THE STRUCTURE OF RISØRITE

BY

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After the accomplishment of the preceding *X*-ray investigation on fergusonite, Professor J. SCHETELIG has kindly drawn my attention to the mineral species risørite.

This mineral has been found in a felspar quarry at Gryting in the neighbourhood of the town Risør.

It crystallizes tetragonally as fergusonite, and save that the colour of risørite is brown, contrary to the velvet black of fergusonite, the two minerals have apparently identical properties. However, an analysis by O. HAUSER[1] has shown that the chemical composition differs from that of fergusonite, on account of which he has registered the risørite as a new mineral species.

J. SCHETELIG[2] has later made a comparison between HAUSER's analysis of risørite and analyses of fergusonites, whereby he has arrived at the result, that risørite is a mineral similar to fergusonite, where half of the ortoniobic acid is replaced by ortotitanic acid.

Through the kind favour of Professor SCHETELIG, Director of the Mineralogical Museum in Oslo, the museum's collection of risørite was given to my disposal.

All the samples of risørite examined were isotropic, became however after ignition anisotropic.

In order to get distinct *X*-ray reflections (cfr. the preceding article on fergusonite p. 27) the mineral was fused. After that

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[1] Zeitschr. anorg. Chemie., *60*, 230 (1908).

[2] Vid.-Selsk. Skr. I. 1922, No. 1, p. 142.

it was ground and mixed with rock salt (according to the method of WYCKOFF) and a powder diagram was made.

The observed and calculated reflection lines are recorded in the following table.

Table. Risørite.

Camera Diameter = 57,65 mm. Copper Radiation: $K\alpha$ = 1,539 Å.

Intensities	Indices	η		Intensities	Indices	η	
		obs.	calc.			obs.	calc.
10	113	14,27	14,24	0	331	-	-
10	122	15,02	15,01	2	225	26,05	25,98
0	220	-	-	5	333	27,78	27,75
2	104	16,71	16,70	0	007	-	-
2	301	17,67	17,70	4	414	29,27	29,27
0	105	-	-	4	226	29,47	29,47
10	304	-	-	3	511	30,62	30,56
	215	23,75	23,78	2	424	31,22	31,19
3	314	-	-	1	440	34,05	34,00
	411	24,35	24,40				

$$\sin^2\eta = \Sigma h^2 \cdot 0{,}00977 + l^2 \cdot 0{,}00455$$

$a_0 = 7{,}78$ Å, $c_0 = 11{,}41$, c/a 1,467.

As seen by a comparison between the table of the reflection planes of risørite and of fergusonite (p. 33), the structure of risørite is almost identical with that of fergusonite. There is, however, a slight difference in the dimension of the unit cell and in the axial ratio:

Fergusonite: $a_0 = 7{,}74$ Å, $c_0 = 11{,}31$ Å, $c/a = 1{,}460$

Risørite: $a_0 = 7{,}78$ Å, $c_0 = 11{,}41$ Å, $c/a = 1{,}467$

The specific gravity of risørite has besides an unusually low value: $G = 4{,}678$ (according to HAUSER)

According to SCHETELIG's calculations the chemical constituents of risørite are: $\overset{III}{R}NbO_4$; $\overset{II}{R}_2TiO_4$; $\overset{III}{R}_4(TiO_4)_3$.

For the same reasons already assigned for fergusonite, risørite has to crystallize in one of the following space groups; C^1_{4h}; C^2_{4h}; C^3_{4h}; C^4_{4h}. Eight molecules of risørite have to enter into the unit cell, and consequently the formula of the main constituent may be written as $\overset{III}{R}_8Nb_8O_{32}$, where all the $\overset{III}{R}$-atoms

and all the *Nb*-atoms may be equivalent and situated in general positions (x, y, z). The formula of the next constituent may be written as $\overset{II}{R}_{16}Ti_8O_{32}$; but here the $\overset{II}{R}$-atoms may be divided in two groups of eight atoms each, all of them, as well as all the *Ti*-atoms may be situated in general positions. The formula of the smallest constituent may be written $\overset{III}{R}_8Ti_{12}O_{24}$. All the $\overset{III}{R}$-atoms may be equivalent and situated in general positions, but the *Ti*-atoms have to be divided in one group of eight atoms all of them in general positions and one group of four atoms, in special positions.

Computed from the analysis of HAUSER, the atomic weight of the trivalent elements are on an average 105, of the niobium 103, and of the divalent elements 49. The specific gravity of these constituents are then:

$$\overset{III}{R}NbO_4 = 5{,}17$$
$$\overset{II}{R}_2TiO_4 = 3{,}99$$
$$\overset{III}{R}_4(TiO_4)_3 = 3{,}59$$

The molecular ratio of these three constituents is: 0,288; 0,108; 0,048 respectively. Taking notice of this, the specific gravity of risørite is computed to: $G = 4{,}72$ (HAUSER: 4,68).

Thus this X-ray analysis verifies the conclusion of HAUSER *and* SCHETELIG, *that risørite is a mineral, closely related to fergusonite, but owing to a comparatively great content of ortotitanic acid it has a lower specific gravity, and a greater volume of its unit cell.*

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