FORMATION OF COESITE AND KYANITE FROM PYROPHYLLITE AT VERY HIGH PRESSURES AND HIGH TEMPERATURES

SiO_2

BY

A. A. GIARDINI, J. A. KOHN, D. W. ECKART AND
J. E. TYDINGS

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THE FORMATION OF COESITE AND KYANITE FROM PYROPHYLLITE AT VERY HIGH PRESSURES AND HIGH TEMPERATURES

A. A. Giardini, J. A. Kohn, D. W. Eckart, and J. E. Tydings
U. S. Army Signal Research and Development Laboratory, Fort Monmouth, New Jersey

In the course of studies carried out during the past two years on various chemical systems at elevated pressures and temperatures, the alteration of pyrophyllite specimen capsules was investigated. The pyrophyllite was found to decompose to coesite and kyanite, the present note being a preliminary report on this finding. Additional, more detailed studies will be presented as a portion of a more comprehensive paper at a future date.

A few words are in order concerning pyrophyllite-like materials as components in high-pressure equipment. The use of catlinite as a compressible, solid, pressure transmitting material was first recognized by Bridgman (1938). More recently, massive pyrophyllite (commercially, Tennessee Grade A Lava Stone or Wonderstone) has received wide acceptance both as a solid, pressure-transmitting medium, and as an electrical and thermal insulator in equipment capable of generating sustained very high pressures and high temperatures (Birch and Robertson, 1957; Hall, 1958; Giardini, Tydings and Levin, 1960). Both materials are very fine-grained, relatively homogeneous, hydrous aluminum silicates that are readily machinable. Compositionally, pyrophyllite is relatively pure and can be described by the chemical formula $H_2Al_2(SiO_3)_4$, whereas catlinite may contain up to 8 or 9% Fe_2O_3 and occasional traces of quartz. In practice, catlinite generally performs in a manner superior to pyrophyllite because of the high coefficient of static surface friction imparted by the presence of Fe_2O_3, which tends to restrict flowage under pressure. With respect to availability, however, catlinite is difficult to obtain, whereas pyrophyllite can be purchased in commercial quantities of relatively uniform quality. Consequently, the latter is in general use today in static high-pressure high-temperature devices.

Figure 1 shows a sectioned specimen capsule (graphite charge) before being subjected to elevated pressures and temperatures. A detailed description of the entire pressure apparatus has already been given (Giardini, Tydings and Levin, 1960).

Figure 2 depicts a polished section of a specimen capsule that was stressed at 85 kilobars (1,250,000 psi) and heated to approximately 1600° C. in the vicinity of the charge. The latter in this case was graphite (A, Figure 2), placed between two solid nickel cylinders (B). Note the