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Heavy Metals in Mangrove Surface Sediment of Mengkabong Lagoon, Sabah: Multivariate and Geo-Accumulation Index Approaches

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ABSTRACT: The inter-tidal mangrove environment of Mengkabong lagoon is important as it supports the local fishing activities, nursery grounds for many fish and shellfish species, and as well as being central for ecotourism activities. The study showed that in general, the physicochemical parameters (pH, salinity and electrical conductivity), granulometric fractions, organic matter, base cations (Na, K, Ca and Mg) and heavy metals (Fe, Cu, Pb, Zn and Al) showed increasing loadings at high tide compared to low tide. Multivariate statistical techniques, principal components analysis (PCA) and cluster analysis (CA), were employed to better interpret information about the sediment and its controlling factors. The PCA results revealed six controlling factors at high tide while seven at low tide. In CA there are two district clusters were identified at high and low tides. The calculation of geoaccumulation index (I_{geo}) suggests the Mengkabong mangrove sediments are having background concentrations for Al, Cu, Fe, and Zn and unpolluted for Pb.

Key words: Mangrove, Sediment, Tide, Multivariate analysis, Geo-accumulation index

INTRODUCTION

Mangrove sediments have been extensively studied all around the world (Malaysia, China, Australia, Brazil, India United Arab Emirates, and Thailand etc) and some of these studies assessed the pollution status of the sediments. For example, a study done by Kehrig, *et al.*, (2003) in Jequia mangrove forest, Brazil concluded that the mangrove forest has been polluted with heavy metals by the anthropogenic sources surrounding the estuary. Study done by Ramanathan, *et al.* (1999) concluded the concentration of heavy metals in Pichavaram mangrove forest, India were generally below the levels found in polluted and unpolluted estuaries and mangroves.

Heavy metal cycling is a serious problem addressed in mangrove environments (Marchand, *et al.*, 2006; Pekey, 2006). The high concentrations of heavy metals are derived from anthropogenic inputs from industrial activities around the estuary such as discarded automobiles, batteries, tires, waste water disposal etc (Shriadah, 1999). For an example, Shriadah (1999) found high concentrations of lead due to the inputs from oil spills from discarded automobiles in addition to petrol combustion while study done by Bloom and Ayling (1977) in the Derwent Estuary revealed high concentration of zinc and lead due to a zinc refining company situated near the estuary. Sediments act as sinks and sources of contaminants in aquatic systems because of their variable physical and chemical properties (Priju and Narayan, 2007; Pekey, 2006, Marchand, *et al.*, 2006; Rainey, *et al.*, 2003). Pekey (2006) demonstrated that heavy metals tend to be trapped in the aquatic environment and accumulate in sediments.A multivariate statistical approach allows the researhers to manipulate more variables (Davis, 1986). Principal Components Analysis

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