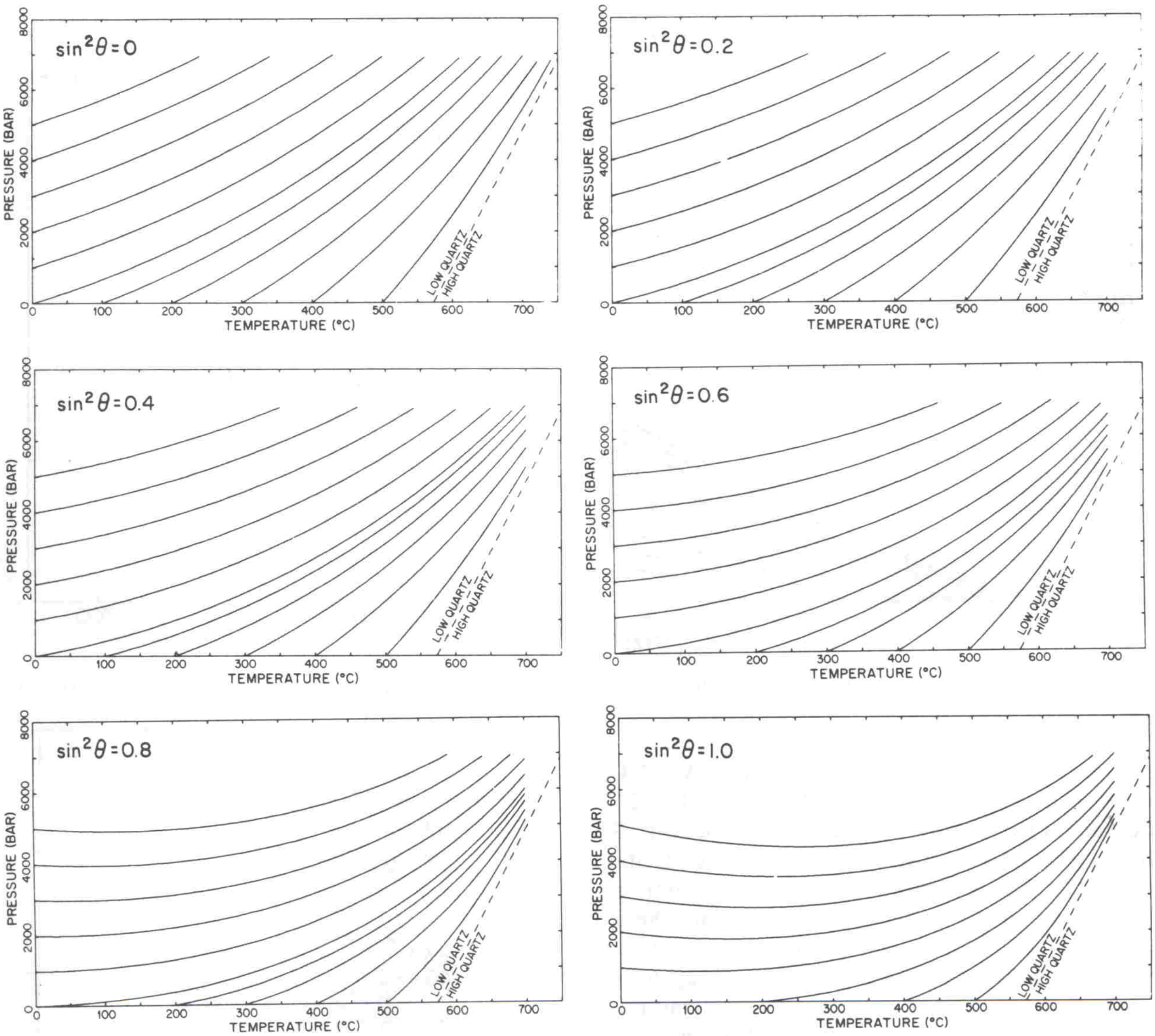

FIG. 8. Calculated sets of isomekes at intervals of 0.2 in $\sin^2\theta$: almandine-type garnet and quartz.

that we now believe are too low as a result of experiments reported above. Figure 10 updates the most critical parts of his illustration for localities in New England and includes new information from the southern Gotthard Region in Switzerland.

