of the analyzed sample. Using the present x-ray method, the sulfur and cobalt contents were estimated as 2.5_5 and 0.9 weight per cent, respectively. Analysis of the Kuortane loellingite, performed by P. Kivalo (in Pehrman, 1950), indicated 1.34 weight per cent sulfur and no Co, Ni, Bi, or Sb. The present x-ray method indicates 0.9 weight per cent sulfur and $\leqslant 0.1$ per cent cobalt.

The correlation between results obtained by the two analytical procedures, wet chemistry and x-ray diffraction, is not excellent. However, the differences may in part be due to (1) errors in the wet chemical analyses since determinations of sulfur, and perhaps also of cobalt, are difficult to perform; and (2) admixed phases in the chemically analyzed samples.

REFERENCES

CLARK, L. A. (1960): The Fe-As-S system: phase relations and applications, *Econ. Geol.*, **55**, 1345–1381, 1631–1652.

HOLMES, R. J. (1947): Higher mineral arsenides of cobalt, nickel, and iron, *Bull. Geol. Soc. Am.*, **58**, 299–392.

NEUMANN, H., HEIER, K., & HARTLEY, J. (1955): On loellingite ($FeAs_2$), *Norsk Geol. Tidsskr.*, **34**, 157–165.

BUERGER, M. J. (1937): Interatomic distances in marcasite, and notes on the bonding in crystals of löllingite, arsenopyrite, and marcasite types, *Zeits. Krist.*, **97**, 504–513.

PEHRMAN, G. (1950): Löllingite von Kuortane (W. Finland), *Acta. Acad. Åbo*, Math. Physica, **17**, 6 pp. (in *Min. Abstr.*, **11**, 300.)

ROSEBOOM, E. H., JR. (1958): Phase relations in the arsenic-rich portion of the system Co-Ni-Fe-As, *Unpublished Ph.D. dissertation, Harvard University.*

Manuscript received January 11, 1962

ON KOLOVRATITE[1]

J. L. JAMBOR AND G. R. LACHANCE
Geological Survey of Canada, Ottawa

Kolovratite, a vanadate of uncertain composition, is reported to be widely distributed as yellow to greenish yellow incrustations and botryoidal crusts in quartz schists and carbonaceous slates at Ferghana, Russian Turkestan (Palache, Berman & Frondel, 1951). Partial analyses of ore samples by Preobrazhensky (in Chirvinsky, 1925) gave 6.50 to 12.22 per cent NiO, and 5.94 to 11.55 per cent V_2O_5. The lack of descriptive data has long resulted in the mineral being regarded as a doubtful species (Foshag, 1926).

[1] Published by permission of the Director, Geological Survey of Canada.

In an investigation of copper and vanadium arsenates, Guillemin (1956) examined a specimen of "kolovratite" from Agalik, Uzbekistan, U.S.S.R., and found it to be identical to his new mineral, vésigniéite. Guillemin also stated that, contrary to the definition given by Vernadsky (1922), a fragment of the specimen contained only faint traces of nickel. Consequently, and because of the vague original description, Chudoba (1958) regarded kolovratite as a discredited species.

Two specimens of kolovratite from the type locality were examined by the present writers. The *x*-ray powder data for one of these has been published recently by Sabina & Traill (1960); additional mounts prepared from the same specimen gave identical patterns. The second specimen of kolovratite (M 14455), was obtained from the Royal Ontario Museum through the courtesy of J. A. Mandarino, Associate Curator of Mineralogy. The *x*-ray powder patterns of the two kolovratites are identical, but differ markedly from the pattern of vésigniéite (Table 1). The measured values, obtained with a Norelco camera of 11.46 cm. diameter, and nickel-filtered copper radiation, are not corrected for film shrinkage.

Table 1. Kolovratite and Vésigniéite: *X*-ray Powder Patterns

Kolovratite		Vésigniéite (Guillemin)	
I (obs.)	*d* (meas.) Å	*I* (obs.)	*d* (meas.) Å[a]
s	11.6	*w*	6.97
vw b	7.1	*m*	4.96
s	5.83	*m*	4.59
vw b	4.62	*vw*	3.47
s	3.88	*s*	3.21
w/m	2.62	*m*	2.97
w/m	2.57	*ms*	2.72
w/m b	2.39	*m*	2.56
vw b	1.95	*w*	2.47
vw	1.54	*ms*	2.29
w/m	1.52	*vw*	1.92
vvw	1.50	*w*	1.82
w	1.47	*vw*	1.74
w	1.42	Plus several additional weak lines.	

[a] Converted from k*X* units.

