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DETERMINATION OF SILICON AND VANADIUM IN WATER
SAMPLES OF OHRID'S LAKE

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ИЗВАДОК

Јордановска В., Генчова О., Тошев Д. (1986/87): Определување на силициум и ванадиум во води од Охридското езеро. Год. зб. Фарм. фак., Скопје.

За определување на ванадиумот и силициумот во води од Охридското езеро се применети спектрофотометриски методи.

Количината на силициумот се движи помеѓу 0,000 и 0,170 мг Si/dm³, а на ванадиумот помеѓу 0,120 и 0,600 μ g/dm³. При рН околу 8 во земените приморецони вода силициумот се јавува во растворлива форма.

ABSTRACT

Jordanovska V., Cenčova O., Toshev D. (1986/87): Determination of silicon and vandium in water samples of ohrid's lake. God. zb. Farm. fak., Skopje. Institute of Chemistry, University of Skopje.

Spectrophometric methods were used for determination of soluble and total silicon^v as well as vanadium in water samples from Ohrid's Lake.

The amounts of silicon vary in range from 0,000 to 0,170mg Si/dm³ and vanadin 0,120 to 0,600 μ gV/dm³. At pH 8 of water samples, silicon appears in soluble form.

It is known that the healthy human body contains about 0,01% silicon. The role of silicon in the metabolism is not quite clear.

Vanadium has role in formation of dents with children¹ and in the growing process of some domestic animals.

Natural waters contain about 25—30 mgSi O₂/dm³ 2-5 in forme of ions of silicic acid at pH higher than 8 and at lower pH and concentration higher than 100 mgSI O₂/dm³ in colloidal form. In lower concentrations of about 100 mgSi O₂/dm³ are not unusual, especially in mineral waters.

The amounts of vanadium in waters appear as submicroquantities in range from 0,0 to 50,0 $\mu\text{gV}/\text{dm}^3$ ⁶⁻¹⁰.

In this paper we present the results of spectrophotometric determination of soluble and total silicon as well as vanadium in water samples of Ohrid's Lake.

There are many methods for a determination of silicon. Usually spectrophotometric methods are being used. One group of them is based on the ability of silicon to form a yellow complex with molybdcic acid with empiracel formula $\text{H}_4 [\text{Si} (\text{Mo}_3\text{O}_{10})_4] \cdot n\text{H}_2\text{O}$ ¹¹. The sensitivity of these methods is not high because of near absorption area of free molybdcic acid¹¹. Another group of spectrophometric methods is based on transformation of the above yellow complex to blue heteropolycomplex with different reducing reagents such as: tin (II) chloride, hydrazine sulphate, thiourea, sodium sulphite, 1-ammino-2-naphthol-4- sulphonic and ascorbic acid.

For determination of vanadium in water there are many different methods¹². In all of them preconcentration of vanadium is necessary because of its very low water. *water, taken in water*

For determination of silicon in water samples we have applied spectrophotometric methods proposed by Golterman¹³ and Potter¹⁴.

For determination of submicroamounts of vanadium we have applied spectrophotometric method proposed by Jordanovska and al.¹².

The water samples of the Lake were taken in polyethylen bottles from about one hundred meters of the beach from thirteen different spots around the Lake, in 1978 year.

EXPERIMENTAL

Apparatus:

The absorbance measurements were made on Beckman model DU.

Spectrophotometer in 1-cm. cells.

pH-values were measured on Ionalyser Orion Research Model 407A.

Reagents:

All water solutions were made with redistilled water and in polyethylene bottles.

1. Silicon standard solution. An ampoule with $1\text{g} \pm 0,002\text{g}$ Si (SiCl_4 in NaOH) Titrisol Merck, was diluted to 1 dm^3 with water. From this stock solution (1 mgSi/cm^3) by dilution was obtained a working solution with concentration 10 mgSi/cm^3 .

2. Hydrochloric acid (1 : 1).

3. 10% ammonium molybdate in water.

4. 10% oxalic acid in water.

5. 1-ammino-2-naphthol-4-sulphonic acid.

I 9 g $\text{H}_2\text{S}_2\text{O}_5$ in 70 cm^3 water.

II 0,7 g Na_2SO_3 were dissolved in small quantities of water and

0,15 g of 1-ammino-2-naphthol-4-sulphonic acid was added.

