The Genesis of a Mordenite Deposit by Hydrothermal Alteration of Pyroclastics on Polyegos Island, Greece

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Abstract: The vitric component of the silicic pyroclastic flows and surge deposits (Prassa ignimbrite unit), from the northwestern exposures of the pyroclastics formation of Polyegos Island, South Aegean Sea Volcanic Arc in Greece, is replaced by authigenic zeolite and clay minerals. Mordenite dominates, and clinoptilolite (heulandite type 3), illite and illite-smectite (I—S) are subordinate. Opal-CT, quartz, feldspar, biotite and halite complete the mineralogical suite. In the southwestern part of the pyroclastics formation (Myrsini pyroclastics unit), kaolinite, halloysite, alunite and amorphous silica are the major mineralogical constituents as a result of a strong hydrothermal alteration by solutions enriched in SO_4^{2-}. Scanning electron microscope (SEM) examination proved that the 1st type of zeolites formed within the area were heulandite minerals, following the formation of smectite, as a result of the activity of pore fluids within the volcaniclastic pile. There was no substantial evidence to support a hypothesis that mordenite was formed with the heulandite minerals after the initial stages of glass dissolution, other than some very minor mordenite that was formed from a gel-like type of material. The majority of mordenite present is most often draped over and formed from the crystals of heulandite minerals. Heulandite minerals often show advanced dissolution effects. The mineral dissolution was due to the emplacement of rhyolite lava domes and flows and the associated temperature rise and circulation of hydrothermal fluids, which had also mixed with seawater. The volcanic activity raised the temperature and changed the pore fluid chemistry, and the more unstable members of the heulandite minerals group were transformed to mordenite. Clinoptilolite (heulandite type 3), which was found within a few samples, was thermally more stable than any heulandite type 1 or 2 phases initially present. Therefore, clinoptilolite was either transformed more slowly or within a very few cases, it has not been affected at all. A heulandite-minerals-derived material acted as the major precursor for the formation of mordenite. The temperature increase within the area and the later hydrothermal alteration effect are also indicated by the illitization of the smectite. Mordenite is also found to have formed from I—S clays. Overall, mordenite formed as a result of elevated temperature and high Na^+ concentration.

Key Words: Clinoptilolite • Greece • Heulandite • Hydrothermal Alteration • Mordenite • Polyegos • Pyroclastics • Rhyolite • Zeolites

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