Diagenetic mordenite from Ponza, Italy

ELIO PASSAGLIA*, GILBERTO ARTIOLI**, ALESSANDRO GUALTIERI* and ROBERTA CARNEVALI*

* Dipartimento di Scienze della Terra, Università di Modena, Via S.Eufemia 19, I-41100 Modena, Italy
**Dipartimento di Scienze della Terra, Università di Milano, Via Botticelli 23, I-20133 Milano, Italy

Abstract: Diagenetically altered rhyolitic rocks consisting of major mordenite and minor cristobalite and smectite occur beneath a thick (about 90 m) smectite-rich layer in an abandoned quarry at Cala Fontana, in the northwestern part of the Ponza Island (Thyrrenian Sea, Gulf of Gaeta). The structure of the mordenite was refined by full-profile Rietveld analysis on X-ray powder diffraction data. Quantitative mineralogical analysis of the specimen having the highest zeolite content from the Rietveld-refined phase-scale factors yield: mordenite 72.8 %, smectite 2.0 %, cristobalite 5.9 %, illite 3.0 %, sanidine 13.9 %, augite 2.4 %. The chemical composition of the mordenite from electron microprobe analysis resulted in a content of tetrahedral atoms \[\frac{\text{Si}}{(\text{Si} + \text{Al})} = 0.83\] in agreement with the range (0.80-0.85) known for this zeolite. Both the chemical analysis and the structure refinement showed a high K content among the extraframework cations. The assemblage of the authigenic minerals is interpreted as the result of diagenetic alteration of the rhyolitic glass by meteoric or ground water in an hydrologically open system, and the crystallization of mordenite instead of the most common smectite is interpreted as due to locally high pH conditions.

Key-words: mordenite, diagenesis, Ponza Island, Rietveld analysis, electron microprobe analysis.

Introduction

Mordenite is an orthorhombic, silica-rich zeolite occurring both as macroscopic fibrous crystals clustered in vugs of massive igneous rocks (often but not exclusively attributed to hydrothermal genesis), and as diagenetic micrometer-size fibers in silicic tuffs (sedimentary genesis).

The chemistry, as determined on samples from igneous rocks (Passaglia, 1975) shows only small variations; the tetrahedral sites are occupied by Si in the range 80-85 % and the extraframework cations are mainly Na and Ca (normally Na > Ca), with minor K. Reliable chemical analyses of sedimentary mordenite are very scarce, mainly due to the difficulty of obtaining pure material; however, reported analyses in the literature generally show a remarkable K enrichment with respect to mordenite samples from igneous rocks.

In Italy, mordenite samples from basalt vugs are quite common (occurrences quoted in Passaglia, 1975; Brigatti & Gottardi, 1971; Pongiluppi, 1974; Pongiluppi et al., 1974; Vezzalini & Alberti, 1975; De Michele, 1976; De Gennaro et al., 1977), but one sample of diagenetic mordenite has been reported (Island of Ponza: Lombardi & Mattias, 1981; Carmassi et al., 1983; Pozzuoli, 1988). The complete structural and crystal-