

Visualization of 3-D ped structure of undisturbed clay using high resolution X-ray CT at SPring-8

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Mechanical properties of clay are governed by its microstructure and microstructural interaction. A clay particle is composed of crystalline thin layers and its average size is less than 1 micron. The particle interaction can be described by three types of force; the double-layer repulsive force, the van der Waals attractive force, and the mechanical contact force. These forces cause the particles to group together into a larger structural unit, which is called “ped”. It is believed that the size of a ped ranges from 1 micron to over 50 microns, depending on the material property and the chemical circumstances. Marine clay often has a relatively large ped structure.

This kind of microstructure has been observed by SEM so far, though it cannot provide us the 3-D information. Therefore we attempt to capture a 3-D ped structure of undisturbed marine clays. Since the spatial resolution of the X-ray CT system at BL47XU reaches around 1.0 micron for a specimen of 1.0mm in diameter, it may be sufficient to detect a relatively-large ped structure. Several undisturbed clays, including Ariake clay (void ratio; the ratio of void volume to the solid

volume, $e \approx 3.7$), Osaka bay clay ($e \approx 2.0$), Okayama diatom soil, Numazu loam and so on was used in this experiment. Among them, Fig.1(a) shows an example of reconstructed CT image of Ariake clay. Apart from some relatively large silt particles, small network can be recognizable, which may indicate the microstructure of clay matrix. In order to quantify such microstructure in 3-D, it is necessary to distinguish the clay matrix from the void by a binarization process. However, when the threshold grey-scale intensity is chosen based on the measured void ratio (black/white=3.7), the obtained Fig.1(b) cannot properly describe the microstructure. Therefore it is necessary to establish a reasonable way to determine the appropriate threshold. In Fig.1(c), where the most frequent value in the image is chosen as the threshold, the image seems to well describe the microstructure.

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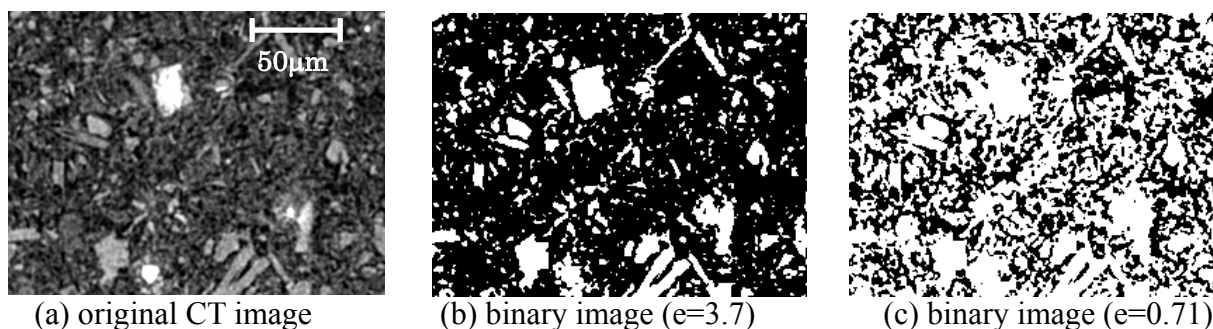


Fig.1 Identification of ped and pore (Ariake clay)