PETROGENESIS OF BENTONITES

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ABSTRACT

The formation of typical bentonites occurs in two stages. The first stage comprises the development, transportation, and deposition of the volcanic ash, which determines the geometry and structure of the bentonite rock and influences the alteration of the ash during the second stage. The second stage encompasses the alteration of volcanic glass to montmorillonite and other minerals.

The distribution of ash particles in the bentonite beds of Wyoming is satisfactorily explained by a theoretical model based on equations similar to heat flow equations. An extended model, assuming a disk-shaped volcanic cloud containing ash particles, also accounts for the geometrical shapes and geographic variations of the textural parameters of the bentonite beds.

The alteration of Wyoming bentonite ashes to montmorillonite occurred undoubtedly at low temperatures in an aqueous environment. Petrologic evidence indicates that all of the Wyoming ashes and many ashes deposited elsewhere contained sufficient magnesium to form montmorillonite with no addition necessary from without. Also evidence indicates variations of pH of perhaps 5 to 8 made little difference in the alteration products of the ashes.

Laboratory evidence of the processes and products of alteration of ashes to bentonite accord with field observation. With simplifying assumptions, the formation of montmorillonite from volcanic glass may be elucidated from the viewpoint of the stability of montmorillonite with respect to other similar minerals. The results of theoretical calculations of the mineral stabilities will be presented. Three energy parameters will be considered: the Coulomb energy, Van der Waals' repulsion, and the London energy Thermal motion of the atoms will be taken into account.

https://doi.org/10.1346/CCMN.1963.0120117 Published online by Cambridge University Press