The solutions I and II were mixed and filled with water to 100 cm^3 .

6. Sulphuric acid (1 : 1).

7. 5% ammonium molybdate in 10% sulphuric acid.

8. Concentrated solution of tin (II) chloride—40 g SnCl_2 were dissolved in concentrated hydrochloric acid and diluted to 100 cm^3 with water. Diluted solution of tin (II) chloride — Before use 1 cm^3 of the above solution was diluted to 100 cm^3 with water.
9. Sulphuric acid with $c = 2 \text{ mol } (\text{H}_2\text{SO}_4)/\text{dm}^3$.
10. 2% solution of sodium potassium carbonate in water.

PROCEDURE FOR DETERMINATION OF SILICON

For the determination of soluble silicon two methods were used:

A. 2—50 cm^3 filtered water sample 2 cm^3 of 5% ammonium molybdate were added. It was left 15 minutes and 5 cm^3 of sulphuric acid (1 : 1) and 2 cm^3 freshly prepared diluted solution of tin (II) chloride was added. Diluted with water to 100 cm^3 and after 20 minutes was measured the absorption at 815 nm against blank solution prepared with all reagent except silicon. From the standard curve obtained from known quantities of silicon and their extinctions, the quantity of silicon in water sample was determined.

B. To 2—50 cm^3 filtered water sample which contains less than 0,1 mg Si (in measuring flask of 100 cm^3) 1 cm^3 hydrochloric acid (1 : 1) and 2 cm^3 ammonium molybdate were added. After 15 minutes 1,5 cm^3 10% oxalic acid and 2 cm^3 1-amino-2-naphthol-4-sulphonic acid reagent were added. It was diluted to 100 cm^3 with water and in 20 minutes the absorption at 815 nm against blank sample was determined.

For total silicon:

To 2—50 cm^3 water sample, 10 cm^3 2% solution of sodium potassium carbonate were added. The mixture was evaporated (in platinum dish) to dry residue. It was left 1 hr in electrical furnace at about 900°C. The residue after cooling was dissolved in 40 cm^3 water and 1 cm^3 sulphuric acid with $c = 2 \text{ mol } (\text{H}_2\text{SO}_4)/\text{dm}^3$ and diluted with water to 200 cm^3 . Next the description for soluble silicon (methods A or B) follows.

The reagents used and the procedure for determination of vanadium in water samples are the same as described by Jordanovska and al.¹²

RESULTS AND DISCUSSION

It can be seen from the Table 1. that amounts of silicon and vanadium in waters of Ohrid's Lake are very low and vary from 0,000 to 0,170 $\mu\text{gSi}/\text{dm}^3$ and of vanadium from 0,120 to 0,600 $\mu\text{gV}/\text{dm}^3$. This is in agreement with the results for amounts of silicon in lake's water obtained by Richards¹⁵. The low concentration of vanadium can be expected because of the rocks around the Lake are marbles from Paleozoic which are poor in minerals with vanadium. The amounts of silicon obtained with three methods for a same sample are similar and there is

not great difference between soluble and total silicon. That means that all silicon at an average pH of about 8 is in soluble form. This is in agreement with the results of G. Govet¹⁶ and E. Egorova¹⁷.

Table 1.

The contents of silicon and vanadium in water samples of Ohrid's Lake.

Area	$\mu\text{gV/dm}^3$	A	B	mgSi/dm^3 Total
Camping „Gradište”	0,406	0,000	0,000	0,023
Hotel „Desarat”	0,120	0,000	0,010	0,090
Peštani	0,400	0,000	0,020	0,170
Lagadin	0,600	0,000	0,000	0,040
Hotel „Metropol”	0,560	—	—	—
Orce Nikolov	0,360	0,000	0,000	0,023
Gorica	0,360	—	—	—
Biljanini izvori	0,150	—	—	—
Quay Ohpid	0,400	0,120	0,040	0,120
Camping „Livadište”	0,480	0,000	0,020	0,120
Hotel „Biser”	0,216	0,160	0,160	0,160
Camping „Treska”	0,300	0,000	0,090	0,100
Ohrid's Lake — Crn Drim	0,350	0,022	0,020	0,170

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