Figure 10 applies the data presented here to garnet-quartz combinations from areas selected to yield information bearing on Al_2SiO_5 polymorphism. Restrictions on the location of the andalusite-kyanite-sillimanite triple point are inferred as follows:

(1) Specimen Gar. 1 is a kyanite-bearing paragonite schist from the well-known locality of Gassetts, Vermont, that (a) is located in the kyanite zone many miles from any known contemporaneous sillimanite (Thompson and Norton, 1968, p. 320); (b) shows, using the two-dimensional approach, weak piezobirefringent halos in almandine around quartz inclusions having $\theta = 0°$; (c) is isogradic with marble, cropping out 4.13 km to the north in Duttonsville Gulf (Thompson and Norton, 1968, p. 320), that consists mostly of dolomite with minor calcite having 5.8 mole percent $MgCO_3$ [9](Rosenfeld, 1969, p. 343); (d)

[9] This composition includes thin dolomite lenses that show evidence of exsolution because they are oriented normal to *c* of the host calcite, they extinguish under crossed polars parallel to the host calcite, and they have a graded range of coarseness that is of finer grain than that of the dolomite of the matrix.

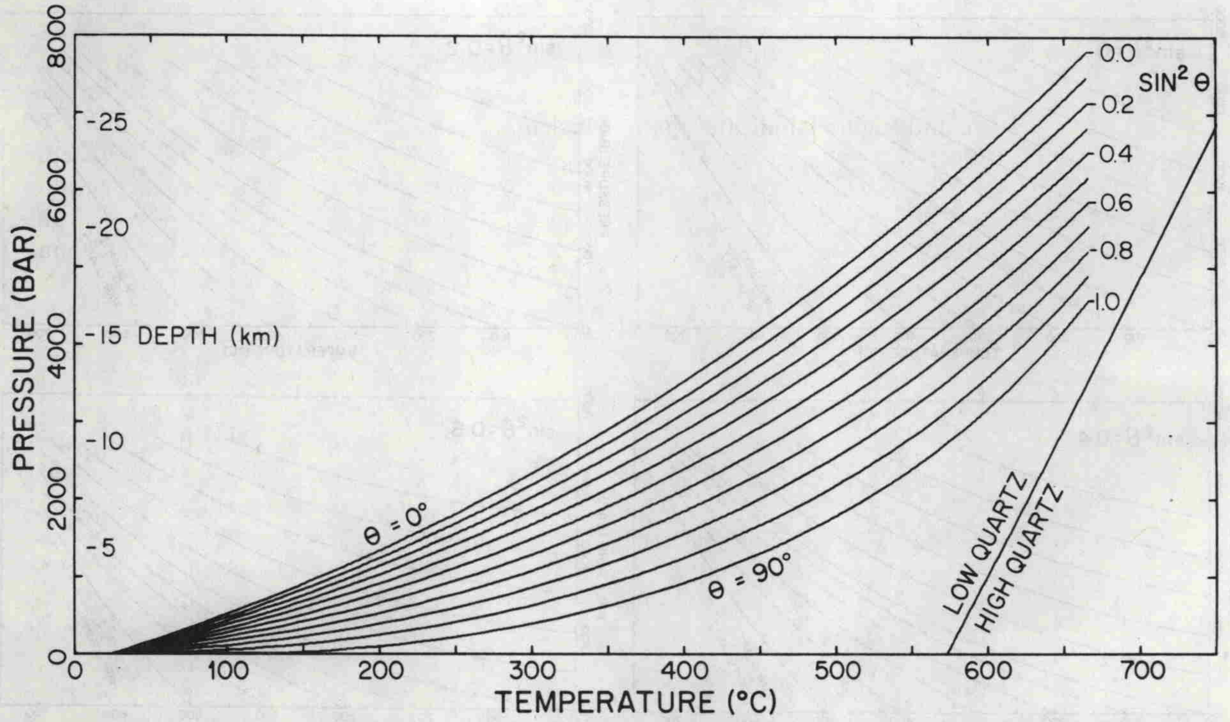

FIG. 9. Calculated "fan" of isomekes between almandine-type garnet and quartz, emanating from $P = 1$ bar and $T = 25°C$ at intervals of 0.1 in $\sin^2\theta$.

has, in an adjacent sample, the following $\Delta\ O^{18}/O^{16}$ values (Garlick and Epstein, 1967, p. 192–193, 212) between quartz and the minerals indicated: 3.0 (muscovite), 4.3 (garnet), 5.0‰ (biotite). Utilization of (a), (b), (c), Figure 9, and interpolated isopleths for $MgCO_3$ solubility in calcite obtained from the experimental data of Goldsmith and Newton (1968) places kyanite in a small $P - T$ region above 5.6 kbar at a temperature of 545 ± 20°C. This temperature, in turn, calibrates facts (d)[10], to be used below.

