

Genesis of Hypogene Psilomelane Fibers from the Tower Mine Area, New Mexico

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Abstract

Botryoidal psilomelane from the Tower Mine Area, New Mexico, exhibits normal “colloform” banding and distinct radial structure. The outer bands consist of flexible elastic psilomelane fibers elongated along the *b* axis and oriented parallel with the radial structure. A possible growth mechanism involves crystal growth from dilute solutions. Continuing fiber growth results in a dense mass which forms the “colloform” bands exhibiting radial structure on broken surfaces.

Introduction

Hypogene psilomelane deposits typically contain “colloform” banded manganese minerals with botryoidal habit. Such specimens commonly exhibit on freshly broken surfaces a series of concentric growth zones of varying widths and, perpendicular to this concentric “colloform” banding, a radial fibrous structure. Most authorities (*e.g.*, Edwards, 1960) have ascribed the origin of these structures to precipitation and growth from a colloid or gel. This conclusion is based mainly on the concentric growth habit, whereas little attention has been directed to the radially developed fibrous habit which resembles columnar basalt in microperspective.

An additional significant feature relates to the chemistry of the material. It is well known that the low-temperature psilomelane structure characteristically accepts so many elements as to be called “a garbage can.” Yet microprobe traverses across the “colloform” banding of several hypogene nodules reveal little compositional zoning despite the obvious banding visible under reflected light.

Characteristics of Tower Area Psilomelane

The Tower Area psilomelane displays most of the characteristics of hypogene psilomelane. In addition, however, its outer zones consist of discrete flexible elastic fibers (Fig. 1) which average 5 mm in length and 0.001 mm in width, for a length-breadth ratio of 5000/1. Although in macroperspective the fibers appear circular in cross section and follow closely the habit of the solid specimen, scanning electron microscopy reveals a prismatic habit. The

region of discrete fibers forms essentially one “colloform” zone.

Chemical analyses performed with the microprobe indicate, surprisingly, a relatively pure psilomelane mineral (Table 1) with only small chemical differences between the flexible fibers and the massive interiors of the nodules. The main difference is a partial solid solution towards coronadite in the massive material.

X-ray diffraction analysis confirms the chemical identification of psilomelane, although the patterns exhibited broad weak peaks in accord with a poorly crystalline low temperature phase. Studies with a Buerger precession camera clearly showed the fibers to be uniquely elongated parallel to *b*. This is in accord with the Law of Bravais because elongation occurs along the shortest lattice parameter ($a = 13.94 \text{ \AA}$, $b = 2.85 \text{ \AA}$, $c = 9.68 \text{ \AA}$).

Genesis of the Fibers

The fibers grow perpendicular to the “colloform” banding in a partial radial pattern, oriented with the *b* axis parallel to the radial structure. Such controlled growth probably occurs by precipitation from a dilute solution. As growth proceeds, the fibers become progressively more numerous and eventually coalesce into a solid mass. During this process a large solid surface area parallel to the fibers is presented to the liquid and this essentially negates the development of concentric chemical zoning. Following the closure of the discrete fiber zone into a “colloform” band, new fibers begin to develop, perhaps with the influx of new liquid.

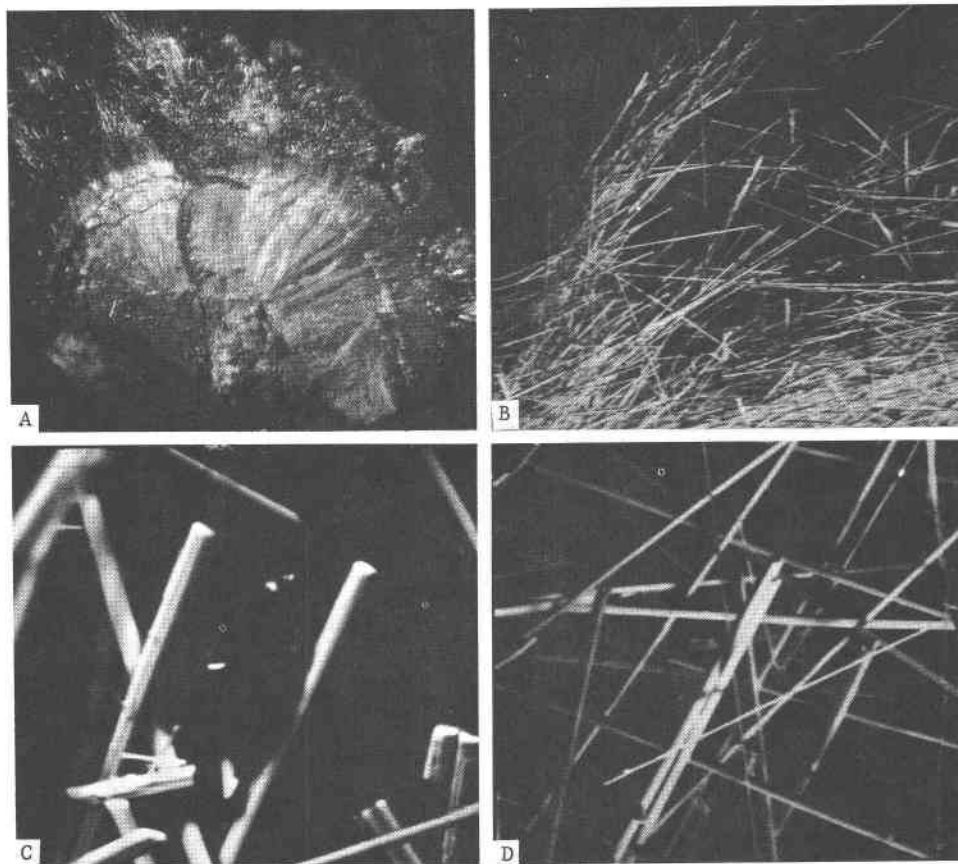


FIG. 1. Tower Area psilomelane. A. Clinographic view of hard concentric psilomelane with radial fibrous habit, coated with flexible fibers in the outer zone. B. C. D. Scanning electron micrographs of random mounted fibers. B. 100 \times ; C. 1000 \times ; D. 500 \times .

TABLE 1. Comparative Chemical Data of Hypogene Manganese Minerals and Tower Mine Area Psilomelane

	Coron- adite*	Holland- ite*	Psilo- melane*	Massive	Fibers	Dana***
MnO	8.7	9.5	7.4	76.7**	76.4**	8.0
MnO ₂	63.9	69.9	72.7			67.3
BaO	-	20.6	16.0	15.0	16.3	15.8
Fe ₂ O ₃	-	-	-	.4	.5	.5
PbO	27.4	-	-	3.8	.1	
K ₂ O	-	-	-	.3	.2	.3
H ₂ O ⁺	-	-	3.8	5.2	5.5	4.3
	100.0	100.0	99.9	101.4	99.0	96.2

* Ideal chemistry.

** Total Mn expressed as MnO. Determination by Microprobe.

*** Average of 9 analyses from Dana Volume 1.

Conclusion

For hypogene psilomelane from the Tower Mine Area, New Mexico, a different mechanism of growth

of psilomelane is suggested. The "colloform" banding with successive zones of radial *fibrous psilomelane* develops by successive growth stages of discrete psilomelane fibers; these eventually close by continuing growth into a normal dense mass.

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References

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