Zeolitization of a phonolitic pyroclastic ash flow by ground water in the Laach volcanic area, Germany

BERNHARD, F. and BARTH-WIRSCHING, U. Institute of Engineering Geology and Applied Mineralogy, Graz, Austria.

The up to 35 m thick phonolitic pyroclastic ash flows of the Laach volcanic eruption, Germany, are zeolitized in three, up to 10 m thick layers. These layers are intercalated by fresh ashes. The fine-grained, vitreous ash particles of the matrix are variably altered to chabazite, chabazite + phillipsite + analcime, phillipsite + analcime or analcime + K-feldspar. K-feldspar occurs only in the lowermost zeolitized layer. Pumice clasts within the zeolitized matrix are altered to chabazite throughout the whole deposit, despite the same precursor glass chemistry.

Experiments (0.5, 1 or 2 g of ground, fresh pumice as starting material, 25 ml H_2O, 0.01n NaOH, KOH, NaCl and mixtures as reacting solutions, 100-200°C, 8-400 days reaction time, unstirred system) showed that chabazite and phillipsite represent transition phases with respect to analcime and K-feldspar at all conditions. A high solid/liquid ratio speeded up the beginning of zeolite formation, but slowed down the conversion of phillipsite to analcime and K-feldspar. Predominantly chabazite forms experimentally at temperatures > 100°C only with a slight increase of the K/Na ratio of the reacting system. At 100°C, no increase of the K/Na ratio is necessary to produce large amounts of chabazite as metastable transition phase.

Judging from the field and experimental data, formation of zeolites and K-feldspar most probably took place in the fringe water zone above temporally changing paleo-ground-water levels. Small-scale mineralogical differences between matrix and pumice clasts are probably the result of differences in specific surface between the precursor glass and the first authigenic mineral formed, chabazite, and hence their different reactivity.