

Fig. 1. Influence of time and temperature on the alteration of coesite. Time is plotted the coordination number is 6) could on a logarithmic scale. Solid and dotted filling indicate relative amounts of quartz, avoid the SRO stage and indeed there cristobalite, and tridymite modifications determined by x-ray diffraction. Circle and square points are for separate lots of concentrated coesite in which grain sizes averaged 8 and 17 microns respectively. The square marked X represents the average observations during a 5-hour x-ray study at high temperature.

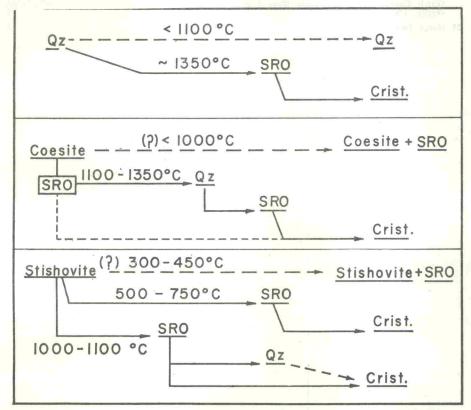


Fig. 2. Scheme of the most likely inversion paths of coesite and stishovite. Lower temperature limits are strongly dependent on time.

stishovite differs markedly from the the change of the aggregate refractive coesite in metastable persistence. It index, stishovite breaks down slowly at withstands exposure at 425°C for a few hours, but becomes completely amor- lower temperatures the stishovite should phous to x-ray diffraction methods be more resistant to change, obvious in

The data in Table 2 show that the tween 650° and 750°C. Judging from 350°C and much faster at 425°C. At after heating less than 5 minutes be- its persistence in the crushed sandstone

of the Arizona Meteor Crater formed thousands of years ago. At higher temperatures and longer heating times (1/2 to 18 hours) crystallization of quartz (in the stability field of tridymite) in the presence of the SRO phase is again observed. Although cristobalite is the first to be observed by x-ray diffraction it is barely evident microscopically after 18 hours at 1100°C whereas quartz can be detected microscopically after 2 hours. No evidence of a transient formation of coesite from the much denser stishovite has as yet been found.

In Fig. 2, we attempt to summarize schematically some of the results obtained and to offer a probable interpretation. Coesite apparently forms a "dense," fine grained SRO phase, which then is converted to quartz. In the case of stishovite it is inconceivable that the rutile-type structure (where is direct evidence for the formation of the SRO and subsequent conversion at low temperatures. That the refractive index of the SRO phase rapidly approaches that of silica glass, may be a manifestation of a high disordering tendency of the coordination change, not involved in the case of coesite. The relative amounts of the various phases formed in any particular run might be explained on the basis of the competing reactions stishovite (or coesite) → SRO, SRO → quartz, quartz → SRO, and SRO → cristobalite with widely differing activation energies (12).

> FRANK DACHILLE ROBERT J. ZETO RUSTUM ROY

Table 2. Heat treatment of stishovite at 1 atm pressure. The bulk color of the samples changed from grey to white with the presence of a large amount of amorphous material. A, amorphous, C, cristobalite, Q, quartz, S, stishovite, W, weak. For comparison, data from the literature is included. a. Synthetic stishovite of Stishov and Popova [Geokhimiya No. 10, 837 (1961)]. b. Natural stishovite, Fahey (11).

Temp.	Time (hr)	Results		
		X-ray	Microscopy	R.I. aggre- gate*
1100	18	C+Q	Q+A+C	
1100	2	C+Q	Q + A + C	
1060	0.5	C	A	1.456
1040	0.1	A	A	1.456
750	0.1	A	A	1.480
750	0.2	A	A	-
650	0.2	WS	S	1.500
500	0.2	S	S	
425	3.5	S	S	1.740
350	70.	S	S	1.783
350	0.2	S	S	
130	0.5	S	S	-
900 (a)	6.0	C + A		
498 (b)	165.	A + S		1.557

\* R.I. of starting stishovite aggregate (1.793 aver-

Minerals Research Laboratory and Department of Geochemistry and Mineralogy, Pennsylvania State University, University Park References and Notes

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