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Clay minerals behaviour in thin sandy clay-rich lacustrine turbidites (Lake Hazar, Turkey)

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Turbidites have been extensively studied in many different areas using cores or outcrop, which represent only an integrated snapshot of a dynamic evolving flow. Laboratory experiments provide the missing relationships between the flow characteristics and their deposits. In particular, flume experiments emphasize that the presence of clay plays a key role in turbidity current dynamics. Clay fraction, in small amount, provides cohesive strength to sediment mixtures and can damp turbulence. However, the degree of flocculation is dependent on factors such as the amount and size of clay particles, the surface of clay particles, chemistry and pH conditions in which the clay particles are dispersed.

The present study focuses on thin clayey sand turbidites found in Lake Hazar (Turkey) occurring in stacked thin beds. Depositional processes and sources have been previously studied and three types were deciphered, including laminar flows dominated by cohesion, transitional, and turbulence flow regimes (Hage et al., in revision). For the purpose of determine the clay behavior in the three flow regimes, clay mineralogical, geochemical measurements on the cores allow characterising the turbidites. SEM observations provide further information regarding the morphology of clay minerals and other clasts. The study is particularly relevant given the highly alkaline and saline water of the Hazar Lake.

Clay minerals in Hazar Lake sediments include kaolinite (1:1-type), illite and chlorite (2:1-type). Hazar lake water is alkaline having pH around 9.3, in such alkaline environment, a cation-exchange reaction takes place. Furthermore, in saline water (16‰, salts can act as a shield and decrease the repulsive forces between clay particle surfaces. So, pH and salt content jointly impact the behaviour of clays differently. Since the Al-faces of clay structures have a negative charge in basic solutions. At high pH, all kaolinite surfaces become negative-charged, and then kaolinite particles are dispersed, and the suspension is stabilized supported by our SEM observations. In alkaline water, kaolinite reveals a lower degree of consolidation. While, alkaline water has no measurable effect on illite and chlorite surface properties due to the absence of modifications in charge. Illite and chlorite form with other clasts clusters or aggregate structures in suspension when the particle interactions are dominated by attractive energies were formed. The aggregate structure plays a major part in the flow behavior of clay suspensions. Flocs will immobilize the suspending medium, and give rise to increasing viscosity and yield strength of the suspension.

S. Hage, A. Hubert-Ferrari, L. Lamair, U. Avşar, M. El Ouahabi, M. Van Daele, F. Boulvain, M.A. Bahri, A. Seret, Al. Plenevaux. Flow dynamics at the origin of thin sandy clay-rich lacustrine turbidites: Examples from Lake Hazar, Turkey, submitted to Sedimentology, in revision.