Developing efficient methods to collect and observe microfossils of fish teeth (ichthyoliths) from pelagic clay for determining depositional ages of pelagic clay

*Kazuhide Mimura[1], Shugo Minabe[1], Junichiro Ohta[1,2,3], Kentaro Nakamura[1], Kazutaka Yasukawa [1,2], Koichiro Fujinaga[2,1], Kazuhiro Takao[1], Yasuhiro Kato[1,2]

1. Department of Systems Innovation, School of Engineering, the University of Tokyo, 2. ORCeNG, Chiba Institute of Technology, 3. JAMSTEC

Deep-sea sediments record paleo-environmental changes thorough geologic time. Among them, pelagic clay is one of the most widely distributed sediment in global ocean and thus is an important medium recording changes of atmospheric/oceanic circulations and surface ocean productivity that occurred in pelagic realm [1]. Although studies on pelagic clay [e.g. 2] have suggested that pelagic clay has significant variations in bulk geochemistry, possibly reflecting long term environmental changes, less attention has been paid to pelagic clay due to a difficulty in determination of depositional age.
It has long been recognized that determining depositional ages of pelagic clay is a challenge, because age-diagnostic calcareous/siliceous microfossils are seldom contained and paleomagnetic records are often ambiguous. Our studies [2,3] have shown that biostratigraphy of 'ichthyoliths' (microfossils of fish teeth and denticles [e.g. 4]) provide key constraints on depositional age of pelagic clay. However, traditional methods for collection and observations of ichthyoliths were troublesome; ichthyoliths were concentrated from samples by sieving and then manually picked from sieved samples to slide glasses under stereomicroscope. Therefore, observing enough amount of ichthyoliths from various samples is time consuming.
To overcome the problem, we first constructed a new method to concentrate a lot of ichthyoliths in a short time. We found that a combination of elutriation and heavy-liquid separation effectively accumulates ichthyoliths from pelagic clay. We then developed a method for direct detection of ichthyoliths by utilizing a slide scanner and deep learning-based technologies called 'Mask R-CNN' [5]. We are now improving the accuracy of the model. The latest results will be shown in the presentation.

References : [1] Kyte et al. (1993) *Geochim. Cosmochim. Acta* **57**, 1719-1740. [2] Mimura, K et al. (2019) *JpGU Meeting 2019*. [3] Minabe, S et al. (2019) *JpGU Meeting 2019*. [4] Doyle and Riedel (1985) *Init. Repts. DSDP* **86**, 349-366. [5] He et al. (2017) *Proc. IEEE ICVC*, 2961-2969

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