Akhtenskite MnO_2

Crystal Data: Hexagonal. *Point Group:* $6/m\ 2/m\ 2/m$. As microscopic crystals, flaky to platy on {001}, in parallel aggregates, sometimes in rows at 120°, probably due to replacement of an earlier hexagonal mineral; as flaky polycrystalline aggregates.

Physical Properties: *Cleavage:* {001}. Hardness = n.d. D(meas.) = n.d. D(calc.) = [4.78]

Optical Properties: [Opaque.] *Color:* Pale gray to black.
Optical Class: Uniaxial.
R_1–R_2: n.d.

Cell Data: *Space Group:* $P6_3/mmc$. $a = 2.83$–2.85 $c = 4.47$–4.88 Z = [1]

X-ray Powder Pattern: Mt. Zarod, Russia; calculated from an electron diffraction pattern.
2.45, 2.15, 1.65, 1.42

Chemistry: Sufficient material for direct chemical analysis cannot be separated; energy-dispersive analysis shows Mn as the only cationic species; Mn^{4+} and O were established by X-ray photoelectronic spectroscopy, as was the absence of OH and H_2O.

Polymorphism & Series: Trimorphous with pyrolusite and ramsdellite.

Occurrence: In mixtures in "psilomelane" with other manganese oxides in an iron oxide deposit, probably bacterially altered from a previous mineral (Akhtensk deposit, Russia); in incrustations of ferromanganese minerals on oceanic basalt on a guyot (Mt. Zarod, Russia).

Association: Cryptomelane, nsutite, pyrolusite, todorokite, goethite (Akhtensk deposit, Russia); vernadite, manganite, Fe–Mn oxides (Mt. Zarod, Russia).

Distribution: In the Akhtensk brown ironstone deposit, north of Magnitka, Southern Ural Mountains; on Mt. Zarod, Sikhote-Alin Mountains, Primorskiy Kray, Russia.

Name: For the Akhtensk deposit, Russia, where it was first noted.

Type Material: Mining Institute, St. Petersburg, Russia, 307/5.

References: (1) Chukhrov, F.V., A.I. Gorshkov, and V.S. Drits (1987) Advances in the crystal chemistry of manganese oxides. Zap. Vses. Mineral. Obshch., 16, 210–221 (in Russian). (2) Chukhrov, F.V., A.I. Gorshkov, A.V. Sivtsov, V.V. Berezovskaya, Y.P. Dikov, G.A. Dubinina, and N.N. Varinov (1989) Akhtenskite – the natural analog of ϵ-MnO_2. Izv. Akad. Nauk SSSR, Ser. Geol., 9, 75–80 (in Russian). (3) (1990) Amer. Mineral., 75, 931 (abs. refs. 1 and 2).