

PHOSPHATE DISTRIBUTION  
IN THE COASTAL WATER OF MALACCA STRAITS  
FROM LANGKAWI TO JOHOR

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FACULTY OF APPLIED SCIENCE AND TECHNOLOGY  
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IN THE COASTAL WATER OF MALACCA STRAITS  
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**BY**

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the requirements for the Degree of  
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## ABSTRACT

The distribution of phosphorous in coastal water and sediment in the Malacca Straits from Langkawi to Johor were studied during the Malacca Straits Expedition of the Japan International Co-operation Agency (JICA) and Universiti Putra Malaysia (UPM) Collaboration Project. A total number of 24 sampling stations were established.

For 1<sup>st</sup> Cruise sampling (Northeast Monsoon), the overall mean ortho-phosphate concentrations at 0.5, 5, 10, 15, 20, 25, 40, and 50 meter water depths were 0.242, 0.213, 0.205, 0.294, 0.342, 0.494, 0.192, and 0.244  $\mu\text{M}$  respectively. For organic phosphorous distribution at the above mentioned water depths, the overall mean values were 2.319, 2.353, 2.456, 3.446, 2.841, 3.627, 1.523 and 2.834  $\mu\text{M}$  respectively.

For 2<sup>nd</sup> Cruise sampling (Pre Southwest Monsoon), the overall mean ortho-phosphate concentrations at 0.5, 5, 10, 15, 20, 25, 40, and 50 meter water depths were 0.21, 0.27, 0.31, 0.42, 0.53, 0.28, 0.33, and 0.69  $\mu\text{M}$  respectively. For organic phosphorous distribution at the above mentioned water depths, the overall mean values were 4.85, 5.72, 5.54, 4.88, 7.00, 5.64, 3.40, and 4.93  $\mu\text{M}$  respectively

For 3<sup>rd</sup> Cruise sampling (Southwest Monsoon), the overall mean ortho-phosphate concentrations at 0.5, 5, 10, 15, 20, 25, 40, 45, 50 and 60 meter water depths were 0.209, 0.256, 0.185, 0.276, 0.441, 0.430, 0.125, 0.273, 0.834 and 0.182  $\mu\text{M}$  respectively. For organic phosphorous distribution at the above mentioned water depths, the overall mean

values were 3.339, 3.136, 3.243, 2.765, 2.521, 3.373, 6.235, 2.360, 2.330 and 2.471  $\mu\text{M}$  respectively.

Generally, the ortho-phosphate level increased with depth with lower phosphate was detected in the surface water. The horizontal ortho-phosphate distribution showed that the ortho-phosphate concentration reduced seawards, the highest concentration was found in near shore stations.

There was no obvious trend of organic phosphorous distribution in the water column for all three cruises. In addition, the dissolved organic phosphate concentration were higher than inorganic phosphate at all sampling stations. In contrast to inorganic phosphate, the horizontal organic-phosphorous distribution showed that the organic-phosphorous concentration increased seawards, the higher concentration was found in offshore stations.

In contrast to that found in coastal water, very high total phosphorous and organic phosphorous levels in sediment were detected. The ranges of total phosphorous and organic phosphorous in sediment were 3.96 - 26.10  $\mu\text{g-at P / g dry sediment}$  and 0.90 - 9.23  $\mu\text{g-at P / g dry sediment}$  (1<sup>st</sup> Cruise), 3.57 - 29.50  $\mu\text{g-at P / g dry sediment}$  and 2.04 - 11.86  $\mu\text{g-at P / g dry sediment}$  (2<sup>nd</sup> Cruise) and 6.21 - 26.42  $\mu\text{g-at P / g dry sediment}$  and 2.34 - 9.18  $\mu\text{g-at P / g dry sediment}$  (3<sup>rd</sup> Cruise).

For coastal water, the ortho-phosphate and organic phosphorous concentration is much higher than those found in the coastal waters off Kuala Terengganu (Law and Kamil, 1986) and coastal water off Port Dickson (Law and Chu, 1990).

From the results, the sediment phosphorous content were much higher than reported in coastal water off Pahang (Law and Rahman, 1986) and Sarawak (Law and Zawawi, 1987). These results reveal that the sediment in this portion of Malacca Straits is rich in phosphorous.

The distribution of phosphorous content in both coastal water and sediment can be due to active primary productivity by phytoplanktons, active mineralization processes, terrestrial input, land run-off, precipitation rate during Southwest Monsoon season and the topography changes in Malacca Straits region from deeper water (Northern) to shallow water depth (Southern).

## ABSTRAK

Taburan fosforus di dalam air dan endapan dalam perairan Selat Melaka iaitu dari Langkawi sehingga Johor telah dikaji semasa Ekspedisi Selat Melaka di antara Japan International Co-operation Agency (JICA) dan Universiti Putra Malaysia (UPM). Sebanyak 24 buah stesen kajian dikaji.

