Dissolution rates of plagioclase feldspars as a function of solution composition

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Feldspars are the most abundant mineral in the Earth's crust and plagioclase is the most abundant of these feldspars. Plagioclase dissolution is therefore a major, and at times dominant, contributor to global weathering rates. It is therefore remarkable how little work has been performed to systematically characterize the dissolution rates of this mineral as a function its composition and the composition of the fluid phase.

Towards the improved characterization of the dissolution behaviour of the plagioclases in natural processes, the steady-state dissolution rates of 5 distinct plagioclase feldspars, spanning the compositional range from albite to anorthite, have been measured in mixed-flow reactors at 25 ºC as a function of pH from pH 2 to 11. Rates tend to exhibit a typical U-shape behaviour; rates decrease with increasing pH at acidic conditions, then increase with increasing pH at basic conditions. Similar to past work [1, 2] plagioclase dissolution rates increase with increasing An content at acidic conditions. In contrast, preliminary work suggests little effect of An content at basic pH.

Interpretation of the dissolution rates of the plagioclase feldspars is challenging because this mineral tends to consist of finely intergrown albite rich and anorthite rich phases. To address this challenge, measured rates have been interpreted assuming the dissolving plagioclase is a mechanical mixture of two distinct end-member feldspars similar to that done recently for the dissolution of crystalline basalt [3].

[1] Oxburgh, *et al.* (1994) *Geochim. Cosmochim. Acta* **58,** 661-669. [2] Oelkers & Schott (1995) *Geochim. Cosmochim. Acta* 59, 5039-5053. [3] Gudbrandsson *et al.* (2008) *Min. Mag.* **72,** 155-158.

^{3}H – ^{3}He isotopic tracer for age estimating of the ground waters (Aquifers of the Khibiny slopes, Kola Peninsula)

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To introduce the ^{3}H - ^{3}He method samplers of stainless steel and degassing of water, using the flow of water vapor through the capillary as a gas – carrier have been developed and made. When being pumped through the capillary almost all helium and neon (over 95%) is collected in the trap. At the same time gets not more than 0.5 grams of water (i.e. approximately 0.3% of the sample mass, Beyerle *et al*., 2000) gets in the trap. The extraction and purification processes take approximately 30 minutes. The water samples were taken from the bores located at the southern slope of the Khibiny mountains (the Kola peninsula). The picture shows the measured relations of ^{3}He / ^{4}He and ^{20}Ne / ^{4}He in the samples from water inlets "Centralniy" (the grey squares, the figures are numbers of the bores Kamensky *et al*., 1991) and "Klyuchevoy" (the grey circles). In these coordinates the mixture of young waters (the corresponding points, the square and the circle are located above the coordinates of the air saturated water, ASW) and the deep ancient waters (in the lower left corner of the graph, the radiogenic He is formed in enclosing rocks, and migrating from them, is accumulated in ground waters) is expressed in the straight line. Regression line extrapolation of the samples from the water inlet "Centralniy" (the black line on the graph) to the trend APB + $^3He_{TRI}$ gives ^{3}He / ^{4}He = 3, 65 × 10^{-6}. Concentration of the $^3He_{TRI}$ in the young water, $[^3He]_{TRI} = [^3He]_{MEASURED} \times \{(^3He / {}^4He)_{YOUNG} - (^3He / {}^4He)_{ASW}\}$ и $[^3H]_{MEASURED}$ = 30 TE gives 3H - 3He the age of 16. The intersection of the regression line and the line of accumulation of radiogenic helium (the black square in the circle) gives the parameters of ancient water, whose age is estimated as40,000 years old (Kamensky *et al*, 1991). In the case of water inlet "Klyuchevoy" ^{3}He / ^{4}He relations in ground waters are close to those in the ASW whereas ^{20}Ne / ^{4}He is slightly lower which indicates to an admixture of ancient waters. Supposing that these isotopic relations in ancient waters of the Khibiny southern slopes are close, one can build a line passing through the points corresponding to the ancient waters and waters from the water inlet "Klyuchevoy" (the black dotted line). Extrapolation of this line to the trend ASW + $^3He_{TRI}$ gives $(^3He / {}^4He)_{YOUNG}$ = 1,65 × 10^{-6} a slightly higher value than the value of ASW.A small excess of ^{3}HeTRI along with a relatively low [3H] MOD = 12, TE correspond to the water age.