Tourmaline in Pennsylvanian Sediments of the Ardmore Basin

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The weathering and truncation of the Pre-Pennsylvanian rocks of the Arbuckle Mountain region seems to have been the source for some of the sediments carried into the Ardmore basis during the Pennsylvanian period. These sediments have a thickness of approximately 18,000 feet and have also suffered considerable folding during and into late Pennsylvanian time. The major bulk of the sediments are shales, but samples were collected for special study from some of the sandstone exposures which occur at rather convenient intervals in the lower, middle and upper portions of the Pennsylvanian section.

The purpose of this study is to gather some evidences which are expected to shed light upon the source and nature of the rocks from which the sediments in this local area were derived. Special attention is focused upon the varieties and shapes of tourmaline grains occurring with the heavy minerals in the sandstone members of the Pre-Pennsylvanian, Springer, Dornick Hills, Deese and Hoxbar formations. Tourmaline was chosen for special study since it occurs abundantly in sediments of all environments and ages. The variation in composition, color, shape and nature of inclusions are very important in tracing the origin and history of source rocks in a given distributive provenance. The mineral is so resistant to mechanical and chemical wear that its various modifications in shape analyses may easily represent more than one cycle of reworked sediments. Tourmaline grains were observed in the different size fractions, but the grains which passed the 100-mesh screen and caught on the 200-mesh screen were chosen for this special study. Physical properties of tourmaline grains from some of the Simpson sandstones of Ordovician age were compared with those occurring in the Rodclub, Overbrook and Lake Ardmore sandstones of Springer age; Primrose and Bostwick sandstones of Dornick Hills age; Devil's Kitchen sandstones of Deese age; and the Zuckermann sandstones of Hoxbar age.

Tourmaline is abundant in all the heavy mineral assemblages which were separated from the Pennsylvanian and Simpson sandstones. However, a very distinctive feature of this mineral occurring in the Simpson sandstones is the well-rounded grains with many showing a high degree of sphericity. The most common colors are brown to reddish brown. Other colors are green, blue, black, yellowish orange, clear and colorless. The vacuole type of inclusions are the most common with fewer of the microlite kind. (See Figs. 1 and 2).

Characteristic features of tourmaline grains found in the Pennsylvanian sandstones are shown in (Fig. 3 to Fig. 6). It is the most abundant non-opaque mineral in the heavy residues. A striking feature of these grains is the mixture of euhedral crystals with those so well rounded that practically no trace of the original faces and edges of the grains remain. The physical features of the latter grains bear such close resemblance to those found in the Ordovician sandstones that one is forced to consider the Simpson sandstones as their source.

There are several varieties of tourmaline occurring in these sandstones and may be classified roughly into three groups according to Winchell (1931) on the basis of colors which reflect the following general chemical composition:

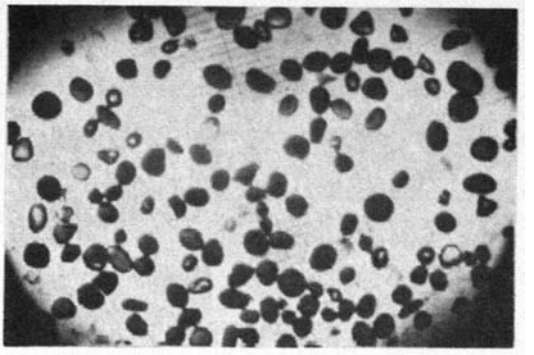

Fig. 1. Suite of heavy minerals from a Simpson sandstone. Plane polarized light.

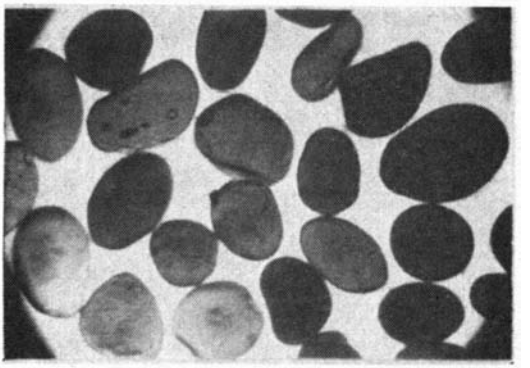

Fig. 2. Tourmaline from a Simpson sandstone. Plane polarized light.

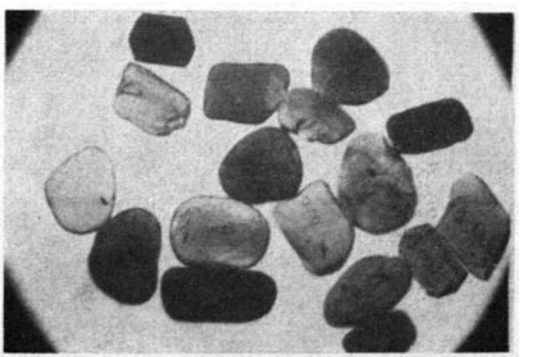

Fig. 3. Tourmaline from an Overbrook sandstone. Plane polarized light.

