Figs. 10 (a) and (c) the basal extensions observed in Fig. 10 (b) are not revealed at all. It was thought initially that the basal extensions of the pits may be similar to the wings associated with etch pits as observed on some natural Australian muscovite by Patel and Tolansky (1957), but it is quite clear from the above pictures that the basal extensions have nothing to do with the surface. They are due to something happening within the body of the crystal. It is therefore conjectured that they are the air wedges produced by the etchant in the body of the crystal.

References

PANDYA, N. S. AND J. R. PANDYA (1959), Etching of mica by fused alkalies. *Bull. Nat. Inst. Sci. India*, **14**, 148–151.

PATEL, A. R. (1961), Structure of etch pits on diamond surfaces. *Physica*, **27**, 1097–1100.

——— AND S. RAMANATHAN (1962), Etching of mica cleavages. *Acta Cryst.* (in press).

——— AND S. TOLANSKY (1957), The etching of crystal cleavages. *Proc. Roy. Soc.* **A-243**, 33–40.

VAN VALKENBURG, A. AND R. G. PIKE, (1952), Synthesis of mica. *Jour. Res. Natl. Bur. Standards*, **48**, 361–369.

THE AMERICAN MINERALOGIST, VOL. 47, SEPTEMBER-OCTOBER, 1962

BLUE QUARTZ FROM THE WIND RIVER RANGE, WYOMING

RONALD B. PARKER, *Department of Geology, University of Wyoming, Laramie, Wyoming.*

A granodiorite gneiss in the central Wind River Range, Wyoming contains numerous veins of blue, opalescent quartz (Parker, 1962) which owes its blue color to scattering of light by tiny needles of tourmaline. The color of blue quartz has been attributed to the presence of minute rutile needles by a number of authors (Goldschmidt, 1954; Holden, 1923; Lukesh, 1945; Watson and Beard, 1917.) Gordon (1946) attributes the blue color to "blue needles" which he identifies as trains of minute bubbles. Goldschmidt (1954) states that blue, rutile-bearing quartz is not to be confused with Cambrian and Ordovician blue quartzites of Norway which owe their color to fine, disseminated magnetite dust. Boyle (1953) notes the presence of graphite in certain black and gray quartz from Canada.

The fine needles in the Wind River Range blue quartz show straight extinction in thin section, and are length fast. Because no additional properties could be determined in thin section, ten grams of the quartz was dissolved in hydrofluoric acid with loss of the silica. The residue was washed with water to remove soluble fluorides, and the insoluble residue examined with an x-ray diffractometer. The only detectable reflections proved to be from tourmaline. No rutile was noted.

The paragenesis tourmaline-quartz suggests pegmatite affinities, so the quartz was analyzed in order to determine whether any rare elements typical of pegmatites were present. A 40 gram sample was dissolved in hydrofluoric acid and the residue of tourmaline, other insoluble minerals and fluorides was analyzed semiquantitatively by x-ray emission spectrography. An air path was used which allowed detection of elements heavier than titanium (At. no. 22). The following elements were present (values in ppm of element in quartz): Ba 10; Fe 600; La 5; Lu 5; Mn 40; Rb 20; Th 10; U 10; Y 5; and Zr 10. Qualitative examination by emission spectroscope showed the presence of minor amounts of Li, Sn and Ti. Hurlbut (1946) reports the presence of small amounts of Ag, Al, Ca, Cr, Cs, Cu, K, Mg and Na, in addition to some of the elements above, in oscillator-grade quartz. He does not, however, report Fe, La, Lu, Sn, Th, U or Y; many of which are typical pegmatite elements. It is suggested that the Wind River Range blue quartz is, except for the absence of feldspar, not unlike a pegmatite in its chemistry.

The tourmaline needles show a preferred orientation with three sets at 60° to one another in a plane approximately normal to the c-axis of the enclosing quartz. Thus, perhaps the tourmaline formed by exsolution from the quartz with the numerous tiny crystals forming because of a combination of a relatively high rate of nucleation and a relatively low rate of diffusion in the quartz. Under other conditions the rock might have been composed of quartz with minor crystals of tourmaline, zircon, cassiterite and rare-earth minerals; a normal pegmatite or high-temperature quartz vein. It is suggested that the blue quartz veins represent a pegmatite-type magma in which a deficiency of water or other volatiles during recrystallization inhibited diffusion, and hence inhibited formation of large crystals of the typical "rare minerals" of pegmatites.

References

Boyle, R. W. (1953), On the colour of black and grey quartz from Yellowknife, Northwest Territories, Canada. *Am. Mineral.* **38,** 528–535.

Goldschmidt, V. M. (1954), Geochemistry. Oxford, London.

Gordon, S. G. (1945), The inspection and grading of quartz. *Am. Mineral.* **30,** 269–290.

Holden, E. F. (1923), The color of three varieties of quartz. *Am. Mineral.* **8,** 117–121.

Hurlbut, C. S., Jr. (1946), Influence of twinning on the usability of quartz from various localities. *Am. Mineral.* **31,** 443–455.

Lukesh, J. S. (1945), The effect of imperfections on the usability of quartz for oscillator-plates. *Am. Mineral.* **30,** 291–295.

Parker, R. B. (1962), Precambrian agmatites of the Wind River Range, Wyoming. *Contrib. to Geol.* **1,** 13–20.

Watson, T. L. and R. E. Beard (1971), The color of amethyst, rose, and blue varieties of quartz. *Proc. U. S. Nat. Mus.* **53,** 553–563.