

Modern processes of sediment formation in Lake Towuti, Indonesia, as derived from the composition of lake surface sediments

Ascelina Hasberg (1), Martin Melles (1), Marina Morlock (2), Hendrik Vogel (2), James M. Russel (3), and Satria Bijaksana (4)

(1) Institute of Geology and Mineralogy, University of Cologne, Zùlpicher Str. 49a, 50674 Cologne, Germany, (2) Institute of Geological Sciences and Oeschger Centre for Climate Change Research, University of Bern, 3012 Bern, Switzerland, (3) Department of Geological Sciences, Brown University, Providence, RI 02912, USA, (4) Faculty of Mining and Petroleum Engineering, Institute Teknologi Bandung, Bandung 40132, Indonesia

In summer 2015, a drilling operation funded by the International Continental Scientific Drilling Program (ICDP) was conducted at Lake Towuti (2.75°S, 121.5°E), the largest tectonically formed lake (surface area: 561 km²) of the Republic Indonesia. The Towuti Drilling Project (TDP) recovered more than 1000 meters of sediment core from three sites. At all three sites replicate cores down to 133, 154, and 174 m below lake floor have penetrated the entire lake sediment record, which is expected to comprise the past ca. 650.000 years continuously. Lake Towuti's sediment record thus can provide unique information for instance concerning the climatic and environmental history in the Indo-Pacific-Warm-Pool (IPWP) and concerning the evolutionary biology in SE Asia.

For a better understanding of the palaeoenvironmental proxies to be analyzed on the drill cores, the modern processes of sediment formation in the lake and in its catchment - under known environmental conditions - were investigated on a set of 84 lake sediment surface samples. Sampling was conducted by grab sampler (UWITEC Corp., Austria) in a grid of 1 to 4 km resolution that covers the entire lake. The samples were analyzed for inorganic geochemical composition (XRF powder scans and ICP-MS), magnetic susceptibility (Kappabridge), grain-size distribution (laser scanner), biogenic components (smear-slide analyses), biogenic silica contents (leaching), and carbonate, total organic carbon (TOC), nitrogen (TN), and sulfur (TS) concentrations (elemental analyzer).

The sediments close to the lake shores and in front of the major river inlets are characterized by mean grain sizes coarser than average and high magnetic susceptibilities presented by high ratios of Cr, Ni, Co, and Zr. This reflects higher energies due to wave action and fluvial sediment supply, as well as the occurrence of magnetic minerals particularly in the sand and gravel fractions of the sediments. In regions of deeper waters and more distal to the shore the grain size and magnetic susceptibility decrease, but the organic carbon vs. total sulfur (C/S) ratio and the redox-sensitive elements such as U, Cd, Mo, and V increase. This suggests that sulfur accumulation in lake Towuti is controlled by autochthonous pyrite formation, in dependence on differences in redox conditions, rather than gypsum accumulation. Highest silicon (Si) concentrations appear in front of the four major inlets of Lake Towuti, however, a distinct maximum also occurs close to the southeastern shore, where larger river inlets are missing. Hence, the silicon distribution is partly controlled by fluvial input and partly by biogenic silica deposition; the latter is confirmed by high concentrations of pelagic and benthic diatoms as well as sponge spiculae in smear slides from the sediments at the southeastern shore.

Hence, the data thus far obtained on the surface sediments of lake Towuti show a strong influence of fluvial sediment supply and water-depth dependent redox conditions on the sediment composition. No indication, in contrast, was found for a significant influence of lake currents on the distribution of the sediments supplied by riverine input.