THE AMERICAN MINERALOGIST, VOL. 56, JULY–AUGUST, 1971

A PSEUDOMORPHIC QUARTZ-TOURMALINE RELATIONSHIP FROM NORTHERN NIGERIA

PATRICIA McCURRY, *The Open University, Walton Hall, Walton, Bletchley, Buckinghamshire, United Kingdom*

ABSTRACT

Tourmaline crystals from a pegmatite in northern Nigeria have central cores composed of aggregates of quartz grains. The cores show a pseudomorphic relationship with the tourmaline, having trigonal to pseudo-hexagonal cross-sections and striations reflecting the negative surfaces of the tourmaline. Optical observations suggest that quartz has preferentially replaced zones of green tourmaline, leaving predominantly brown tourmaline surrounding the cores.

Shaposhnikov (1959) has described a pseudomorphic relationship of quartz and tourmaline in pegmatites from SE Tuva in Russia. He notes that the axial part of individual prismatic tourmaline crystals is replaced by quartz with regular hexagonal form, surrounded by negative surfaces of the encasing tourmaline.

A literature search has failed to reveal any record of other similar relationships. It is, therefore, worth recording that during reconnaissance mapping in northern Nigeria (McCurry 1970). an almost identical association of quartz and tourmaline was found in crystals from a quartz-microcline-muscovite bearing pegmatoidal knot among migmatites exposed in the River Sokoto 2 km north of Funtua.

Each composite crystal, which consists of a central core of quartz surrounded by tourmaline, forms a striated prism with trigonal or hexagonal cross-section. They are between 1 and 1.5 cm across with quartz cores up to 1 cm in diameter. The cores show striated longitudinal faces pseudomorphing negative surfaces of the enclosing tourmaline (Fig. 1), and have triangular or pseudo-hexagonal basal sections roughly parallel to the external form of the tourmaline (Fig. 2). The quartz cores are not constant in shape, nor are they necessarily continuous throughout the length of the crystal. There are also thin layers of striated quartz within the tourmaline, approximately parallel to the core (Fig. 2). A thin section cut perpendicular to the tourmaline *c*-axis shows the core to be composed of a mosaic of irregular, strained quartz grains, their optic axes almost in parallel alignment. Simple calculations from interference figures indicate that the *c*-axes of the quartz are inclined at about 30° to that of the tourmaline.

In all composite specimens collected, the predominant color of the tourmaline is brown, though occasional narrow, sharply defined zones of green tourmaline, parallel to the crystal faces, are also evident. From

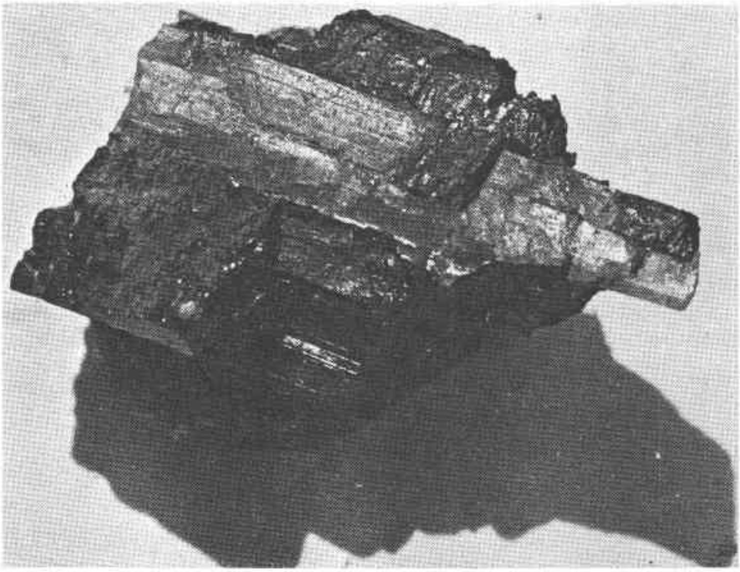

FIG. 1. Longitudinal section of tourmaline crystal with slender quartz column showing negative form of striated tourmaline. (×4).

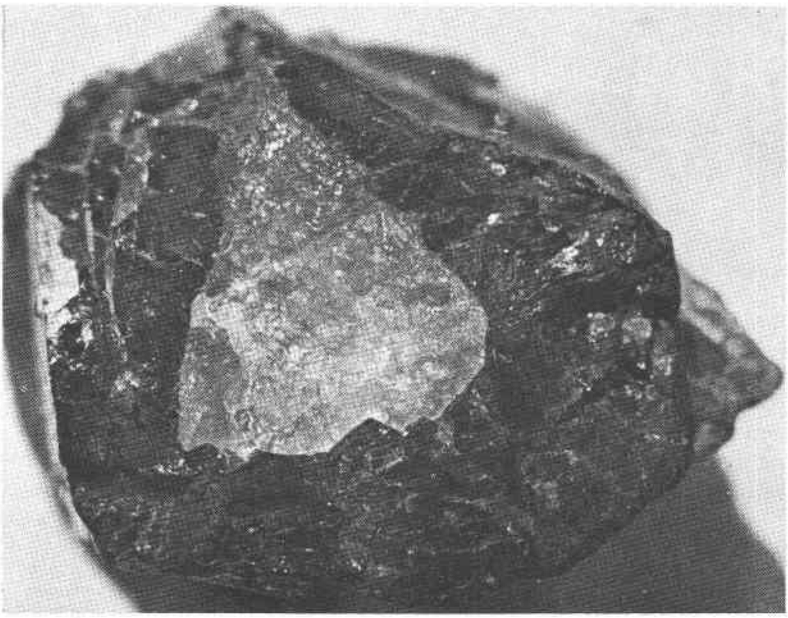

FIG. 2. Cross-section of tourmaline prism with central trigonal core of quartz grains. A narrow layer of quartz in the tourmaline approximately parallels one surface of the core. (×6).

limited optical observations it would appear that the thin layers of quartz in the tourmaline occupy the green zones. Where the quartz core is not continuous throughout the length of the crystal, the tourmaline core itself is green, being rimmed by brown tourmaline which is continuous with that surrounding the quartz.

The brown tourmaline has $a = 1.659(2)$, whereas the green tourmaline gives $a = 1.655(2)$. These values are anomalous with respect to the usual pattern of refractive index and color variations of tourmalines in northern Nigeria (McCurry, 1971). Applying results of correlations deduced by Ward (1931), the brown tourmalines contain 9 weight percent total iron as Fe_2O_3, and the green tourmaline 7 weight percent. Slivko (1957) has determined that the color of brown tourmaline is controlled by Fe^{3+} as the leading chromophore, and of green tourmaline by Fe^{2+}.

Although he cites no optical data, Shaposhnikov (1959) suggests that in a zoned tourmaline, one zone could be replaced by quartz, the replacement being limited by a zone of differing composition. It would appear that in the Nigerian specimens, quartz is preferentially replacing green tourmaline, leaving brown tourmaline unaffected. If this inference is correct, it seems possible that Fe^{2+} is more readily removed by hydrothermal solutions than Fe^{3+}, a process perhaps facilitated by the lower percentage of total iron in the green zones. In addition, compositional variations between brown and green zones may be reflected by subtle structural differences, further increasing susceptibility to differential replacement. The possibility that the intergrowth was formed by simultaneous crystallization of quartz and tourmaline cannot be ruled out, but the evidence presented here suggests that this is unlikely for the Nigerian specimens.

Acknowledgements

I thank Mr. J. B. Wright for helpful discussion, and Professor A. D. Rajkovic for assistance with translation of Shaposhnikov's paper.

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