EGU2020-21806, updated on 29 Oct 2020
https://doi.org/10.5194/egusphere-egu2020-21806
EGU General Assembly 2020

Paleoenvironmental indications and cyclostratigraphic studies of sediments from tropical Lake Towuti obtained from downhole logging

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Lake Towuti is a tectonic lake on central Sulawesi, Indonesia. It is located within the Indo Pacific Warm Pool, a convection cell which has major impact on tropical climate and the ability to project its influence on a global scale (Chiang, 2009; De Deckker, 2016). Pre-site surveys using seismic methods and piston cores indicated that sediments in Lake Towuti provide best conditions to obtain a long-term paleoclimate record in this key region (Russel et al., 2014).

During an ICDP-project in 2015, downhole logging equipment of the Leibniz Institute for Applied Geophysics was used at two drill-sites to record a series of chemical and physical parameters (spectral gamma ray, magnetic susceptibility, resistivity, sonic velocity, dipmeter, ultrasonic imaging of the borehole wall). Continuous lithological logs based on downhole logging data were constructed using cluster analysis. Although the spatial resolution of constructed logs is not as detailed as core descriptions, good correlation to core descriptions and differentiation between the upper lacustrine facies and the lower pre-lacustrine facies (Russell et al., 2016) show that cluster analysis is a powerful tool in giving an instant overview of in situ sediments and determining their physical properties.

Cyclostratigraphic methods in downhole logging can help developing a better understanding of sedimentation rates and thus improving age-depth models for lacustrine sediments (Molinie and Ogg, 1990; Hinnov, 2013; Baumgarten et al., 2015). In case of Lake Towuti, a magnetic susceptibility log from the upper lacustrine facies (0-98 meters below lake floor) was analysed to calculate changes in sediment influx. A careful pre-processing of the data is crucial to secure undisturbed amplitude spectra. This includes the identification and exclusion of event-layers (tephra and turbidite-like mass movement deposits) from the log. Also side effects of those layers to surrounding sediments were diminished from the record.

Sedimentation rates for certain parts were calculated and complement the preliminarily age model derived from ^{14}C- (Russel et al., 2014) and tephra-dating (A. Deino, personal communication, December, 2018). Further refining of the model and omission of an interpretation of long cyclicities results in the most detailed age-depth model for Lake Towuti, and thus is a fundamental step towards our understanding of paleoclimate processes in this region.