Synthesis and the experimental study of (K, Rb)- feldspar solid solutions

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Series of order and disorder (K,Rb)- feldspar solid solutions were synthesized by the method of hydrothermal recrystallization of gel mixtures and cation-exchange of natural feldspars with molten salts. The phase and chemical compositions of solid products and natural samples were analysed by X-ray powder diffraction, AAS and microprobe methods. The cell parameters were refined for triclinic (Rb-microcline) and monoclinic (Rb-sanidine) series.

Smith [1] proposed the diagram in coordinates of the cell parameters b and c for determination of degree of ordering of binary (Na,K)- feldspars. In the present work the similar diagram sets up for ternary (Na,K,Rb)- feldspars based on the cell parameters of synthetic (Na,K)- feldspars [2], Rb-microcline [3], Rb-containing feldspars, synthesized in the present research.

The compositional dependences of the cell parameters b and c of the (Na,K)- feldspars describes by the third degree expressions [2]. The compositional dependences of these parameters for order [4] and disorder (results of the present work) (K,Rb)- feldspars are linear. The expressions of b - c parameters for other solid solutions were accepted linear. The cell parameters of different Rb- bearing alkaline feldspars are plotted on the diagram. The data on Rb- bearing microcline by present research are close to results of [4]. The parameters of natural Rb- containing microclines from Red Cross Lake pegmatite (Canada) [5], are similar to the results of [4] for synthetic samples and data of the present work on natural Rb-bearing microclines from massif Orlovskiy (Zabaykalye, Russia). The natural Rb- microcline (rubicline) from San Piero in Campo (Elba, Italy) [6] by the cell parameters gets in area of disorder (Na,K,Rb)- feldspars.

The computer program was created for degree of ordering estimation of Rb- containing alkaline feldspars using composition and cell parameters data.

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Potential habitats in impact-generated hydrothermal systems

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Analysies of shock-metamorphosed lunar samples, in addition to meteorites from the asteroid belt and Mars, suggest planetary bodies throughout the inner solar system were affected by a flurry of impact events about 3.9 billion years ago. The data also suggest that this event was a sudden and dramatic enhancement of the impact rate lasting from 20 to perhaps 200 million years. Most of Earth was likely resurfaced during this time when at least 20,000 impact craters with diameters >20 km were produced, including some with diameters the size of modern continents. These impacts would have severely affected the environment and potentially the early biologic evolution of Earth.

While devasting for any extant life, the impacts may have also created new habitats in the form of vast hydrothermal systems in the Earth's crust. These may have been particularly important for life, because N. Sleep and K. Zahnle have shown that the larger impact events may have completely vaporized Earth's oceans and removed surface water for periods of approximately 1000 years. Thus, the only suitable habitats may have been in subsurface hydrothermal systems.

Each impact would have generated a hot central uplift, an impact melt sheet, and impact melt breccias. The breccias would have been conduits for degassing and likely sites for fumaroles. The central uplift and the melt sheet should have driven larger circulating systems. Observations at younger craters suggest impact-generated hydrothermal systems can extend across the entire diameter of a crater and down to depths of several kilometers. Large regions would have had appropriate temperatures for thermophillic and hyperthermophillic life, particularly in near-surface areas where ambient temperatures were already in a thermophillic domain. When craters were subaerially exposed, the hydrothermal systems would have vented via mud pots, hot springs, and geysers, similar to those in volcanic terranes, either through the overlying breccias or through faults generated during the modification stage of crater formation. When craters were filled with freshwater lakes or marine incursions, the systems would have vented subaqueously, like those in volcanic crater lakes and deep-sea vents. The surface area affected by each of the tens of thousands of craters ranged from 10^2 to 10^7 km^2 and the life time of each hydrothermal system ranged from 10^3 years to periods exceeding 10^6 years, depending on the size of the crater. Thus, impact-generated hydrothermal systems involved a large proportion of the Earth's surface and crust's volume during the Hadean-Archean transition.