A new method for measurement of core quality using X-ray CT data of IODP Expedition 370

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Geological drilling aims to obtain high-quality cores for various purposes, such as the studies of mineralogy, physical properties and subsurface biogeochemistry. It is critical to quickly evaluate the quality of the drilled cores to assess the level of recovery, decide drilling methods, identify intervals for subsampling and estimate the extent of contamination by drilling mud or seawater. X-ray computed tomography (CT) is a powerful tool which shows the distribution of materials, drilling disturbance and geological structures throughout the core in three dimensions. X-ray CT can be carried out without splitting the cores or opening core liners and hence is efficient for core evaluation and desirable for studies sensitive to contamination and disturbance. X-ray CT is generally used as a qualitative method so far. Here we introduce the Core Quality Factor (CQF) as a quantitative method for analyzing and comparing core qualities using X-ray CT data.

Each pixel in X-ray CT images gives a CT number depending on the density of the material, for example, 0 for air (unrecovered area) and 2500 for standard aluminium. The CQF method first examines a cross-sectional slice of the core section at one depth, producing a histogram of numbers of pixels against CT numbers for the slice. The major material in the slice gives a dominant CT number and produces a peak in the histogram. Pixels with CT numbers higher than a threshold (e.g. 70% of the dominant CT number) are considered ‘high-quality slice’. We repeat this at intervals of 0.625 mm throughout the entire core section. Then we can calculate the CQF score which is the percentage of ‘high-quality slice’ among all slices in the section.

We applied the new method to the X-ray CT data at Site C0023 of IODP Expedition 370. The X-ray CT measurements were made on 598 sections from 189 to 1177 mbsf. The X-ray CT instrument on the *Chikyu* is a Discovery CT 750HD (GE Medical Systems) capable of generating thirty-two 0.625 mm thick slice images every 0.4 s, the time for one revolution of the X-ray source around the sample. The CQF scores are lower than 70% at intervals 189–430 mbsf and 1100–1177mbsf, matching the shipboard geological observation of sandy or soupy sediments and heavy drilling disturbance at these intervals. The CQF scores are above 80% at intervals 540–630 mbsf, 710–790 mbsf, and 860–1080 mbsf. The high CQF scores representing high core quality are in line with geological description of firm sediments and minor drilling disturbance at these intervals.

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