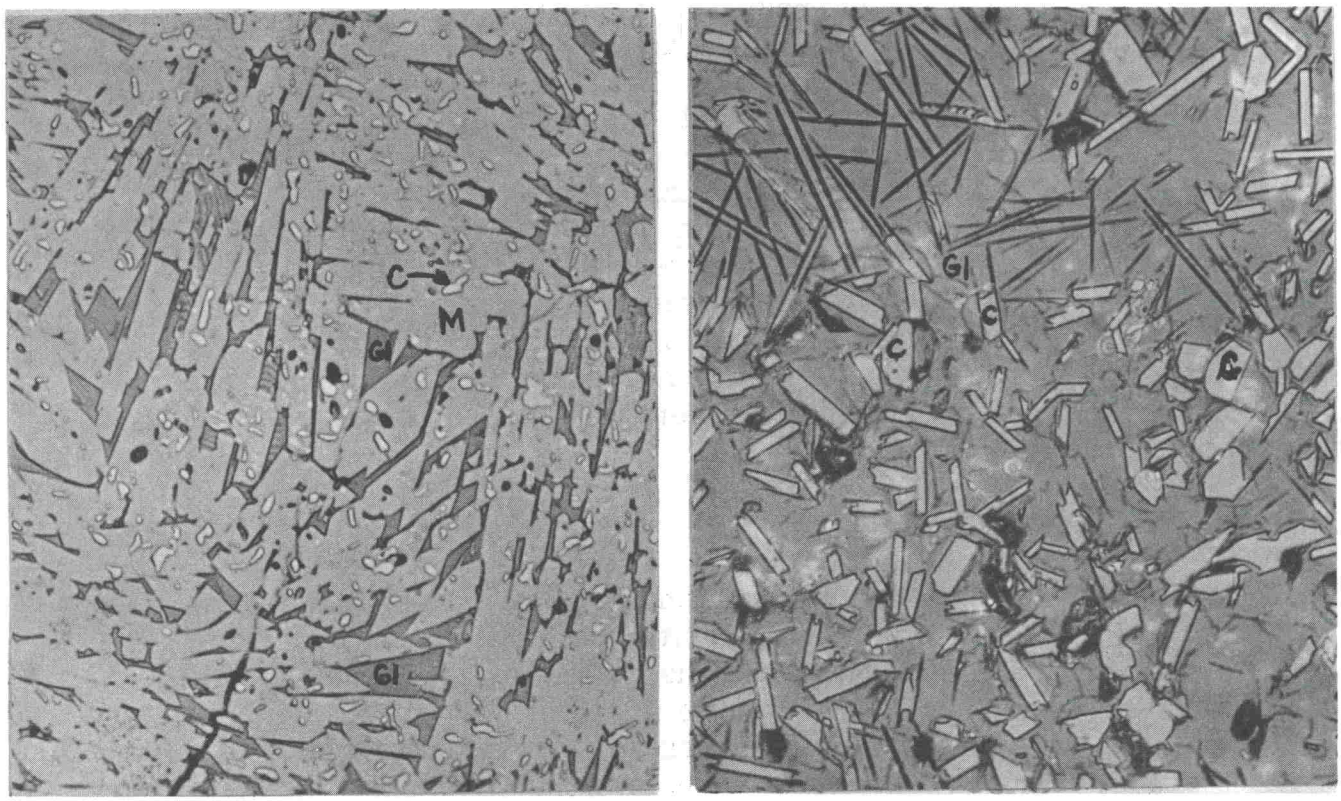

(c) (d)

Fig. 5

Andalusite appears to decompose in the same way as kyanite, but sillimanite transforms very quickly to Al_2O_3 plus glass and the intermediate mullite stage has not been seen [Fig. 5(d)]. The behavior of sillimanite under these conditions seems qualitatively consistent with the results with kyanite after the mullite stage is reached in large crystals. It would be expected that mullite and sillimanite would decompose in a similar way because of their structural similarity.

From the point of view of the mechanism of the reactions, it would be interesting to see if the results can be explained in terms of the respective structures and the differences in the aluminum ion coordination characteristic of each. From the point of view of phase equilibria, it is possible that the formation of corundum plus glass from the nominal Al_2O_3:SiO_2 composition can be considered in terms of a shift of the corundum plus liquid region of the Al_2O_3-SiO_2 system toward the silica end of the system with increasing pressure. An extrapolation of

the preliminary results suggests that the Al_2O_3-SiO_2 phase diagram at high pressure would show a large region of corundum plus liquid with kyanite melting incongruently into this region.

The decomposition curve of kyanite as presented here explained in part the predominance of corundum plus glass in most of the runs that have been made with gels and other starting materials in the present study. The P-T curves of Clark et al.[1] are included in Fig. 1 to illustrate the obvious disagreement between their results and the present study insofar as the stability of kyanite is concerned. If one disregards the nature of the reactions taking place and considers only the stability region of kyanite, it would be necessary to lower the curve up to 25,000 atm in order to be in agreement with the previous work or an extrapolation of it.

KYANITE X-RAY PATTERN

The differences between peak intensities in the x-ray spectrometer patterns of synthetic and natural kyanite (mentioned in second quarterly report) have been shown to be due to preferred orientation of the latter. If finely ground natural kyanite is sprinkled onto a slide covered with a thin layer of grease, the resulting x-ray spectrometer pattern is essentially identical in all respects to that of synthetic kyanite. This technique reduces the amount of preferred orientation when mounting the powder of a mineral with well-developed cleavage on a flat surface via a liquid medium. Random orientation is apparently achieved in the synthetic material because of the fine grain size and the intergrown arrangement of the crystals.

PROGRAM FOR THE NEXT QUARTER

During the final quarter it is proposed to (1) complete the determination of the P-T curves of the Al_2SiO_5 polymorphs from both the synthetic and decomposition directions; (2) to try to obtain some data on the kinetics of the transformations; and (3) to see if the mechanisms of the transformations can be treated from the available structural data.

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