Origin and abrasion process of mud clasts in turbidity currents: A case study of the lower Pleistocene Otadai Formation, Kazusa Group central Japan

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The abrasion process of mud clasts in turbidites and debrites are investigated by the elliptic Fourier shape analysis of outcrop photographs in this study. As a result, the shape analysis of mud clasts suggests that intense abrasion occurs in turbidity currents while mud clasts contained in debris flows retain their angular shapes. Here we discuss the relationships between reconstructed flow properties and mud clasts preservation.The abrasion process of mud clasts in turbidites and debrites are investigated by the elliptic Fourier shape analysis of outcrop photographs in this study. As a result, the shape analysis of mud clasts suggests that intense abrasion occurs in turbidity currents while mud clasts contained in debris flows retain their angular shapes. Here we discuss the relationships between reconstructed flow properties and mud clasts preservation.

Mud clasts are gravels of mudstone which occur in sandy deposits such as turbidites or debrites. Recent studies suggest that the mud clasts in turbidites are generally originated from rip-up clasts eroded from the sea floor. Besides, the abrasion process of these unconsolidated mud clasts can be a trigger of flow transformation in which sandy turbidity currents turn to muddy debris flows. Thus, the origin and abrasion process of mud clasts in turbidity currents are significant in terms of the understanding of the behavior of sediment gravity flows. However, there is few previous research pertaining to quantitative analysis of the origin and abrasion process of mud clasts.

In this study, variations in characteristics of individual turbidites and debrites were investigated in detail in the lower Pleistocene Otadai Formation distributed in Boso Peninsula, central Japan. It is suggested that the origin of mud clasts in turbidites in this area are rip-up clasts eroded from the surface of the seafloor. The elliptic Fourier shape analysis of outcrop photographs of mud clasts indicated that mud clasts in the turbidites reduce their size downstream and show rounded shape. On the other hand, the mud clasts in the co-genetic debrite-turbidites are relatively bigger and more angular than mud clasts in the turbidites. These facts imply that intense abrasion of mud clasts occurs in turbidity currents, while the clasts in debris flows were less abraded. If the abrasion process of mud clasts in turbidity currents causes flow transformation and the subsequent debris flow transports the mud clasts which are abraded by the original turbidity current, the mud clasts in debrites in co-genetic debrite-turbidite should be also well-abraded. There are two possible explanations for the angular shape of mud clasts in the co-genetic debrites. The first explanation is that mud clasts in the debrites of co-genetic debrite-turbidites have a different origin from well-abraded mud clasts in the turbidites. The second explanation is that flow transformation occurred much more proximal area than previously thought such as the submarine canyon. In future studies, the origin of mud clasts in debrite of co-genetic beds should be investigated.

Keywords: Turbidity currents, Flow transformation, Mud clasts, Elliptic Fourier shape analysis, Kazusa Group, Inverse analysis

