INVESTIGATION OF SYNTHETIC TITANATES

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The purpose of this work was to study properties and determine parameters of the elementary cell of synthesized accesory minerals (perovskite, loparite) as well as Eu aluminate. As a rule, these compounds are solid solutions and potential matrices to fix alkaline, alkaline- and rare-earth elements (Cs, Sr, Ba, Ce, Eu etc) which can enter the crystalline lattice of minerals as isomorphous impurities, replacing Ca-atoms and partially Ti. A well-known stability of these minerals at airing of rocks, gives us grounds to expect their stability and radionuclide leaching.

Mineral synthesis was made by hot pressing method in to 3 stages: 1) drying of charge in vacuum during 0.5 hour; 2) pressing at 1350^0C and axis pressure of 300 bar during 0.5 hour; 3) completing synthesis at 1350°C and remaining axis pressure (50 bar) during 4 hours [1]. Synthesized solid solution of titanates which Na, Ca, Sr, Ce and Eu enter isomorphously, represent samples of poly- and monomineral ceramics with the density of 88-98% from the theoretical one. Chemical composition, equations of synthesized matrices and stable phases of the stadied part of the system CaO - (SrO) - (EuO) - TiO - CeO_2 are given in tabl.1 (according to the microprobe data). For some of these solid solution parameters of the elementary (PEC) cell are calculated. The results of the calculations are given in Tabl.2 (the errors of some more exact definitions are given in brackets and refer to the last decimal sihgs).

These samples of titanates and aluminate were subjected by us to leaching of Na, Sr, Ca, Ce and Eu. One should emphasize that velocities of leaching V $g/(m^2{\cdot}day)$ of alkaline and alkaline-earth elements from solid solution of titanates increase in the following seguence: Na -> Ca -> Sr. The velocities of leaching after 28 days are equel to $9.83 \div 5.87{\cdot}10^{-3}$ for Na, $1.2{\cdot}10^{-2}$ for Ca and $2.8{\cdot}10^{-2} \div 3.3{\cdot}10^{-2}$ for Sr. Low velocities of leaching Na, Ca, Sr and Ti (no leaching from any sample) showed high stability of solid solutions of perovskite and loparite, constituting synthesized samples, comparable with the stability of Sinrok-C [4] and natural monocrystals of plagioclase [5]. It testifies to a possibility to use these solid solutions of titanates as matrix materials - fixators of alkaline, alkaline- and rare-earth radionuclides of RAW (radioactive waste). Also, the data on the leaching of Ce ($5{\cdot}10^{-6}$ $g/(m^2{\cdot}day)$) and Eu ($9{\cdot}10^{-6}$ $g/(m^2{\cdot}day)$) testify to the uniqueness of titanates as matrices, keeping these elements.

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Table 1

Contens of oxides (wt%) and eguation of samples

N sample	Mineral phase	CaO	SrO	TiO_2	Ce_2O_3	Eguation
1104/1	Prv[a]	48.24	-	51.76	-	$Ca_{1.98}Ti_{2.02}O_{6.02}$
1105/1	SrPrv[b]	23.41	6.13	55.46	-	$(Ca_{0.82}Sr_{0.18})_{1.98}Ti_{2.02}O_{6.02}$
1108/1	Lpr[c]	Na_2O 22.55	-	54.17	21.21	$Na_{0.8}Ce_{1.18}Ti_{2.00}O_{6.2}$
1109/1	EuLpr[d]	Na_2O 22.55	Eu_2O_3 2.066	54.17	21.21	$Na_{0.91}(Ce_{0.91}Eu_{0.09})_{1.08}$ $Ti_{2.07}O_{6.1}$
1113/1	Sr Prd[e]	K_2O 2.27	9.39	65.17	MgO 12.89	$(K_{0.4}Sr_{0.8})_{1.2}Mg_{0.2}Ti_{6.8}O_{16}$
Ст 20/2	$EuAlO_3$	BaO 1.73	Eu_2O_3 73.5	Al_2O_3 19.18	SiO_2 2.33	$(Eu_{1.03}Gd_{0.02}Ca_{0.01}Ba_{0.01}$ $Fe_{0.027}Si_{0.084})_{1.2}Al_{0.8}O_3$

[a] - perovskite; [b] - Sr-bearing perovskite; [c] - loparite; [d] - Eu- bearing loparite;
[e] - Sr- bearing priderite.

Table 2

Parameters of the elementary cell of the number of the titanates row and Eu aluminate

N sa-mple	Basic phase	Struc-ture*	a, Å	b, Å	c, Å	α, °	β, °	γ, °	V, (Å)^3
1104/1	Prv	orto [2]	5.382 (08)	7.646 (1)	5.446 (07)	90.00	90.00	90.00	224.2 (0.4)
1105/1	Sr Prv	«	5.420 (3)	7.757 (7)	5.436 (2)	90.00	90.00	90.00	225.6 (2)
1109/1	EuLpr	«	5.769 (14)	7.723 (16)	5.454 (12)	90.00	90.00	90.00	242.9 (7)
Ст 20/2	$EuAlO_3$	orto [3]	5.273 (2)	5.291 (2)	7.467 (2)	90.03 (1)	90.46 (1)	89.76 (1)	208.3 (0.7)

* - structure in the approximation of which the calculation was made.