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THE AMERICAN MINERALOGIST, VOL. 47, NOVEMBER-DECEMBER, 1962

CRYSTAL-OPTIC STUDY OF SECONDARY OVERGROWTH IN QUARTZ

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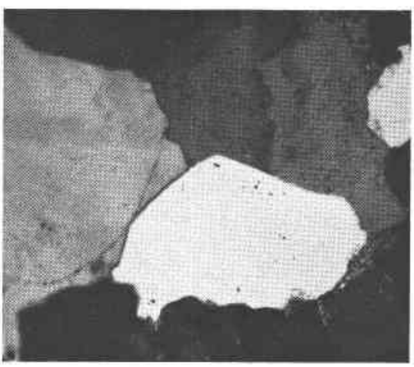
Sandstones in which silica forms the cementing material commonly exhibit secondary overgrowth, in optical continuity, on detrital quartz grains (Pettijohn 1957). A line of inclusions and/or a precementation limonitic coating usually marks the detrital boundary. Juxtaposition of secondary rims separately overgrown on several adjacent nuclei produces a sort of interlocking fabric. A conspicuous tendency shown by sandstones having a considerable proportion of silica cement is the formation of idiomorphic facets on the reconstituted grains (Fig. 1).

When a quartz grain is placed in a chemically identical solution, it begins to enlarge, itself forming a sort of seed crystal. A secondary rim may be formed continuously as a single shell or may be formed in a series of successive shells. Figure 2 shows a detrital grain (d) in the center and a portion of the outer rim with well marked idiomorphic facets at the boundary and a few faint lines (marked by dusty inclusions) parallel to the latter. This feature may be indicative of growth in a series of succes-



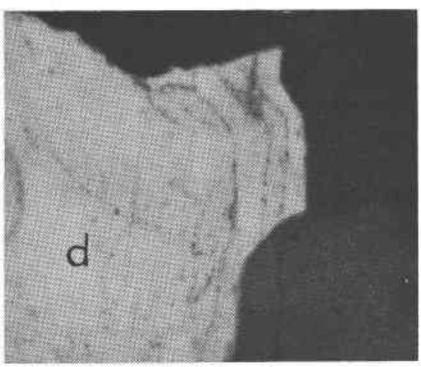


Fig. 1. (left) Photomicrograph showing idiomorphic facets in secondarily enlarged detrital quartz grains; crossed nicols, ×100.

Fig. 2. (right) Photomicrograph showing a detrital grain (d) and a portion of the outer rim with well marked idiomorphic facets at the boundary and a few faint lines parallel to the latter; crossed nicols, ×200.

sive shells, the intervening periods being marked by adsorption of impurities on the growing facets or it may be a case of continuous growth, the impurities being periodically set on crystallographic planes whenever adequate concentration is reached.

In order to judge whether the facets of the overgrowth are rational crystallographic planes or not, the following procedure was adopted. This procedure is somewhat similar to that suggested by Turner and Gilbert (1949); however, the analytical part concerning the recognition of suspected faces is somewhat different.

Grains with idiomorphic overgrowths specially those with a greater number of facets are selected from thin section and with the help of the universal stage the positions of the optic axis (C_v) and the pole of each suspected crystal face are measured in the usual way.

