Heulandite-group zeolites in volcaniclastic deposits of the southern Basin and Range province, Mexico

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Abstract: Volcanogenic sandstones and conglomerates of the molassic Baucarit Formation of northern Mexico, Sonora State, fill intermontane extensional basins generated by the Miocene Basin and Range tectonics. Their cements consist of heulandite-group zeolites (up to 40% of rock volume), smectites and calcite or silica minerals. Heulandite-group zeolites have been distinguished by their thermal stability and chemical composition. The calcium content of all the heulandite-group minerals, clinoptilolite included, is very high, frequently exceeding 50% of the total exchangeable cations. These calcic heulandite-group zeolites have been formed by reaction of acidic ashes and lithic fragments with interstitial water. Minor compositional changes have been observed and two kinds of variations have been distinguished: (i) variation from one basin to another; (ii) variation between heulandite cementing sandstones and heulandite replacing glassy volcanic fragments, the latter being more siliceous than the former. These two kinds of variations are related to the strong influence of the chemical composition of source materials, although the second one might also be controlled by the permeability of the sandstones and by the rate of temperature increase. The presence of heulandite suggests a widespread hydrothermal activity and a steep geothermal gradient in the region during the Miocene.

Key-words: zeolite, heulandite, clinoptilolite, very low-grade metamorphism, Basin and Range, Mexico.

1. Introduction

The sedimentary heulandite-group zeolites generally form as alteration of rhyolitic glassy materials (Hay, 1966). Occurrences in southwestern United States are widely scattered throughout the Basin and Range province and belong to Oligocene to late Quaternary basin infill deposits (Defffeyes, 1959; Hay, 1966; Sheppard, 1971). Different types of zeolite deposits have been recognized throughout the province: (1) deposits in closed hydrologic systems such as saline, alkaline lakes (Sheppard & Gude, 1973; Surdam & Sheppard, 1978), (2) deposits in open hydrologic systems, formed by water percolating through a sedimentary pile (Hoover, 1968; Walton, 1975; Broxton et al., 1987), (3) deposits formed by low-grade burial metamorphism (Moncure et al., 1981).

In the southern Basin and Range province, Mexico, the study of sedimentary zeolite deposits has just begun to receive attention (Gonzales, 1987; Villaescusa, 1987). Throughout the Sonora State, these deposits are mostly represented by altered ash-fall deposits, Pliocene to Pleistocene in age (Villaescusa, 1987). They unconformably overlie a well indurated sedimentary formation, with characteristic ruinistic landform, named Baucarit Formation by King (1939). In a preliminary work Cochemé et al. (1988) pointed out the presence of a cement of heulandite-group minerals in a locality of the formation. The present research has been undertaken to determine, on a