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Experimental Leaching of Volcanic Glass

Thoroughly analyzed samples of natural glass were subjected to experimental open-system leaching by aerated alkaline solutions at controlled temperature, pressure, and flow rate. The concentrations of dissolved U, Si, K, and Li were monitored and the amounts dissolved during a fixed time were expressed as percentages of the amounts contained in the unaltered glass. The results serve to identify likely mechanisms for U removal to evaluate the *relative* influence of some environmental parameters affecting the rate of leaching of U from volcanic glass. Of the measured variables, temperature had the greatest influence on the removal of U and Si. Percentages of leached U and Si increased two to three times over the range from 90 to 120°C. In all experiments, the percentage of uranium that was removed was similar to the percentage of Si that was removed, implying that U removal proceeds by a mechanism of glass-matrix destruction. As the pH of the solutions increased from 8.5 to 10, the percentages of U and Si that were removed increased by a factor of three to four. In most experiments, Li and K were leached in greater percentages than Si and U, reflecting additional diffusional transport of these elements across a proposed surficial "leached layer." Hydrated glass (perlite) produced two times more dissolved Si and U than equivalently treated obsidian of similar composition, a result of the increased effective surface area produced by perlitic fracturing. An increase of dissolved carbonate from 0.005 to 0.2M (pH $\pm$ 8.5) caused preferential removal of U (40% increase) relative to Si (20% increase). Rhyolite glasses of different alkali content showed no apparent difference in the percentage of U removed when leached by identical alkaline solutions. The apparent greater reactivity of alkali-rich glasses in nature is caused by increased exchange of alkalis for H^+, which promotes more rapid evolution of interstitial solution to the pH favorable for glass dissolution.