

X-ray computed tomography characterization of the distribution of biogenic apatite and sedimentary structures in pelagic clay around Minamitorishima Island, western North Pacific

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The apparent absence of visible sedimentary structures in pelagic clay often hampers their systematic classification into lithostratigraphy. On the other hand, large variation in biogenic apatite content in some pelagic clay has been recently recognized. Because the density of apatite is higher than the bulk of pelagic clay, the spatial distribution of apatite may be detected through physical properties to detect sedimentary structures. Biogenic apatite in pelagic clay hosts rare earth elements and yttrium (REY), so capturing their distribution is also important for resource exploration. Here we examine non-destructive X-ray computed tomography (CT) in comparison with chemical analysis of REY and P_2O_5 for piston cores obtained around Minamitorishima Island. The depth profile of CT-based density estimates matches well with the direct measurements of bulk density and gamma-ray attenuation data. The density profiles also show clear positive correlation with the REY and P_2O_5 profiles. Some deviation is attributed to the presence of micro Mn nodules, which show characteristic textural pattern on CT images and are easy to distinguish. Moreover, X-ray CT reveals the relationship between sedimentary structures and the distribution of biogenic apatite: biogenic apatite can be transported vertically by bioturbation (burrowing) for more than 30 cm, while there are thin (<10 cm) layers of high apatite content where burrowing is less severe. These features can be overlooked by visual inspections or conventional chemical analysis of discrete samples. Our results demonstrate X-ray CT as a rapid and complementary tool to study biogenic apatite and REY distribution as well as sedimentary structures within pelagic clay.

Keywords: pelagic clay, X-ray CT, sedimentary structures