

## Role of Zeolites Crystallisation in the Kinetic of Volcanic Glass Corrosion

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Zeolites are very common minerals resulting from volcanic glass alteration in meteoric conditions. These Si and Al-rich tectosilicates crystallise during the final stage of glass alteration under very high silica concentration conditions and after clays appearance. Crovisier (1989) has studied very young samples from Iceland (inferior to 1 My) and has never observed zeolites. In the present study basaltic hyaloclastites, from Vatnajökull, in Iceland, were studied. These glasses, ranging from 3 to 4 My in age, zeolitised and altered by meteoric waters, constitute a good sampling to study the effect of zeolites crystallisation on glass alteration.

The estimated corrosion rate based on the alteration layers thickness is about 0.2  $\mu\text{m}/1000$  years in the case of young samples (Crovisier, 1989). This layer is made up of poorly crystalline clays. The old samples from Vatnajökull show a thicker alteration layer (about 200  $\mu\text{m}$ ), different from previous one and made up of an isotropic hydrated gel (20 percent of water). This layer is micro-porous, amorphous and depleted in Ca and Na compare to the fresh glass. In this samples, zeolites are systematically observed in intergranular spaces (chabazite, phillipsite, analcime) and sometimes combined with calcite or opal. Calculation of the dissolution rate indicates very low values of about 0,05  $\mu\text{m}/1000$  years. This rate represents a decrease with factor 2500 of the initial glass corrosion rate measured during laboratory experiments.

Grambow (1985) showed that saturation of the solution with respect to silica lead to a decrease of the alteration rate of the glass. In this way, the zeolites crystallisation plays a chemical role. Nevertheless, Advocat et al. (1998) concluded, after experiences in silica saturation conditions, that the rate can only

decrease of about a factor of 200. Hence, an other mechanism is illustrated here to explain the decrease of glass corrosion in presence of zeolites. Porosity measurements show that zeolites do not constitute a cement but a network of micro-channels less than 5 angstroms. These zeolites play an additional physical role by forming a diffusion barrier capable of slowing down the alteration process. Indeed, zeolites are able to initiate a selective dissolution of volcanic glass (which replace the initial congruent dissolution) due to a cation exchange process occurring in the micro-porosity.  $\delta^{18}\text{O}$  measurements indicate low temperature condition and major modification of the initial glass structure during the gel formation by hydrolyse concerning the network forming elements.

In conclusion, zeolites appearance do not necessarily initiate a resumption of glass corrosion as observed previously by some authors (Iseghem & Grambow, 1988; Advocat et al., 1990; Gauthier et al., 1999), but in contrary, they constitute here a protective layer which slow down the glass corrosion.

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