

Phosphorus forms in sediment and sedimentation flux in the East China Sea

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Core sediment samples were collected from the middle shelf of the East China Sea (ECS) to study the phosphorus forms, P accumulation rate, P burial efficiency and the burial flux in the ECS. The sediment samples were sequentially extracted and directly extracted to analyze different forms of sedimentary P: loosely sorbed P and iron-bound P (P_{CDB}); inorganic P associated with francolite (carbonate fluorapatite), biogenic hydroxyapatite, smectite, and CaCO_3 (P_{CFA}); detrital P (P_{detrital}); organic P (P_{organic}); and total P. In addition, the Fe contents in the citrate-bicarbonate-dithionite (CDB) extracted solution were also measured.

The total concentrations of P in the surface sediments in the study area ranged from 13.5 to 22.3 $\mu\text{mol g}^{-1}$. Inorganic P was the major form and accounted for 72% to 93% of the total P pool. The average percentage of each fraction of P followed the sequence: P_{Detrital} (70%) > P_{Organic} (15.5%) > P_{CDB} (8.4%) > P_{CFA} (5.8%). The distribution pattern of total P in the surface sediment was similar to that of P_{Detrital} and P_{Organic} , but different from that of P_{CDB} and P_{CFA} . The profile variation of P_{Organic} was the most significant among the phosphorus forms at the study stations. The concentrations of P_{CDB} and P_{CFA} showed minor variation with depth. These results may suggest that transformations of P_{Organic} , P_{CFA} and P_{CDB} occurred at the study stations during sedimentary P burial.

Based on the concentrations of total P, P_{CDB} and Fe_{CDB} obtained in the present study and the mass accumulation rate reported in the literature, the values of the P accumulation rate (PAR), the P diffusion flux (J_{PFe}) supplied by reducible iron hydroxides and the P burial efficiency were calculated. The calculated results for PAR and J_{PFe} in the study area ranged from 1.02 to 24.23 $\mu\text{mol cm}^{-2} \text{yr}^{-1}$ and from 0.1 to 2.11 $\mu\text{mol cm}^{-2} \text{yr}^{-1}$, respectively. The phosphorus burial efficiency was approximately 90%. The ECS is a phosphorus sink, and the average annual P burial flux has been reasonably estimated to be in the range of 20-25 $\times 10^9 \text{ mol yr}^{-1}$.