## Environmental Variation off Berau Delta, East Kalimantan Derived from Microfaunal and Heavy Metal Data from Subsurface Sediments

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The purpose of this study is to determine the environmental variations in East Kalimantan coastal waters in the recent past. This is done based on micropaleontological data and heavy metal concentrations in subsurface sediments, representative of environmental condition of the last 50 years. The study is part of a survey that investigates the environmental status of deltaic systems along Indonesian coastlines, the Mahakam and Berau Deltas.

Our results indicate that the coastal and marine system off Berau Delta, East Kalimantan, Indonesia is still in a good environmental condition compared to the large Mahakam Delta. Forty five subsamples of five short sediment cores were used for a microfaunal (ostracoda and foraminiferal) study. Twelve selected subsamples, taken at 20 - 110 cm depth, were analyzed for heavy metal contents, including Pb, Cr, Cu, and Zn, by AAS method. The age of the subsurface sediments at 90 cm depth in the core is derived from <sup>210</sup>Pb analysis and is approximately 49.50 years.

The study shows that the generally high diversity index of both ostracoda and foraminifera fluctuates throughout the cores. The index of ostracoda is between 0.69 (Site 18, in the southern part of the delta, at 50-52 cm depth) and 3.5 (Site 24 at 40-42 cm depth). The lowest index for foraminifera occurs at interval 90-92 cm depth at Site 26 close to the river mouth. The highest index occurs in surficial sediment at Site 24 that lies in the offshore area. A low diversity of microfauna is mostly found in the parts of the delta system where the industrial (pulp production and coal mining) are located. On the other hand, the low diversity index also occurs in several bottom parts of core samples. It means that the conditions reflected by a low index in the latter samples occurred before the increase in industrial activity in the 1990s. Therefore, a simple conclusion of a low diversity index representing high industrial activity cannot be derived. Rather, this result shows the high level of natural variability of the environments in the deltaic system of the study area.

The heavy metal concentrations in the sediments, however, appear to monitor well the industrial activities in the area, both spatially and over time. The range of values of heavy metal concentrations are wide, for Pb, 2.02 - 207.37 ppm; for Cr 20.03 - 90.25 ppm; for Cu 9.58 - 83.57 ppm; and for Zn 83.32 - 205.03 ppm. The highest contents of Pb, Cu and Cr were found at 110 cm depth below seafloor, at a site that is located close to industrial activities on pulp and coal mining. At the site, the lowest concentrations found were for Cu = 25.28 ppm; Pb = 2.02 ppm; Zn = 86.19 ppm and Cr = 32.71 ppm. These low concentrations can be assumed to be close to natural background levels of heavy metal concentrations, caused by human activities, can be viewed.