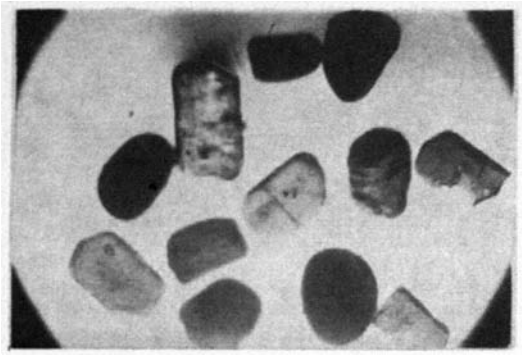

Fig. 4. Tourmaline from a Bostwick sandstone. Plane polarized light.

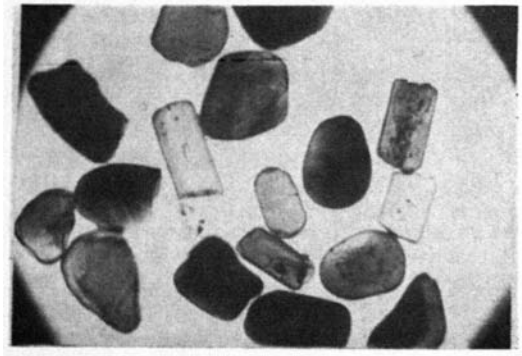

Fig. 5. Tourmaline from a Devil's Kitchen sandstone. Plane polarized light.

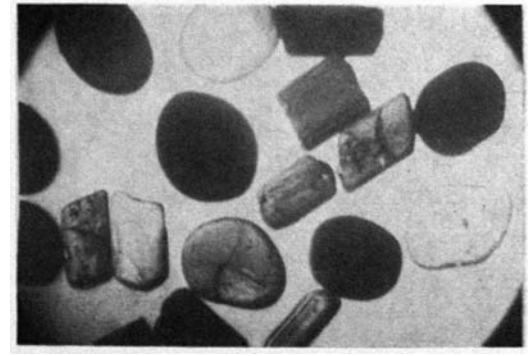

Fig. 6. Tourmaline from a Zuckermann sandstone. Plane polarized light.

1. Lithium tourmaline occurring in pinkish colors.
2. Iron tourmaline being black to brown.
3. Magnesium tourmaline is commonly colorless to yellow.

The varying percentage of calcium and sodium along with magnesium and iron may cause different colors such as green and bluish shades. The colors described above have been found in the Pennsylvanian sediments as well as in the Ordovician sandstones.

The tourmaline assemblage of both Ordovician and Pennsylvanian sandstones include the following possible types as described by Krynine (1946).

1. Granitic tourmaline: medium crystals; dark brown, green or pink to green; bubbles, cavities and microlites.
2. Pegmatitic tourmaline: large crystals which break into angular pieces during erosion. Typically blue to pink; fewer inclusions.
3. Tourmaline from injected metamorphic terranes: very small to medium crystals; colorless to pale yellow or brown and may have carbonaceous inclusions.
4. Reworked tourmaline from older sediments.

From this data, one may consider progressive erosion of the Arbuckle Mountains and other now buried land masses with contemporaneous deposition of Pennsylvanian sediments in the Ardmore basin. The tourmaline of the Springer and Dornick Hills sandstones suggests a source of sediments derived from deeply dissected valleys which had cut through the Simpson sandstones and possibly into the igneous rocks. During Deese and Hoxbar time, deposits as a result of widening and deepening of valleys could have continued supplying the well-rounded tourmaline grains as well as the euhedral crystals coming from the granites and dike intrusions.

SUMMARY

The outstanding features of the tourmaline of the Pennsylvanian sandstones show a mixture of reworked well-rounded grains typical of those in the Ordovician sandstones occurring with those derived from fresher igneous and metamorphic terranes. This is the kind of tourmaline assemblage one would expect from such a source as the truncation of the Arbuckle Mountains.

Positive evidence is suggested by this data that the Arbuckle Mountains, Criner Hills and possibly uplifts now buried beneath younger rocks supplied an appreciable amount of sediments to the Ardmore basin.

LITERATURE CITED

Krynine, Paul D. 1946. Tourmaline Group in Sediments. J. Geol. 54: 65.

Winchell, A. N., Winchell, H. 1931. Description of Minerals. Elements of Optical Mineralogy. (John Wiley) Part 11. P. 465.