AI based automatic microfossil counting system and its appication for the Pleistocene *Cycladophora davisiana* curve in the Southern Ocean

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Cycladophora davisiana is a radiolarian species widely distributed in the world ocean. Because it is known that this species significantly increased its abundance during the Pleistocene glacial intervals in the sub-arctic and sub-antarctic areas, the abundance curve has been used as an important tool for the Pleistocene stratigraphy or paleoceanography in these areas. However, it is not always collect such dataset due to recent lack of micropaleontologists who has a high degree of skill for identification of radiolarian species. In addition, traditional mictroscopic work needs a large effort and time for observing microfossils, even if the micropaleontologist agree with your collaboration.

In order to avoid these problems, we therefore have developed a new instrument for automatic microscopic image collector equipped with an AI (deep-learning) software. The instrument used in this study is composed of a digital microscopic system with motorized X-Y stage, and the deep-learning software is instolled in the operating computer. A large amount of microscopic image can be collected by the microscopic system and identify them by the deep-learning.

In this study, automatic counting of radiolarian species *Cycladophora davisiana* for estimation of its relative abundance (%) in total assemblage was conducted using this system. Microscopic images as tranning dataset were collected from Holocene and the last glacial sediments of core DCR-1PC in the Southern Ocean. The deep-learning classification model was constructed based on ~10,000 images divided into 5 categories of *C. davisiana*, *C. bicornis*, other radiolarians, shell fragments and diatoms. In results of classification based on this model for several test slides, microscopic images more than 90 % classified as *C. davisiana* were correct (>95 % confident level). Moreover, the model based *C. davisiana* % [=*C. davisiana* / (*C. davisiana*+ *C. bicornis* + other radiolarians)] ranging between 2 and 20 % shows high correlation (r=0.98) with real data counted by researcher. Therefore, high-resolution record of the *C. davisiana* % curve in the Southern Ocean can be obtained efficiently using our system.