Properties

Under the binocular microscope the mineral is greenish yellow to dark citrine, with vitreous lustre and light yellow streak. The mineral is brittle, has a hardness of 2–3, and an even to conchoidal fracture. All fragments examined in immersion oils were found to be fibrous or felted aggregates, thus accounting for the variable fracture. Attempts at determining the specific gravity with heavy liquids consequently proved unsatisfactory. Under the petrographic microscope, the mineral consists of yellow, non-pleochroic, cryptocrystalline divergent fibres with the mean index of refraction 1.577 ± 0.005. Birefringence is low and extinction parallel. Many of the botryoidal units are sub-fibrous in cross-section and have hollow centres. Colourless, siliceous rims were observed on some grains.

Small samples of the greenish crusts were scraped from each of the G.S.C. and R.O.M. samples, and the materials partially scanned with an x-ray fluorescent spectrometer (G.R.L.). Both samples were found to contain major amounts of vanadium, nickel, and zinc, and minor amounts of copper, iron, and manganese. The intensities of a characteristic spectral line for each of these elements were measured and are reported for each sample in Table 2 as ratios of the intensity of the $VK\alpha$ line.

TABLE 2. RATIO OF INTENSITY OF SPECTRAL LINE TO INTENSITY OF $VK\alpha$

Spectral line	G.S.C. specimen	R.O.M. specimen
$VK\alpha$	1	1
$NiK\alpha$	1.45	1.14
$ZnK\alpha$	1.32	1.34
$CuK\alpha$	0.22	0.37
$FeK\alpha$	0.20	0.33
$MnK\alpha$	0.12	0.27

The close similarity in the ratios of the major constituents and the identical powder diffraction patterns obtained from the two specimens suggests that a single nickel-zinc-vanadium mineral is present in both specimens. The variable intensity ratios of the minor constituents suggests that these may be impurity elements rather than essential constituents of the mineral. Minor to trace amounts of Si, Al, and Mg were detected in both specimens by qualitative spectrographic analyses, and closed tube tests showed that water is an additional major constituent.

Two and a half milligrams of the G.S.C. sample were fused with an excess of $Na_2S_2O_7$ and analysed for zinc, nickel and vanadium by x-ray spectrography. The following values, accurate to within 25% of the amount present, were obtained: ZnO, 15 per cent; NiO, 12 per cent; and V_2O_5, 12 per cent. In view of the mode of occurrence of the zinc-nickel-vanadium mineral as crusts and thin coatings, the sample taken for analysis undoubtedly contained carbonate and silica impurities which would account in part for the relatively low contents of zinc, nickel, and vanadium. In addition, the sample was found to dissolve with moderate rapidity in cold, dilute hydrochloric acid leaving behind a colourless, siliceous skeleton. The ease with which solution takes place may indicate that the siliceous skeletal residue is also extraneous matter and the mineral is a hydrous vanadate rather than a silico-vanadate.

It seems probable that the mineral we have examined in two specimens from the type locality is the vanadate originally described and named kolovratite by Vernadsky (1922). Our evidence suggests, however, that kolovratite is a hydrous zinc-nickel vanadate, or possibly a silico-vanadate, rather than a nickel vanadate as inferred in the original description.

Acknowledgments

The writers are indebted to W. F. White and H. Champ of the Geological Survey of Canada for the spectrographic analyses. H. H. Bostock confirmed the refractive index determination. Particular acknowledgment is made to R. J. Traill for his many helpful criticisms and suggestions.

REFERENCES

CHIRVINSKY, P. N. (1925): Tyuyamunite from the Tyuya-Muyun Radium mine in Fergana; *Min. Mag.*, **20**, 287–295.

CHUDOBA, KARL F. (1958): Neue Mineralien und Neue Mineralnamen; *Hintze, Handuch der Mineralogie*, **2**, no. 8, 570.

FOSHAG, W. F. (1926): New mineral names; *Am. Mineral*, **11**, 136.

GUILLEMIN, C. (1956): Contribution a la Minéralogie des Arséniates, Phosphates et Vanadates de Cuivre, II-Phosphates et Vanadates de Cuivre; *Bull. Soc. franc. Minér. Crist.*, **79**, 219–275.

PALACHE, C., BERMAN, H., & FRONDEL, C. (1951): *Dana's System of Mineralogy*; **2**, 7th ed., John Wiley and Sons, New York.

SABINA, A. P., & TRAILL, R. J. (1960): Catalogue of *x*-ray diffraction patterns and specimen mounts on file at the Geological Survey of Canada; *Geol. Surv., Canada*, Paper 60-4.

VERNADSKY, V. F. (1922): A new nickel-bearing mineral kolovratite (Russ.); *Compt. Rend. Acad. Sci. Russie*, 37–38.

Manuscript received January 25, 1961

SOME MINERAL OCCURRENCES NEAR EAU CLAIRE, ONTARIO*

E. WM. HEINRICH

The University of Michigan, Ann Arbor, Michigan

Pyrochlore Pegmatites

Pyrochlore-bearing pegmatites were found in 1956 in Calvin Township in the Nipissing district, several miles south of Eau Claire, just east of

---

*Contribution No. 244 from the Mineralogical Laboratory, Department of Geology and Mineralogy.