Table 7. *Distances of individual elements within multiple sets of planar structures in μ. (Averages and standard deviations)*

| | B 10 | B 51 | S 289 | B 36 | B 151 | B 1 | S 350 | S 349 | B 7 | B 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| {0001} | 12.5 ± 5.9 | 23.5 ± 14 | — | 16.8 ± 6.7 | — | 22.0 ± 7.2 | 19.0 ± 7.2 | — | 31.5 ± 22 | 22.5 ± 9.0 |
| {$10\bar{1}3$} and {$01\bar{1}3$} | 7.8 ± 2.0 | 8.6 ± 2.6 | 7.8 ± 1.9 | 7.4 ± 1.4 | 7.7 ± 2.2 | 8.8 ± 1.7 | 7.7 ± 1.8 | 7.7 ± 2.2 | 8.6 ± 3.0 | 7.5 ± 1.8 |
| {$10\bar{1}2$} and {$01\bar{1}2$} | — | — | 7.4 ± 1.1 | 6.8 ± 1.2 | 7.3 ± 1.2 | 8.6 ± 1.5 | 6.1 ± 1.2 | 5.8 ± 1.2 | 5.7 ± 1.6 | 6.0 ± 0.96 |
| {$10\bar{1}1$} and {$01\bar{1}1$} | — | 8.4 ± 1.4<br>15 ± 4.0 | 8.4 ± 2.2 | 8.2 ± 2.8 | 7.7 ± 1.8 | 11.0 ± 2.4 | 6.9 ± 1.1<br>17 ± 3.4 | 8.3 ± 3.8 | 8.4 ± 7.0 | 7.5 ± 1.1<br>19.1 ± 4.6 |
| {$2\bar{1}\bar{3}1$} | — | — | 8.4 ± 1.9 | 8.7 ± 2.5 | 7.4 ± 1.2 | 10.0 ± 1.4 | 6.7 ± 0.94 | 8.5 ± 4.2 | 9.6 ± 3.5 | 7.9 ± 1.3 |

Table 7 contains measurements of the distances between individual planes of multiple sets. The irregularity of the spacing is illustrated by the high values of standard deviation. Planar structures parallel to {0001} have the longest distances. Sets parallel to {$10\bar{1}3$} and {$10\bar{1}2$} display the most uniform pattern. {$10\bar{1}1$} shows in some cases a bimodal distribution of distances.

If viewed parallel, the individual planes of multiple sets of planar structures appear in most cases as very straight, extremely plane parallel lines. However if they are not too closely spaced, some deviations from parallelism become obvious as illustrated in Fig. 14. These tilted elements may have been produced by an "en echelon" combination of numerous very small elements, parallel to the principal plane of the set.

An other peculiarity is continuous bending of multiple sets of planar elements or lamellae. Examples are shown in Figs. 15 and 16. This bending demonstrates that slip occurred parallel to the planes of these structures. In the investigated samples, {$10\bar{1}3$} or {$01\bar{1}3$} are the most prominent slip planes. In some cases the slip along such planes can directly be observed by slight displacements of other planar elements crossing the first ones. An example is shown in Fig. 5.

### *3.4. Densities and Optical Properties of Ries Quartz with Planar Deformation Structures*

Quartz with planar deformation structures has considerably lower density, refractive indices and birefringence than normal quartz. This is shown in Table 8, including refractive indices and densities for two diaplectic quartz glasses (B 41 and B 75).

Density and optical properties were measured on isolated grains, handpicked after the rock was crushed and fractioned with a magnetic separator. Grains with the optic axis nearly perpendicular to the microscope axis were used to determine refractive indices by immersion in mixtures of α-monobromnaphthalene and butyleneglycole. Thus the lower index measured corresponds to $n_o$, the higher approximates $n_e$. Accuracy was $\pm 0.0005$. Fifty grains have been measured per sample.

