



Fig. 2. X-ray powder patterns of low-clinoenstatite, high-clinoenstatite (1145 °C) and protoenstatite (from talc) ( $\text{CuK}\alpha$  radiation).

peratures above 1260 °C, can be quenched only partially, and commonly transforms spontaneously to clinoenstatite at room temperature. This contrasts with the behaviour of protoenstatites formed from talc, which are stabilized by excess silica.

We may remember now that protoenstatite is formed reversibly at  $1260 \pm 10$  °C. A detailed investigation, however, reveals that this phase transformation does not originate from unchanged clinoenstatite but from a transitional phase which comes into existence at

$1080 \pm 10$  °C. Clinoenstatite, henceforth more exactly called low-clinoenstatite, transforms at 1080 °C to a phase whose X-ray powder pattern is very similar to that of protoenstatite, but also exhibits some analogies to the diagram of low-clinoenstatite, as fig. 2 demonstrates. Nevertheless, there exist some characteristic differences which make an unequivocal identification possible: for example, the transitional phase has an additional reflection at  $d = 3.06$  Å ( $T = 1145$  °C), which never appears in protoenstatite (SMITH, 1959). Moreover there are some differences also at higher diffraction angles, like splitting of reflections and differences in intensities, which will not be discussed further; in general the X-ray powder patterns point to a close structural relationship between the three phases.

The interpretation that there might exist a really polymorphic phase between 1080 and 1260 °C and that the diagrams may not be interpreted as a result of order-disorder transitions or of the metastable coexistence of two or more phases, is supported by thermal analyses. Besides normal DTA-methods we applied the "dynamical differential-calorimetry" from Schwiete (DDK) and found that the transitions could be fixed surprisingly well in this way. In order to get distinct heat effects it was necessary to take pure and well crystallized samples which had been stored for several months. In this connection it is important to point out that the polymorphic behaviour of the substances is influenced by their chemical composition and thermal history.

The field of the transitional phase is separated by reversible and discontinuous heat effects from the fields of low-clinoenstatite and protoenstatite. The phase therefore has to be regarded as another high-temperature polymorph of  $\text{MgSiO}_3$ . For the present it will be called high-clinoenstatite, mainly because of its physico-chemical behaviour. Unlike protoenstatite, high-clinoenstatite is not quenchable, and we are not yet able to stabilize it in any way. We believe that some previous investigators may have detected this phase, too, but unfortunately did not carry on their studies (BROWN and SMITH, 1963) or perhaps may have regarded it as protoenstatite or as low-clinoenstatite (PEROTTA and STEPHENSON, 1965; LINDEMANN, 1960). Commonly high-clinoenstatite can easily be taken as protoenstatite, especially if the identification is confined to lower diffraction angles and to the stronger reflections.

We have not yet discussed the stability of the rhombic

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