CHAPTER I

INTRODUCTION

Phosphorus is a key element in biogeochemical cycles because of its role as an essential nutrient. Due to the low concentration of bioavailable phosphorus in natural waters, phosphorus plays an important role in being a limiting factor of primary productivity in both fresh waters and marine ecosystems (Krom et al., 1991; cited in Filippelli and Ruttenberg, 1997; and cited in Huanxin et al., 1997).

The most important pathway of phosphorus transported from the continent to the sea is river. Natural weathering and erosion processes, municipal wastewater (degradation of polyphosphate in detergent) and agricultural activities (organophosphorus pesticides and fertilizers) are the ultimate sources of phosphorus entering into the river (Liss, 1976).

Only 5-10% of bioavailable phosphorus is thought to be carried to the oceans in dissolved forms (such as dissolved phosphate), the rest is presumably carried as inert phosphorus in fluvial detrital grains (particulate phosphorus) which cannot be immediately utilized by aquatic organisms (cited in Froelich, 1988; Horne and Goldman, 1994). Human activities have increased phosphate concentration in aquatic systems from the natural existing levels leading to the increased frequency of phytoplankton bloom and eutrophication in estuaries and coastal areas which ultimately affects on marine ecosystems (van Bennekrom and Salomon, 1979; Smith and Longmore, 1980; Horne and Goldman, 1994).

The studies of phosphate forms transported through estuaries were firstly undertaken by using mixing diagram which presents the relationship between dissolved phosphate concentration and salinity gradients along the estuaries (cited in Liss, 1976). The linear relationships between these two end-members found led many researchers (e.g., Albert et al. 1970; Hobbie, 1970 in review of Umnuay,1984; Umnuay, 1984) to believe that phosphate was transported through estuaries in conservative mixing manner. In other words, there is no phosphate addition to or removal from the water. They also believed that physical mixing process between freshwater and seawater was solely responsible for the dissolved phosphate concentration in those estuaries (chemical and biological processes were not taken into account).

In the later studies, non-linear relationships or non-conservative behaviors of phosphate were found in many estuaries. Carritt and Goodgal (1954) proposed that "phosphate is adsorbed onto particles in freshwater, transported in particulate form into estuaries and then desorbed from the particles in estuarine mixing zone". In addition, the finding of non-conservative behaviour of phosphate (by Pomeroy et al., 1965; Butler and Tibbitts, 1972; van Bennekrom et al., 1978; Morris et al., 1981; Sharp et al., 1982; Fox et al., 1985, 1986; Froelich, 1988) all indicated that particulate and sediment play an important role in controlling phosphate concentration. The concentration levels found are constant or slightly changed throughout the salinity gradients by adsorption-desorption processes, especially in the low primary productivity and short residence time estuary. This process is called "Phosphate buffering mechanism"

The discovery of this mechanism led the researchers to study, in the laboratory, phosphate adsorption onto various minerals and compounds (e.g. Iron(hydr)oxides, aluminium(hydr)oxides and clay minerals) which are the important components of particulate and sediment (cited in Froelich, 1988 and Lebo, 1991). It was found that phosphate can enter into particulate and sediment by both adsorption onto mineral surfaces (loosely sorbed-P) and into mineral lattices (lattice bound-P).

Accordingly, several attempts have been undertaken by using sequential extraction methods to investigate what forms of phosphorus associated with particulate and sediment and which is the dominant form that should play an important role in controlling dissolved phosphate concentration. However, the dominant form of

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phosphorus found was different in each estuary. This might be caused by chemical weathering processes of various parent rock materials and a wide variety of human activities along those drainage basins (see Lebo, 1991; Conley, et al., 1995; Eijsink et al., 1997; Huanxin et al., 1997; Vink et al., 1997). In addition, it might be due to the sequential extraction methods applied which are inherently different in the classification of extracted species, types and strength of extractants, extract conditions (temperature, duration of extraction, ratio of the sediment to the volume of extractant and grain size of sediment), sequence of extraction schemes and the steps involved in extraction schemes. Therefore, the phosphorus partitioning results from those studies cannot be compared.

The prime aim of this study is to compare the same phosphorus species extracted by Ruttenberg (1992)'s, Vink et al. (1997)'s, and Agemian (1997)'s sequential extraction methods in the same sediment. The comparison will employ Ruttenberg (1992)' s extraction scheme (SEDEX scheme) as a baseline because it was thoroughly developed and tested for its efficiency and specificity with the widest variety of analog phosphorus standards. Furthermore, the total phosphorus is also determined by Aspila method (Aspila et al., 1976) to confirm the results.

Objective

To compare phosphorus partitioning results obtained from selected sequential extraction methods in the same sediment.

Scope of this study

1. In this study, Ruttenberg (1992)'s, Vink et al. (1997)'s and Agemian (1997)'s methods were selected as the sequential extraction methods to extract the phosphorus species in sediments.

2. The comparison will employ SEDEX schemes (Ruttenberg, 1992) as a baseline.

3. To compare the phosphorus partitioning results extracted by various sequential extraction methods in the same sediment.

4. To compare only the same phosphorus fractionation extracted by various extraction methods.

5. Sediments to be analysed must have grain size less than 125 µm.

6. Do the same from 1-5 of the scope to the other river sediments.

Expected outcomes

1. This will be the pilot study to provide the preliminary phosphorus partitioning data from some Thai major river estuaries and the guideline for comparison of data obtained from different extraction methods.

2. The better understanding of phosphorus behaviour in estuaries can be used to assess the impact of phosphorus on estuarine and coastal ecology.

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