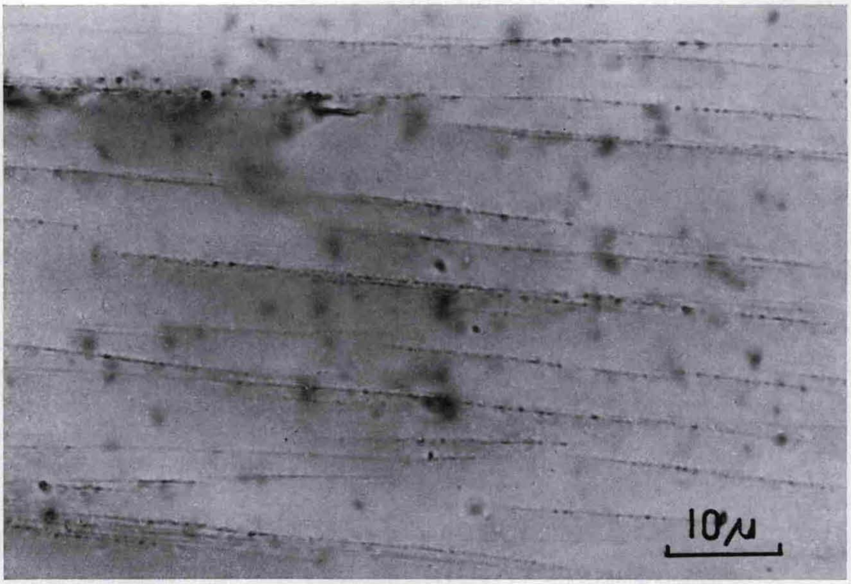


Fig. 14. Deviation from parallelism within multiple sets of planar elements parallel to {10$\bar{1}$3}. Quartzes from sample B 51. Normal light

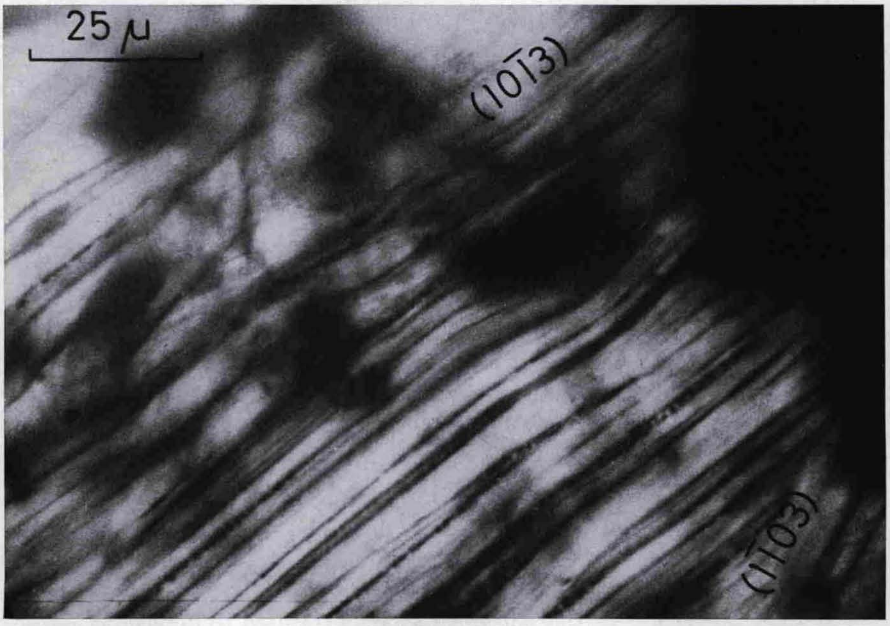


Fig. 15. Bending of filled lamellae. Quartz from sample S 289. Crossed nicols

The densities of 50 grains for each sample were determined by floating techniques (mixtures of bromoforme and dimethyleneformamide, accuracy was $\pm 0.001$ g/cm$^3$).