

Faujasite Growth During Palagonitisation of Mg-rich Sideromelane: an Example from the Kaiserstuhl Volcanic Complex, SW Germany

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Faujasite, $[\text{NaCa}_{0.5}\text{Mg}_{0.5}\text{K}]_x[\text{Al}_x\text{Si}_{12-x}\text{O}_{24}] \cdot 16\text{H}_2\text{O}$, is a rare zeolite, only known from about ten localities, where it occurs in cavities of basaltic lavas and hydrothermally altered granitic rocks. Despite the ease of synthesizing zeolite X and zeolite Y, the industrial analogues of natural faujasite, it is astonishing that faujasite is so sparse in nature.

Low-grade zeolite facies mineralization in the Kaiserstuhl volcanic complex results from subsolidus hydrothermal alteration of alkaline volcanic rocks. Nine different zeolite species are known from the volcanic complex: analcime, chabazite-Ca, faujasite-Na, faujasite-Mg, natrolite, offretite, phillipsite-K, phillipsite-Ca and thomsonite. New microprobe data on barrel-shaped offretite from the Limberg area clearly shows that the postulated epitaxial intergrowth of offretite and erionite (Rinaldi 1976) does not occur.

Zeolite occurrence as well as their chemical composition depends on the chemical composition of the host rock, local hydrological features and porosity of the rock.

In the Kaiserstuhl Volcanic Complex, octahedral crystals of faujasite occur in limburgite (olivine-augite basanite) lava flows as minor secondary mineral, associated with offretite, phillipsite, chabazite, aragonite, calcite, dolomite, montmorillonite and hyalite. The flows consist of a relatively well crystallised main zone, which becomes increasingly vesicular towards the vitreous, scoriaceous top. Faujasite is most abundant in these glass-rich, highly porous zones (Lorent 1933). Compared to other Kaiserstuhl rocks, alkalis are relatively low in limburgite (1.20 % K_2O , 2.50 % Na_2O), whereas alkaline earths are considerably higher (12.23 % CaO , 11.55 % MgO).

Gain and loss of element mass transfer shows the relationship between glass decomposition and element release during the palagonitisation processes. Essential chemical components (Mg, Ca, Na, K, Al and Si) were directly released from the sideromelane glass and immediately consumed for faujasite growth in the pore space of the rock.

The presence of easily alterable Mg-rich glass, high porosity and fluid flow are promoting factors for the formation of faujasite in this example. However, the exact parameters for faujasite growth in natural systems are not well understood. More work is necessary to reconstruct the thermal evolution and changes in fluid composition during zeolitisation of the limburgites of the Kaiserstuhl Volcanic Complex.

References

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