

Crystal Data: Hexagonal. *Point Group:* $\bar{3}$. Rare crystals, showing {0001}, {11 $\bar{2}$ 0}, {10 $\bar{1}$ 2}, {02 $\bar{2}$ 1}, as thin hexagonal plates, in rosettes, to 2 cm; granular, scaly, in aggregates; an exsolution from franklinite and spinel.

Physical Properties: *Cleavage:* {02 $\bar{2}$ 1}, perfect; {10 $\bar{1}$ 2}, less perfect. *Fracture:* Conchoidal to subconchoidal. Hardness = 5–6 VHN = 435–579, average 511 (50 g load). D(meas.) = 4.537 D(calc.) = 4.596

Optical Properties: Opaque, translucent in thin fragments. *Color:* Deep blood-red to black; orange in transmitted light. *Streak:* Ocher-yellow, with greenish tinge. *Luster:* Metallic to submetallic.

Optical Class: Uniaxial (-). $\omega = 2.48$ $\epsilon = 2.21$
 R₁–R₂: (400) 23.5–19.9, (420) 22.7–19.6, (440) 21.8–18.9, (460) 21.1–18.2, (480) 20.4–17.6, (500) 19.9–17.1, (520) 19.4–16.7, (540) 19.0–16.3, (560) 18.8–16.1, (580) 18.5–15.9, (600) 18.3–15.7, (620) 18.2–15.6, (640) 18.0–15.5, (660) 17.8–15.4, (680) 17.8–15.3, (700) 17.6–15.2

Cell Data: *Space Group:* $R\bar{3}$ (synthetic). $a = 5.13948(7)$ $c = 14.2829(4)$ $Z = 6$

X-ray Powder Pattern: Synthetic.

2.785 (100), 2.569 (70), 1.8887 (40), 1.7469 (40), 1.5220 (35), 2.262 (30), 1.4838 (30)

| Chemistry: | (1) | (2) | (3) |
|--------------------------------|--------|------|--------|
| SiO ₂ | 1.58 | | |
| TiO ₂ | 50.49 | 53.0 | 52.96 |
| Fe ₂ O ₃ | 1.16 | | |
| Sb ₂ O ₃ | 0.48 | | |
| FeO | | 4.5 | |
| MnO | 46.92 | 42.4 | 47.04 |
| Total | 100.63 | 99.9 | 100.00 |

(1) Pajsberg, Sweden. (2) Chvaletice, Czech Republic; by electron microprobe, total Fe as FeO. (3) MnTiO₃.

Polymorphism & Series: Forms a series with ilmenite.

Mineral Group: Ilmenite group.

Occurrence: Principally in metamorphosed manganese deposits; less commonly as an accessory mineral in granite, amphibolite, serpentinite; a very rare component in chondritic meteorites.

Association: Ilmenite, geikielite, hematite, spinel, gahnite, chromite, magnetite, ganophyllite, manganophyllite, hendricksite, garnet, calcite.

Distribution: At the Harstigen mine, near Persberg, Värmland, Sweden. From near Ensila, Finland. At Bratthagen, near Larvik, Norway. In the Benallt mine, Rhiw, Gwynned, Wales. At Dalroy Burn, Dalroy, Inverness-shire, Scotland. From Chvaletice, Czech Republic. From Broken Hill, New South Wales, Australia. In Japan, at the Noda-Tamagawa mine, Iwate Prefecture; the Kasama mine, Ibaragi Prefecture; the Taguchi mine, Aichi Prefecture; and others. Fine crystals from Mont Saint-Hilaire, Quebec, Canada. In the USA, from Sterling Hill, Ogdensburg, Sussex Co., New Jersey; at Bald Knob, near Galax, Alleghany Co., North Carolina; on Granite Mountain, near Little Rock, Pulaski Co., Arkansas. Around Manicaragua, Cuba. Additional localities are known, in small amounts.

Name: From the Greek for *fire* and *to appear*, in allusion to its red color.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 534–541. (2) Kidoh, K., K. Tanaka, F. Marumo, and H. Takei (1984) Electron density distribution in ilmenite-type crystals. II. Manganese(II) titanium(IV) trioxide. *Acta Cryst.*, 40, 329–332. (3) Dunn, P.J. (1995) Franklin and Sterling Hill, New Jersey. No publisher, n.p., 603. (4) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 464. (5) (1978) NBS Mono. 25, 15, 42.

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