
Identification and Structure of Two Types of Allophane from Volcanic Ash Soils and Tephra

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Abstract: Samples containing allophane with molar Al/Si ratios from 1.0 to 2.0 have been examined by infrared spectroscopy, X-ray fluorescence, and phosphate adsorption methods. The infrared spectra of allophane with Al/Si ratios close to 2.0 showed that the wall of the allophane spherules is made up of imogolite structural units similar to " proto-imogolite." X-ray fluorescence gave no clear evidence of Al in tetrahedral sites (Al^{IV}), while pyridine adsorption results suggested that a small number of Bronsted acid sites ($Al^{IV}OH$) are present in silica-rich allophanes. Lewis acid sites (AlH_2O) are present in both silica-rich and alumina-rich allophanes. The results suggest that the framework for the allophane structure is an Al octahedral sheet.

Allophanes with Al/Si ratios close to 1.0 contain condensed silicate units either on the outside surface of the Al octahedral sheet, giving rise to a halloysite-like structure, or bonded on the inside surface of an imogolite-like structure. Allophanes with Al/Si ratios between 1.0 and 2.0 appear to be mixtures of the " proto-imogolite" structure and the allophane (Al/Si = 1.0) structure.

Key Words: Allophane • Deuterium exchange • Halloysite • Imogolite • Infrared spectroscopy

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