Structure of short-range ordered aluminosilicates in andic horizons of volcanic soils

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Very high levels of C content characterize Andic horizons of volcanic soils. Stabilization of organic matter is due to the presence of short-range ordered aluminosilicates (imogolites, allophanes or proto-imogolites). These phases are often characterized through selective chemical extractions from which the "allophane" content is calculated. However, chemical dissolutions preclude the characterization of the structure of the short-range ordered aluminosilicates. Imogolite is easily distinguishable because of its tubular structure, whereas allophane compounds—usually described as spheres—are harder to identify, especially because of their variable structure and occurrence patterns. In addition, the local structure of allophanes can be very similar to that of proto-imogolite (imogolite precursor). Strangely, this similarity is seldom considered in most characterization studies. In this context, our study focuses on the structure of two short range-ordered aluminosilicates of two different origins, from: (i) an Andosol B horizon (Andosol sample); and (ii) a weathered pumice grain (pumice sample). These natural samples were compared to a synthetic proto-imogolite. The three samples were analyzed using experimental tools that are commonly used for the identification of these nanophases (chemical composition, X-ray diffraction, nuclear magnetic resonance, Fourier transform infrared spectroscopy and transmission electron microscopy). The three samples exhibited the same local structure, but significant differences were observed at a larger scale. The pumice sample clearly showed ring-shaped particles, while the Andosol sample and the synthetic proto-imogolite were amorphous. Our results suggest that poorly ordered proto-imogolite, rather than allophanes, is present in Andosol horizons.

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