...SPACINGS OF SYNTHETIC CHLORITOID

d	hkl	I
	2	
4.468	$\bar{2}01$ 002	10
3.253[a]	$\bar{1}12$ $1\bar{1}2$	2
2.970	003	8
2.925	112 202	1
2.775	$\bar{2}03$	2
2.699	$0\bar{2}1$ $\bar{3}11$	4
2.461	$\bar{3}12$ $0\bar{2}2$	6
2.400	311	1
—	—	—
2.302[a]	$\bar{1}21$ 113 $2\bar{2}1$ 203	1
—	—	—
1.580	$\bar{3}31$ $0\bar{2}5$ $\bar{2}25$	1

9.483 ± 0.003
5.538 ± 0.005
9.174 ± 0.005
$96°48' \pm 5'$
$101°49' \pm 4'$
$89°59' \pm 3'$

...bar
...bar
...nique to triclinic polymorph.

and quartz are considered to be mutually unstable, the equilibrium high temperature breakdown assemblage being iron cordierite and hercynite. It was, however, possible to synthesize chloritoid, mixed with chamosite, quartz, hercynite and corundum, by taking this high temperature assemblage, iron cordierite, hercynite and quartz, and holding it at a temperature, within the chloritoid stability field (Run 15). The chloritoid, chamosite, quartz, hercynite and corundum assemblage is unstable and is an intermediate step in the reaction in which chloritoid is the final stable product. (Compare with Runs 11, 12).

These results at 1 kbar water pressure are most easily accounted for by assuming that, within the chloritoid stability field, both the iron cordierite and chamosite bearing assemblages have a lower Gibbs free energy than the oxide mix but higher than chloritoid. However, from an oxide mix chloritoid nucleates and grows much more slowly than the chamosite assemblage, requiring either a temperature close to the upper stability limit of chloritoid or long run duration or both to produce chloritoid. At 1 kbar water pressure the run times to produce chloritoid from an oxide mix, via the chamosite assemblage, are prohibitive, but are of reasonable length starting from the iron cordierite bearing assemblage.

The synthesis of chloritoid at water pressures as low as 1 kbar, in a hydrostatic environment, shows conclusively that stress is not a major factor affecting chloritoid stability, (Harker, 1932, pp. 147–151) and serves to emphasize the need for careful experimentation in iron-aluminum-silica systems, where reaction rates are slow and resultant "metastability" may be common.

REFERENCES

APPLEMAN, D. E., D. S. Handwerker and H. T. Evans (1963) The least squares refinement of crystal unit cell with powder diffraction data by an automatic computer indexing method (abstr.). *Program Ann. Meet. Amer. Crystallogr. Ass.*

EUGSTER, H. P. AND D. R. WONES (1962) Stability relations of the ferruginous biotite, annite. *J. Petrology,* **3,** 82–125.

GANGULY, J. AND R. C. NEWTON (1968) Thermal stability of chloritoid at high pressure and relatively high oxygen fugacity. *J. Petrology* **9,** 444–466.

HALFERDAHL, L. B. (1961) Chloritoid: Its composition, X-ray and Optical properties, Stability and occurrence. *J. Petrology* **2,** 49–135.

HARKER, A., (1932) *Metamorphism.* Meuthen, London.

SCHREYER, W. (1965) Zur Stabilität des Ferrocordierits. *contrib. Mineral. Petrology.* **11,** 297–322.