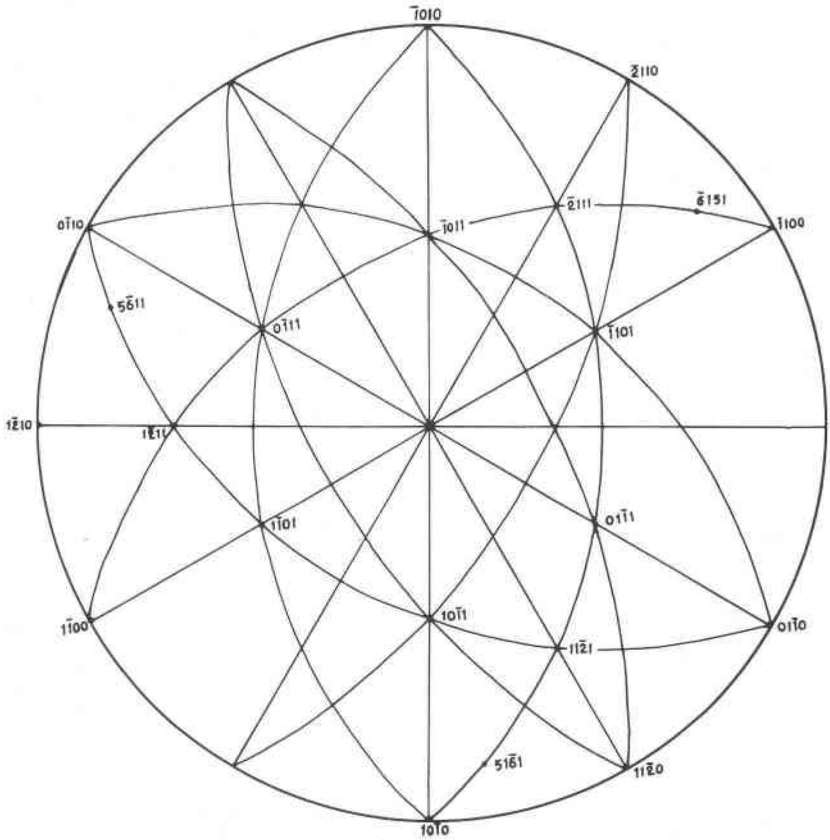


FIG. 3. Standard stereogram of a quartz crystal.

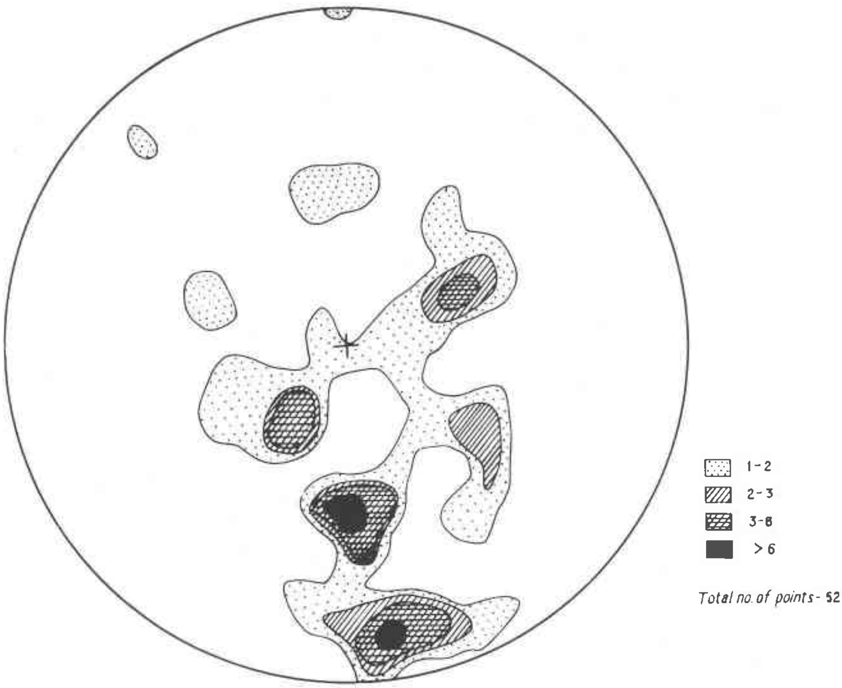


FIG. 4. Contoured point diagram for Rewa specimens.

The readings are plotted on separate stereograms each containing the C_v of a grain and the poles of the adjoining facets. The C_v is then made vertical by giving requisite rotation, and the poles are rotated accordingly corresponding to the new position of C_v.

