Diagenetic chabazites and phillipsites in Italy: crystal chemistry and genesis

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Abstract: Diagenetic phillipsites and chabazites are the main constituents of many Italian zeolitized volcanoclastic deposits. Due to their high zeolite contents and broad extent, many of them are of great economic potential. An overview of the chemistry of these phillipsites and chabazites is presented here. The samples show chemical peculiarities which are closely correlated with the chemistry of their parent glasses and diagenetic environments of crystallization. The observed chemical trends reflect the following zeolitization processes:

a) samples crystallized in “hydrologically open systems” or “geoautoclaves” from alkali-potassic glasses of intermediate acidity (phonolitic, trachytic compositions) or low acidity (tephritic compositions) are peculiarly high in K and display, respectively, low or very low Si/Al ratios;

b) the low Si/Al ratios and high Na contents of samples from the Vivara hyaloclastites agree with the trachybasaltic composition of the parent glass and a diagenetic marine environment;

c) the low Na and high Ca contents of both chabazite and phillipsite from Iblean hyaloclastites are explained by cation exchanges successive to their crystallization in a marine environment.

Key-words: zeolite, chabazite, phillipsite, crystal chemistry, diagenesis.

Introduction

The rock-forming zeolites, usually crystallized during diagenesis of volcanic glasses, clay minerals, feldspars, feldspathoids and gels, are currently termed “Sedimentary Zeolites”.

Unlike the large attractive zeolite specimens in basalt fractures, the sedimentary zeolites are fine-grained and do not appeal to mineral collectors, nevertheless, they are economically important resources for present and future applications in animal husbandry, agriculture, aquaculture and water purification (Mumpton, 1984).

Among the 44 countries known for sedimentary zeolite occurrences, Italy appears particularly rich in chabazite and phillipsite. On the basis of its geological environment, Italy presents good prospects for future discoveries (Hawkins, 1984).

Sedimentary zeolites in Italy are made up of only six mineral species: phillipsite, chabazite, clinoptilolite, mordenite, laumontite and analcime (Gottardi & Obradovic, 1978; Sersale, 1978). Except for analcime and laumontite, the above zeolites are suitable for many important applications, and, whereas clinoptilolite and mordenite occurrences are limited, widespread chabazite and phillipsite occurrences are common. Many of them may be economically important on account of the high modal zeolite content (up to 70—80 %) (Aiello & Porcelli, 1974; Sersale, 1978; De Gennaro & Franco, 1988) and the wide extent of the deposits.

The geological, petrographic and mineralogical features of these occurrences have been reviewed by Gottardi & Obradovic (1978) and by Sersale (1978). The crystal chemistry and zeolite content of the most important deposits have also been the object of many papers (Ciambeli et al., 1981; De Gennaro et al., 1982; Passaglia & Vezzalini, 1985; De Gennaro & Franco, 1988), but none of these works gives an exhaustive picture of the crystal chemistry of sedimentary chabazites and phillipsites in Italy. Moreover, only few data on the chemical variability of a certain zeolitic species are available within very large deposits. Studies of