamorphic quartz vein sample, composed of diaplectic quartz, diaplectic glass and melt glass showed that stishovite is only in diaplectic quartz, but coesite is in diaplectic glass and sometimes in melt glass in agreement with the data for the Ries crater (6).

This could have been suggested by the schematic mechanism of formation of the high pressure phases (kyanite and garnet phase). Pumiceous impactite are very similar to target clays in bulk chemistry (table 1). This means that the target material was watercontaining and its liquidus curve must correspond to the "BC" curve (Fig.1). During high dynamic loading the rocks were melted behind the front of the shock wave (point H, Fig.1). In this case the path of the release wave HMO must intersect the liquidus curve in point M. The position of point M, depending on the position of point H, the liquidus curve BC and the release curve HMO, defines whether high pressure phases crystallize or not. Some another process responsible for coesite - stishovite association in the shock metamorphic quartz vein can be proposed. During shock compression of quartz hot zones form behind the front of the shock wave (4). Temperature of these zones can be higher than quartz liquidus temperature under some peak pressure (point A, Fig.2). The subsequent behavior of the melted parts will depend on the zone size which are function of peak pressure (the size increases with increase of the peak pressure). If the zone thickness is very small the state will change along ABC line as a result the rapid reducing of the temperature which will lead to intersect the liquidus curve at a point in the stishovite stability. This will cause stishovite crystallization. If the zone thickness is larger the zone temperature will decrease more slowly,

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therefore the release curve ABDE will intersect the liquidus curve at a point in the coesite or cristobalite stability, which will lead to crystallization of these phases.

Table 1.

Sample	Mineral composition	Bulk composition (wt%)											
		SiO ₂	TiO ₂	Al ₂ O ₃	FeO	MnO	MgO	CaO	Cr ₂ O ₃	Na ₂ O	K ₂ O	P ₂ O ₅	L.i.w. Total
Shock metamorphic quartz vein	quartz (diaplectic), coesite (25%), stishovite (.05)												
Shock metamorphic quartzite	coesite, cristobalite, quartz	96.5	.23	2.41	.51	-	.31	.86	.00	.85	.00	.00	99.67
Slaggy glassy impactites	spinel (hercynite), corundum, coesite, hematite, quartz	68.9	.83	14.9	5.67	.22	1.87	1.66	.01	.90	3.06	.17	101.64
		75.2	.81	15.8	2.65	.05	1.52	.75	.02	.34	3.48	.07	100.53
Pumiceous impactite	kyanite, coesite, corundum, spinel, hematite	51.1	.67	23.6	6.70	.05	1.66	1.55	.00	1.99	1.29	.26	98.67
Pumiceous impactite	phase with garnet structure (majorite?) [†] , magnetite, hematite, iron	53.6	.84	17.8	4.91	.07	3.24	4.87	.00	6.54	.39	.40	101.25
Slaggy impactite	mullite, spinel, cristobalite, quartz	62.9	1.46	19.4	3.53	.06	1.84	3.65	.03	.66	1.34	.07	99.97

[†]total iron expressed as FeO

[†]transform in spinel + protoenstatite during annealing

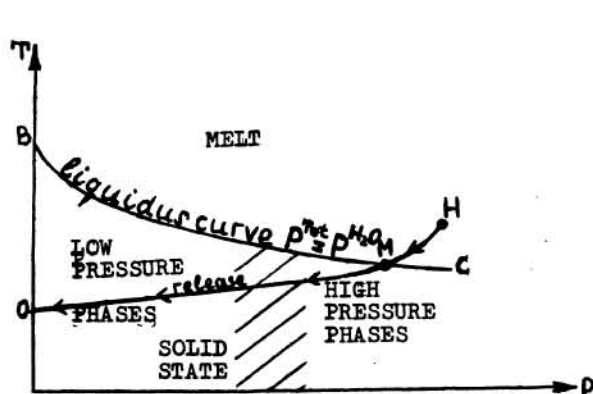


Fig. 1

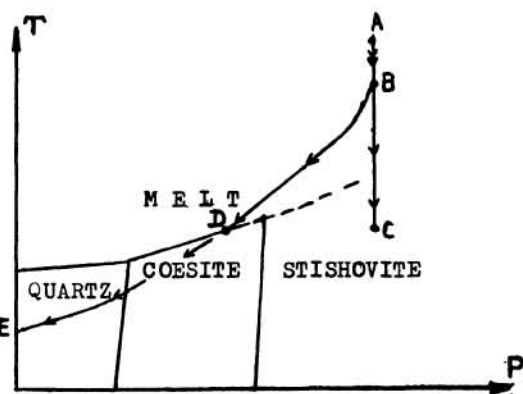


Fig. 2

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