Dalam ekspedisi pertama (Monsun Timur Laut), keseluruhan min kepekatan orto-fosfat pada kedalaman air 0.5, 5, 10, 15, 20, 25, 40, and 50 meter adalah 0.242, 0.213, 0.205, 0.294, 0.342, 0.494, 0.192, and 0.244  $\mu\text{M}$  masing-masing. Bagi taburan kepekatan fosfat organik pada kedalaman air di atas pula, minnya adalah 2.319, 2.353, 2.456, 3.446, 2.841, 3.627, 1.523 and 2.834  $\mu\text{M}$  masing-masing.

Dalam ekspedisi kedua (Peralihan Monsun Barat Daya), keseluruhan min kepekatan orto-fosfat pada kedalaman air 0.5, 5, 10, 15, 20, 25, 40, and 50 meter adalah 0.21, 0.27, 0.31, 0.42, 0.53, 0.28, 0.33, and 0.69  $\mu\text{M}$  masing-masing. Bagi taburan kepekatan fosfat organik pada kedalaman air di atas pula, minnya adalah 4.85, 5.72, 5.54, 4.88, 7.00, 5.64, 3.40, and 4.93  $\mu\text{M}$  masing-masing.

Dalam ekspedisi ketiga (Monsun Barat Daya), keseluruhan min kepekatan orto-fosfat pada kedalaman air 0.5, 5, 10, 15, 20, 25, 40, 45, 50 and 60 meter adalah 0.209, 0.256, 0.185, 0.276, 0.441, 0.430, 0.125, 0.273, 0.834 and 0.182  $\mu\text{M}$  masing-masing. Bagi taburan kepekatan fosfat organik pada kedalaman air di atas pula, minnya adalah



3.339, 3.136, 3.243, 2.765, 2.521, 3.373, 6.235, 2.360, 2.330 and 2.471  $\mu\text{M}$  masing-masing.

Pada keseluruhannya, kepekatan orto-fosfat meningkat dengan kedalaman di mana kepekataannya lebih rendah di permukaan perairan. Taburan mendatar pula menunjukkan kepekatan orto-fosfat berkurangan menuju ke arah laut dengan nilai kepekatan tertinggi adalah dari stesen persisiran pantai.

Tiada taburan yang jelas ditunjukkan oleh fosfat organik. Tambahan pula, kepekatan fosfat organik adalah lebih tinggi daripada kepekatan orto-fosfat pada kesemua stesen kajian. Berbeza dengan taburan orto-fosfat, kepekatan fosfat organik meningkat menuju ke arah laut.

Berbeza dengan taburan di perairan Selat Melaka, nilai kepekatan jumlah fosfat dan fosfat organik yang terdapat dalam endapan adalah lebih tinggi. Julat jumlah fosfat dan fosfat organik yang terdapat dalam endapan adalah 3.96 - 26.10  $\mu\text{g-at P / g}$  endapan kering dan 0.90 - 9.23  $\mu\text{g-at P / g}$  endapan kering (Ekspedisi 1), 3.57 - 29.50  $\mu\text{g-at P / g}$  endapan kering dan 2.04 - 11.86  $\mu\text{g-at P / g}$  endapan kering (Ekspedisi 2) dan 6.21 - 26.42  $\mu\text{g-at P / g}$  endapan kering dan 2.34 - 9.18  $\mu\text{g-at P / g}$  endapan kering (Ekspedisi 3).

Bagi taburan nutrien di dalam air, kepekatan orto-fosfat dan fosfat organik adalah lebih tinggi dari kepekatan yang telah dilaporkan dalam persisiran Kuala Terengganu (Law dan Kamil, 1986) dan Port Dickson (Law dan Chu, 1990).

Daripada keputusan diperolehi, taburan kepekatan fosforus dalam endapan juga adalah lebih tinggi daripada yang telah dilaporkan dalam persisiran Pahang (Law dan Rahman, 1986) dan Sarawak (Law dan Zawawi, 1987). Keputusan ini menunjukkan endapan di perairan Selat Melaka adalah lebih kaya dengan nutrien fosforus.

Taburan fosforus di dalam air dan endapan di perairan Selat Melaka adalah dipengaruhi oleh pelbagai faktor seperti proses produktiviti primer oleh fitoplankton, proses mineralisasi yang aktif, pengaruh aktiviti manusia di daratan, kadar taburan hujan ketika Monsun Barat Daya dan perubahan topografi di Selat Melaka iaitu daripada perairan laut dalam (bahagian Utara) kepada perairan laut cetek (bahagian Selatan) di perairan Selat Melaka.