(2) Specimen A57d is from the Silurian Clough quartzite in the eastern highlands of Connecticut (Garlick and Epstein, 1967, p. 214). Specimen A57d (e) is very near the kyanite-sillimanite isograd 0.44 km northeast of an outcrop of kyanite schist and 0.43 km north-northwest of one of sillimanite-bearing schist; (f) indicates recrystallization temperature very nearly the same, within the precision of measurement, as that of specimen Gar. 1, because the following $\Delta\ O^{18}/O^{16}$ values (Garlick and Epstein, 1967, p. 214) between quartz and the minerals indicated are close to those of specimen Gar. 1: 3.0 (muscovite), 4.4

[10] The work of Clayton, O'Neill, and Mayeda (1972, p. 3064) leaves the earlier experimental calibrations of the O^{18}/O^{16} geothermometer based on fractionation between quartz and muscovite in a very uncertain state.

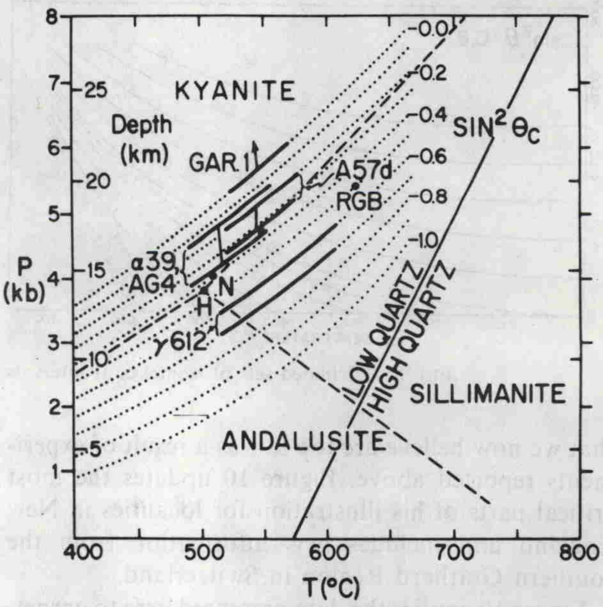

FIG. 10. Geological application of solid inclusion piezothermometry using the garnet-quartz combination. See text for specimen locations and discussion. Dotted isomekes are from Figure 9. Heavy lines indicate range of uncertainty for each specimen. Steep lines attached to heavy lines represent geochemically determined information on temperature of crystallization. Dashed lines are subdivisions of the Al_2SiO_5 diagram after Holdaway (1971). Triple point determinations within that diagram: H = Holdaway (1971); N = Newton (1966); RGB = Richardson *et al* (1969).