Ulvöspinel $TiFe^{2+}_2O_4$

Crystal Data: Cubic. *Point Group:* $4/m\ \overline{3}\ 2/m$. Commonly as an exsolution, forming a fine network along {100} in magnetite, or in ilmenite; rarely as skeletal crystals, to 2 cm.

Physical Properties: Hardness = n.d. VHN = ∼650 D(meas.) = n.d. D(calc.) = 4.78

Optical Properties: Opaque. *Color:* Black; brown to reddish brown in reflected light. *Optical Class:* Isotropic.

R: (400) 17.9, (420) 17.5, (440) 17.1, (460) 17.0, (480) 16.9, (500) 17.0, (520) 17.2, (540) 17.5, (560) 17.8, (580) 18.2, (600) 18.6, (620) 18.9, (640) 19.1, (660) 19.2, (680) 19.2, (700) 19.2

Cell Data: *Space Group: Fd3m* (synthetic). $a = 8.398–8.504$ $Z = 8$

X-ray Powder Pattern: Synthetic.
2.573 (100), 1.5089 (39), 3.018 (33), 1.6426 (33), 2.1339 (19), 1.7419 (10), 0.8711 (10)

Chemistry:

	(1)	(2)
SiO_2	0.2	
TiO_2	26.3	35.73
Al_2O_3	1.4	
Fe_2O_3	16.5	
V_2O_3	0.2	
FeO	51.7	64.27
MnO	0.7	
MgO	1.8	
CaO	0.3	
Total	99.1	100.00

(1) Nass River Valley, British Columbia, Canada; by electron microprobe, Fe^{2+}:Fe^{3+} from charge balance; corresponds to $(Fe^{2+}_{1.60}Ti_{0.73}Fe^{3+}_{0.46}Mg_{0.10}Al_{0.06}Mn_{0.02}Ca_{0.01}Si_{0.01}V_{0.01})_{\Sigma=3.00}O_4$.
(2) $TiFe_2O_4$.

Mineral Group: Spinel group.

Occurrence: A common component of titaniferous magnetite iron ores; in kimberlites; in strongly reduced iron-bearing basalts, terrestrial and lunar.

Association: Iron, magnetite, troilite, cohenite, graphite, ilmenite, pyrrhotite, chalcopyrite, olivine, pyroxene, biotite, plagioclase, apatite.

Distribution: A few localities for studied material include: from the Grundhamn and other mines, near Södra Ulvön mountain, and elsewhere in the Ulvö Islands, Ångermanland archipelago, northern Sweden. In Finland, at Susimäki, Kuisaari, Sammali, and elsewhere. At Bühl, near Weimar, Hesse, Germany. At Padvinsk, Ural Mountains, and in the Udachnaya kimberlite pipe, Sakha, Russia. On Disko Island, near Uivfaq and Kitdlît, Greenland. At the Mooihoek Farm, Lydenburg district; Spitzkop, near Middelburg; and Vygenhoek, Transvaal, South Africa. In Mozambique, from Chapanduka, Massamba, and Canjueira. At Chinumba, Gambos, and Chihamji, Angola. In the USA, in the Duluth Gabbro complex, near Hibbing, St. Louis Co., Minnesota; around Lake Sanford, Essex Co., New York; large crystals from the Soda Springs vent, Gila Co., Arizona. At Lac de Blanche and Benoite Lake, Quebec, Canada. Abundant in some basalts on the Moon.

Name: For the occurrence on the Ulvö Islands, Sweden, and as a member of the *spinel* group.

Type Material: n.d.

References: (1) Mogensen, F. (1946) A ferro-ortho-titanate ore from Södra Ulvön. Geol. Fören. Förhandl. Stockholm, 68, 578–588. (2) Ramdohr, P. (1953) Ulvöspinel and its significance in titaniferous iron ores. Econ. Geol., 48, 677–688. (3) (1955) Amer. Mineral., 40, 138 (abs. refs. 1 and 2). (4) Stout, M.V. and P. Bayliss (1980) Crystal structure of two ferrian ulvöspinels from British Columbia. Can. Mineral., 18, 339–341. (5) Picot, P. and Z. Johan (1982) Atlas of ore minerals. B.R.G.M., Orléans, France, and Elsevier, Amsterdam, Holland, 378. (6) (1983) NBS Mono. 25, 20, 61.