A standard stereogram of a quartz crystal showing the position of common faces (Fig. 3) is prepared from published data (Dana 1863, p. 183).

All the stereograms with rotated C_v and rotated poles are combined by method of superposition and best match (including inversion); taking C_v and a face-pole making an angle of approximately 52° with C_v as the points of reference, to form a single diagram (Figs. 4 and 5); the latter being contoured to give a good idea of the concentration of the points. Figure 4 contains data obtained from Rewa orthoquartzites of Maihar, M.P., whereas in Fig. 5 are plotted the observations on the Kaimur orthoquartzites of Mirzapur, U.P.

Finally each of these experimental diagrams (Figs. 4 and 5) are superimposed on the standard stereogram (Fig. 3) in order to judge whether the poles of the facets are erratic or whether they are concentrated near rational crystallographic face-poles.

A comparison of Figs. 4 and 5 with Fig. 3 suggests the following points:

1. The distribution of points in both Fig. 4 and Fig. 5 is anisotropic.
2. The best concentration of points is around rhombohedral face r($10\bar{1}1$).
3. Other forms which seem to develop include m($10\bar{1}0$), z($01\bar{1}1$) and s($11\bar{2}1$).
4. There is also an appreciably good concentration near the less common form x($51\bar{6}1$) (Fig. 4).
5. There are some erratic points too, which, instead of taking the place of rational face-poles, take an intermediate place; this is particularly seen in Fig. 5.

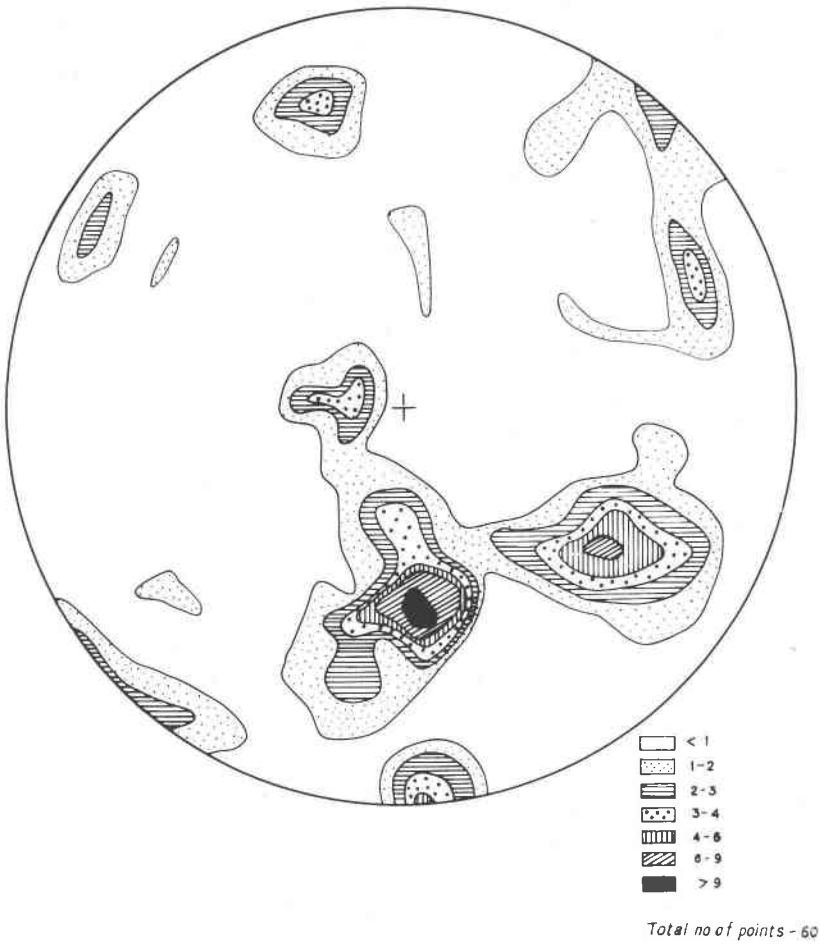


FIG. 5. Contoured point diagram for Kaimar specimens.

