

TABLE I. PYROPHYLLITE REACTION PRODUCTS

Reaction Products	Pressure (kilobars)	Temperature (°C.)			
	10 <sup>-3</sup>	500	pyrophyllite		(principle)
	10 <sup>-3</sup>	1000	modified pyrophyllite		(secondary)
$\alpha$ -Al <sub>2</sub> O <sub>3</sub>	10 <sup>-3</sup>	1500	mulite		(trace)
	13.5	500	pyrophyllite		
	13.5	1000	pyrophyllite		
	13.5	1770	$\alpha$ -Al <sub>2</sub> O <sub>3</sub>	quartz	
	27.0	25	pyrophyllite		
	27.0	500	pyrophyllite		
	27.0	1000	pyrophyllite		
	27.0	1500	kyanite		
$\alpha$ -Al <sub>2</sub> O <sub>3</sub>	27.0	1900	kyanite		
$\alpha$ -Al <sub>2</sub> O <sub>3</sub>	40.5	1500	coesite	coesite	
	40.5	2070	coesite	kyanite	
	47.25	2100	coesite	kyanite	
	54.0	25	pyrophyllite		
	54.0	500	pyrophyllite		
	54.0	1000	pyrophyllite		
	54.0	1500	coesite	kyanite	
$\alpha$ -Al <sub>2</sub> O <sub>3</sub>	54.0	1950	coesite	kyanite	
$\alpha$ -Al <sub>2</sub> O <sub>3</sub>	54.0	2000	coesite	kyanite	
	67.5	25	pyrophyllite		
	67.5	500	pyrophyllite		
	67.5	1000	pyrophyllite		
	67.5	1500	coesite	kyanite	
$\alpha$ -Al <sub>2</sub> O <sub>3</sub>	67.5	2000	coesite	kyanite	
	81.0	25	pyrophyllite		
	81.0	1000	pyrophyllite		
	81.0	2000	coesite	kyanite	

coesite onset at a temperature between 1000° and 1500° C. and a pressure between 13.5 and 27 kilobars. Kyanite is slightly more predominant than coesite up to a pressure between 27 and 40.5 kilobars, above which coesite is the principal phase. The "modified pyrophyllite" obtained at standard pressure and 1000° C. is essentially a dehydrated phase, the x-ray diffraction pattern of which is only slightly changed from that of the original pyrophyllite. This is probably the same phase as that noted by Carte (1955).

Petrographic examination of the alteration zone material obtained at 67.5 kilobars and 2000° C. showed essentially two phases (Fig. 4): a very fine-grained, markedly birefringent, rod-like material (kyanite), and a somewhat more coarsely grained, flaky phase of lower birefringence

(coesite). The kyanite appeared more uniform in crystallite size, averaging approximately  $1 \times 5 \mu$ . Coesite, on the other hand, showed fragments as small as  $1 \mu$  and large flakes up to  $40 \times 85 \mu$ .

Since the original synthesis of coesite (Coës, 1953), interest in this material has grown steadily, the pace having been quickened by its recent discovery at Meteor Crater, Arizona (Chao, Shoemaker and Madsen, 1960). This positive identification of a natural occurrence firmly estab-

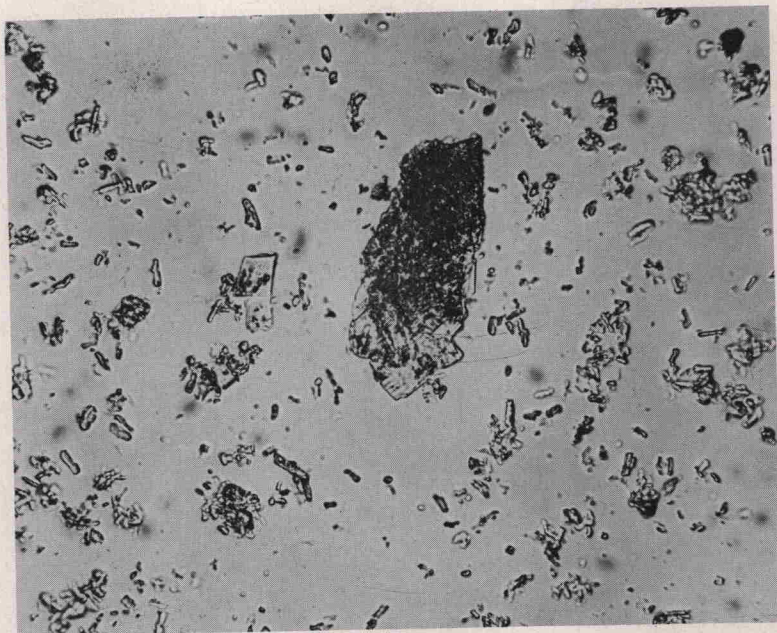


FIG. 4. Photomicrograph showing kyanite (fine-grained, rod-like) and coesite (large flakes) from alteration zone material obtained at 67.5 kilobars and  $2000^{\circ}$  C.; transmitted light, 1.54 immersion oil ( $390\times$ ).

lishes the mineralogical name coesite, as opposed, for example, to the term "silica-C" (Sosman, 1954). The general crystallography of coesite (Ramsdell, 1955) and its crystal structure (Zoltai and Buerger, 1959) have been described, along with further accounts of its synthesis and characteristics (Khitarev, Slutskiy and Arsen'yeva, 1957). In addition, several studies have been made of quartz-coesite relationships (MacDonald 1956; Datchille and Roy, 1959; Boyd and England, 1960).

As of 1954, the synthesis of kyanite had not yet been achieved, the difficulty having been ascribed to the required octahedral coordination for  $Al^{3+}$  (Roy and Osborn, 1954). More recent investigations, however,