Stratigraphic heterogeneity in the Yangtze River subaqueous delta revealed by chronological and mineral magnetic approaches

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Delta deposits show large spatial heterogeneity in terms of depositional rate and age, which is critical to the study of delta erosion in response to the declining fluvial sediment load observed at many river mouths in the world. In this study, we demonstrate the magnetic susceptibility (χ) as a rough indicator to reveal age variations and stratigraphic heterogeneity in the Yangtze River subaqueous delta. Ages of three short sediment cores (<2 m) collected at 20-32 m water depth from the Yangtze River subaqueous delta were determined using ²¹⁰Pb, ¹³⁷Cs, and optically stimulated luminescence (OSL) dating. In addition, depth variation of χ, which is influenced by post-depositional diagenesis and hence age, was used to roughly estimate sediment ages among the cores in a quick way. The profiles of ²¹⁰Pb, ¹³⁷Cs, and OSL results indicate the spatial variability of ages, ranging from the last 100 years to more than 2000 years. Cores at shallow water depths are younger than those from deeper sites. Modern deposits (i.e., <100 years old) occur primarily at water depths shallower than ca. 30 m, which can be explained by the trapping depth of bottom plumes. The Core in the northern part of the subaqueous delta shows much older ages than the core at the southern site with similar water depth, which is caused by their distance relative to the mouth of active sediment discharge distributary. Profile of χ confirms such spatial variation of ages in terms of depth distribution pattern and χ value. Older sediments show lower and uniform χ values due to the reductive dissolution of ferrimagnetic minerals, while younger sediments show higher χ values in the top layer but they decline with increasing depth. Considering the quick way of magnetic measurement, stratigraphic correlation based on χ can be used first to screen for cores before they are subjected to more detailed dating. This study shows that the methodological approach of combining sediment dating with magnetic measurement has great potential in revealing heterogeneous deltaic deposits, which could be easily neglected in morphodynamical and biogeochemical study.