Gilbert (1949, p. 4) however, has, said "Where outgrowths from two sides of a cavity have made contact, the bounding surfaces between them commonly appear to be plane but in no case they prove to be rational crystal faces of either quartz grains." The present observation instead points to the possible development of some rational faces. That some of the facets appear to be erratic is not uncommon because the environment in which the grains are secondarily enlarged has the limitation of mutual interference between facets overgrown on adjacent nuclei. Depending on the crystallographic orientation the force of crystallization in different

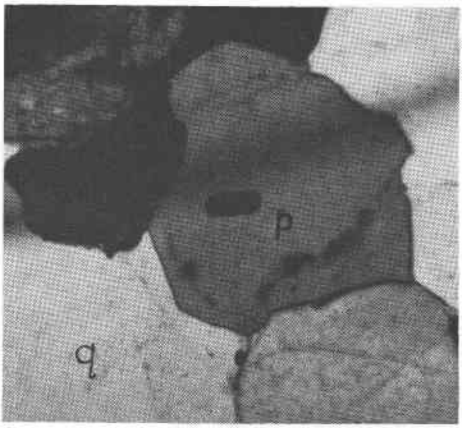


Fig. 6. Photomicrograph showing facets of the grain p interfering the overgrowth of the grain q; crossed nicols, ×100.

faces may differ and consequently some facets of one grain will be more prominent at the expense of the facets of some adjacent grain. In Fig. 6 the facets of the grain "p" hinders the proper development of the overgrowth on the grain "q." Pye (1944, p. 101) has noted: "If a grain being enlarged on a pyramid comes in contact with a grain being enlarged on a prism, the pyramid penetrates the prism and preserves its own sharp crystallographic outline." When the initial porosity of a rock is greater, there is a better chance of the development of the facets, because there would be comparatively less chance of interference. The difference between Figs. 4 and 5 may be ascribed to such a difference in initial porosity. When the mutual interference is readily apparent as in Fig. 6, hindered overgrowth is not taken into account during measurement, but still the effect of mutual interference can not be completely avoided. Taking into account the aforesaid limitation, it may be said that in secondary enlargement of detrital quartz grains there is a tendency of the formation of some rational crystallographic faces.

Acknowledgement

The author acknowledges his indebtedness to Sri Dhrubajyoti Mukherjee and Sri Subimal Sinha Roy for their helpful suggestions and criticisms.

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THE AMERICAN MINERALOGIST, VOL. 47, NOVEMBER-DECEMBER, 1962

EPOXY RESIN FOR OIL IMMERSION AND HEAVY MINERAL STUDIES

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Anyone working with loose mineral grains (especially when using the universal stage) has at some time felt the need of a method of fixing grains on the microscope slide which would permit him to use index oils and retrieve single grains for further studies. Hess (1960, p. 9) has used glycol phthalate, but it is limited to low indexes and at present hard to obtain. Epoxy resin cement appears to be a satisfactory solution to the problem, because it holds the grains, is inert towards standard index oils, isotropic, and easily obtainable. The epoxy resin has a refraction index of 1.55.

The epoxy resin generally comes in two tubes, one containing the resin, and the other a hardner. To use the cement, two drops of about equal size are squeezed on a piece of glass or paper and mixed together. At this stage, the cement is a viscous sticky liquid (with a working life of about an hour), which can be removed with common solvents such as xylene. The cement requires about 12 hours to set at room temperature, but this time can be shortened by heating.

The work cited (below) used Borden's transparent epoxy resin. Some contain opaque fillers and are unsuitable for optical work. The resin and hardner were mixed in about equal parts, the grains were mounted and the cement was cured for at least two hours in an oven at 80° C. Leaving

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