Lake Chala turbidites produced by surficial slope sediment remobilization: A mechanism to bring near-shore macrofossils to the deep basin with only limited time offset

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In paleoclimate and paleoenvironmental studies, turbidites are usually considered as interruptions of the sedimentary sequence and therefore ignored. However, turbidites are composed of sediments from the (shallow) slopes along the lake’s periphery where fossil assemblages are often different to those in the deep basin. Turbidites may thus be valuable as carriers of this near-shore proxy information to a profundal core site. However, as turbidites are composed of reworked (older) sediments, their fossil content can only be exploited if their “mean time offset” can be readily estimated or ascertained to be minimal.

Several recent studies have shown that turbidites can indeed form as a result of surficial slope sediment remobilization, a process – independent of slope failure – in which only a thin veneer (20 cm) of surficial sediment is being remobilized, for example by earthquake shaking, and subsequently transported by a turbidity current. However, demonstrating that this process is active in a basin and determining the remobilization depth, is challenging, especially in the absence of slope cores. Here we study the turbidite record of the 215 m (~260 kyr) long composite core of Lake Chala in the framework of the ICDP project DeepCHALLA. We analyzed its sediment color at a 0.5-cm interval using a spectrophotometer and determined the average color for each of the 391 thickest turbidites (> 3 datapoints) in the L*a*b* color space. For the entire dataset, we performed a linear regression of the turbidite color against the average color of different intervals (2-55 cm) of laminated sediment below. For each combination of paired values, the highest R² values are found for the upper 7-15 cm of matrix sediment below the turbidites, which can thereby be interpreted as the average remobilization depth. These results are mainly based on the a* value, which shows (i) relatively poor correlations between adjacent intervals of laminated sediment (thereby not smearing the signal), and (ii) the most constant values in sediments from across the basin as determined by short-core transects. Depth-dependent variations of sediment
color as determined from these transects further allows to estimate the water depth from which the turbidites were sourced.

Our results show that the sediments of most Lake Chala turbidites are 100-200 yrs older than the laminated sediments upon which they are deposited. We conclude that the turbidites can be used as 'sampling windows' to study temporal trends in macrofossils such as ostracods, chironomids and fish teeth, which are much more common along the basin periphery than in the deep basin.