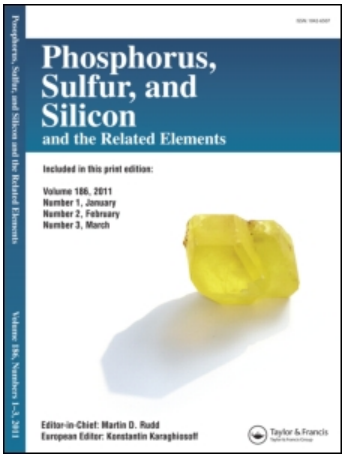

Phosphorus, Sulfur, and Silicon and the Related Elements
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713618290

Kinetics of the Kola Apatite Rock Interaction With H_3PO_4

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To cite this Article Komissarova, L. , Bobylev, A. , Golubina, L. and Melnikov, P.(1996) 'Kinetics of the Kola Apatite Rock Interaction With H_3PO_4', Phosphorus, Sulfur, and Silicon and the Related Elements, 111: 1, 3
To link to this Article: DOI: 10.1080/10426509608054632
URL: http://dx.doi.org/10.1080/10426509608054632

Phosphorus, Sulfur, and Silicon, 1996, Vol. 111, p. 3
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KINETICS OF THE KOLA APATITE ROCK INTERACTION WITH H_3PO_4

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Besides the production of fertilizers, Kola phosphate rock may be used as a source of lanthanides, strontium and fluorine. It implies the necessity to carry out a study of kinetics and mechanisms of the process in order to choose optimal conditions for the realization of the technological scheme [1]. The fluorapatite concentrate used had the following composition: ΣLn_2O_3 - 0.89; Y_2O_3 - 0.04; SrO - 2.80; CaO - 45.40; Fe_2O_3 - 0.42; Al_2O_3 - 0.86; MgO - 0.10; F - 2.80; SiO_2 - 1.80; P_2O_5 - 39.40 weight %; molar ratio CaO : P_2O_5 = 1.5; the content of the apatite - 98.5%. The reaction of H_3PO_4 with fluorapatite was studied using a laboratory reactor with a stationary layer. The following parameters were varied: H_3PO_4 concentration (20, 30 and 50 weight % P_2O_5), temperature (20, 75, 150, 200 and 250°C) and time of contact (1 - 180 min.). A multimethod approach was used. X-ray diffraction, electron probe microanalysis and paper chromatography were applied to follow the bulk structural aspects of the apatite powders. It was shown that at the first stage of reaction a thin film of calcium monophosphate $Ca(H_2PO_4)_2 \cdot H_2O$ is deposited on the apatite particles (avg. diameter 150 nm). The reaction is thought to proceed at the interphase solid/liquid and its kinetics may be described by the equation

$$H(\alpha) = (1 - \alpha)^{-2/3} - 1 = k_R \tau,$$

where α is the fraction reacted. At higher temperature (175 - 200°C) calcium monophosphate $Ca(H_2PO_4)_2 \cdot H_2O$ is transformed into calcium diphosphate $CaH_2P_2O_7$ forming a blocking layer on the apatite surface and thus making access to the surface difficult. Consequently, the diffusion at the next stage is described by the equation:

$$I(\alpha) = 1 - 2\alpha/3 - (1 - \alpha)^{2/3} = k_D \tau$$

The relationship between the two rates may change with time. Graphic representations of both functions H (α) and I (α) vs time show the corresponding kinetic and diffusion areas. The best conditions of Kola apatite treatment with phosphoric acid are: T = 200°C and H_3PO_4 concentration 30%.

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Acknowledgments: CNPq, FAPESP