Potentials of numerical X-CT analysis over sedimentary core materials, obtaining geological sequences at ultra-high resolution

*Hirofumi Asahi[1], Minoru Ikehara[1], Kato Koudai[1], Masafumi MURAYAMA[1], Keiji Horikawa[2], Katsuya Nejigaki[3]

1. Kochi University, 2. Toyama Universitt, 3. Fukada Salvage and Marine Works CO., LTD

X-ray Computer Tomography (X-CT) has been a powerful tool allowing rapid visualizations of internal structures of sedimentary cores. Such non-destructive approach providing structural variations at ultra-high resolution. Although their intriguing implications (e.g. evaluating Physical properties and mineral fractions from CT values) by recent studies has highlighted their promising usages, there is still large requirement of CT values within geological materials, to establish unified/unanimous method. Using ultra-high X-CT data from marine sediment cores, we present a novel approach/method distinguishing various sediment constitutes, understanding sediment sequences, using a medica X-CT (TOSHIBA Aquilion PRIME FOCUS), installed at Center for Advanced Marie Core Research, Kochi University. The instrument can obtain CT values at resolution of 0.45 mm (X-Y plane) at 0.5 mm (Z-plane) slice intervals, respectively. The histogram of CT values throughout core samples suggest that they can be described as the Gaussian Mixture distribution model (GMM), consisting of multiple normal distributions (populations). For instance, histograms of CT values of a core taken at the Antarctic realm (KH19-6 PC01) showed three major peaks: (a) a sharp peak at ~-1000, (b) small peak at ~0, and (c) broad prominent peaks around ~1000. Concerning the value peak (a) is likely reflecting air (empty place), whereas (b) represents plastic outliers (cases) of sediment samples or slurry sediments, respectively. The broad peaks (c) is likely expressing marine sediments, which can be statically spitted (clustered) into various populations. Pixel numbers of each cluster along multiple slices clearly represent variations of sediment constitutes, suggesting potentials of our approach obtaining ultra-high sediment sequence variations. Voxel-scale X-CT values of sediment cores can further be used detecting specific materials contained. The marine sediment at high latitude likely contains stone-sized hard materials delivered from sea ice (IRD: Ice rafted debris). Using the histogram obtained, detailed setting for IRD estimations is evaluated. Resemblance of slice-along variations of total numbers of voxels expected to be IRD (IRD-voxels) and actual IRD particle counts indicates their potentials for further palaeoceanographic usage. Although, implication of IRD-voxels directly into IRD counts need careful/advent evaluation, IRD-voxels are only quantitative data not representing particle numbers within sediments.

Keywords: X CT, sequential identification, BIg data processing

