

THE ECONOMIC IMPORTANCE OF REFINEMENTS IN COASTAL  
LANDS, SOUTH AFRICA

STATISTICAL APPENDIX

DEPARTMENT OF SCIENCE AND TECHNOLOGY  
STATISTICAL BUREAU OF SOUTH AFRICA

2005



THE TEMPORAL VARIATIONS OF HEAVY METALS IN COASTAL JOHOR  
WATERS, SOUTH CHINA SEA.

By

Sumitha d/o Muniyandi

Research Report submitted in partial fulfillment of  
the requirements for the degree of  
Bachelor of Science (Marine Sciences)

Department of Marine Sciences  
Faculty of Science and Technology  
KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA  
2005 / 2006

1100042358

This project report should be cited as:

Sumitha, M. 2006. The Temporal Variations OF Heavy Metals in Coastal Johor Waters, South China Sea. Undergraduate Thesis, Bachelor of Science (Marine Science), Faculty of Science and Technology, Kolej Universiti Sains dan Teknologi Malaysia, Terengganu.141p.

No part of this project may be reproduced by any mechanical, photographic or electronic process, or in the form of photographic recording, nor may it be stored in a retrieval system, transmitted or otherwise copied for public or private use, without written permission from the author and the supervisor of the project.

## ACKNOWLEDGEMENTS

Firstly, thank God for enabling me to complete this thesis successfully. I wish to express the warmest gratitude and deepest and sincere thanks to Assoc. Prof. Dr. Kamaruzzaman Hj. Yunus for his guidance, advices and full time monitoring and valuable suggestions throughout the completion of this project. I would also to express my special thanks to Dr. Nor Antonina Abdullah for her advise and encouragement.

Next, I would also like to thanks all research assistants and the entire master's student for being there when I need them and for sharing their knowledge and helping me to improve my skills in the thesis writing. Thank you Hiezam, Karthik, Jamil, Willison and Ong.

Most importantly, my family for supporting me from the beginning tills the end in pursuing the Degree in Marine Science. Dad and Mom, thank you very much for your caring and encouragements.

And also not forgetting my coursemates and my housemates who had stood by me and gave me their support and help whenever I needed them. Thank you very much, Malini, Ambika, Radha, Uwarani, Gayathree, Nithya and Thana.

Last but not least, in order not to leave anyone out, thank you very much everybody who were involved directly or indirectly during the completion of my project and thank you God.

## ABSTRAK

Suatu kajian geokimia telah dijalankan di kawasan perairan Johor, Laut China Selatan untuk menentukan kandungan logam berat pada musim sebelum monsun and selepas monsun. Kawasan kajian meliputi 48 stesen yang merangkumi 30 stesen utama dan 18 stesen tambahan. Sampel telah diambil bagi dua musim tersebut.

Bagi musim sebelum monsun, nilainya adalah; 0.12 hingga 77.88  $\mu\text{g/g}$  berat kering (Pb); 1.83 hingga 53.33  $\mu\text{g/g}$  berat kering (Co); 1.35 hingga 91.87  $\mu\text{g/g}$  berat kering (Cu); 1.27 hingga 5.12  $\mu\text{g/g}$  berat kering (Fe); dan 4.83 hingga 205.21  $\mu\text{g/g}$  berat kering (Zn).

Bagi musim selepas monsun pula kandungannya adalah; 0.88 hingga 54.53  $\mu\text{g/g}$  berat kering (Pb); 3.86 hingga 14.66  $\mu\text{g/g}$  berat kering (Co); 2.92 hingga 303.71  $\mu\text{g/g}$  berat kering (Cu); 1.01 hingga 4.21  $\mu\text{g/g}$  berat kering (Fe); dan 4.31 hingga 144.44  $\mu\text{g/g}$  berat kering (Zn).

Korelasi antara saiz min sedimen dan kandungan karbon organik didapati lemah bagi musim sebelum monsun dan boleh diabaikan pada musin selepas monsun dengan nilai  $r$  0.15 dan 0.09 masing-masing. Bagi korelasi diantara kandungan karbon organik dan logam berat, hubungan yang kuat dan yang boleh diabaikan telah diperolehi. Nilai  $r$  yang didapati adalah 0.02 hingga 0.23 untuk musim sebelum monsun dan 0.11 hingga 0.44 bagi musim selepas monsun. Manakala bagi korelasi antara saiz min dan logam berat,

kebanyakan logam menunjukkan hubungan yang boleh diabaikan kecuali Pb bagi musim sebelum monsun dan Zn bagi musim selepas monsun yang menunjukkan hubungan yang kuat, dengan nilai  $r$  0.22 untuk Pb dan 0.10 masing-masing bagi logam selepas musim monsun. Nilai  $r$  adalah 0.01 hingga 0.22 dan 0.02 hingga 0.19 bagi musim sebelum monsun dan selepas monsun.

Faktor pengkayaan menunjukkan kebanyakan logam berat berasal daripada sumber semulajadi atau tidak tercemar kecuali Pb yang menunjukkan pengkayaan sederhana. Kandungan logam berat didapati berkurangan selepas musim monsun. Ini mungkin disebabkan oleh pengaliran sungai ataupun arus dasar pada musim musim monsun. Namun, daripada kajian yang telah dijalankan, faktor pengkayaan yang rendah tidak boleh disimpulkan sebagai tiada pencemaran. Beberapa stesen yang berhampiran dengan kawasan persisiran menunjukkan tahap pencemaran logam berat yang tinggi. Ia mungkin berpunca daripada sisa kumbahan, pembuangan sampah kedalam lautan, pelombongan pasir, pelupusan sampah dan aktiviti manusia yang lain.

Secara kesimpulannya, profil sedimentologi dan geokimia di perairan Johor masih berada pada tahap yang terkawal. Namun begitu, pengkawasan yang berkala harus dijalankan di kawasan persisiran yang didapati mempunyai tahap logam berat yang tinggi. Kajian juga mendapati musim perantaraan diantara musim sebelum monsun dan selepas monsun membawa kepada pengurangan bahan pencemar dalam sedimen di Laut China Selatan.

## ABSTRACT

A geochemical study was carried out in Coastal Johor Waters, South China Sea in order to determine the temporal variation of heavy metals during the pre monsoon and post monsoon season. The study was carried out to study and determine the sediment characteristics, organic carbon content and heavy metal contents.

The concentration of heavy metal during the pre monsoon season were ranged from; 0.12 to 77.88  $\mu\text{g/g}$  dry weights (Pb); 1.83 to 53.33  $\mu\text{g/g}$  dry weights (Co); 1.35 to 91.87  $\mu\text{g/g}$  dry weights (Cu); 1.27 to 5.12  $\mu\text{g/g}$  dry weights (Fe); and 4.83 to 205.21  $\mu\text{g/g}$  dry weights (Zn).

As for the post monsoon season the heavy metals concentration were ranged from; 0.88 to 54.53  $\mu\text{g/g}$  dry weights (Pb); 3.86 to 14.66  $\mu\text{g/g}$  dry weights (Co); 2.92 to 303.71  $\mu\text{g/g}$  dry weights (Cu); 1.01 to 4.21  $\mu\text{g/g}$  dry weights (Fe); and 4.31 to 144.44  $\mu\text{g/g}$  dry weights (Zn).

The correlation between the mean size of sediment and organic carbon was weak during the pre monsoon and almost negligible during the post monsoon season with r value of 0.15 and 0.09 respectively. As for the correlation between organic carbon and heavy metals, strong and almost negligible correlations were recorded. The r values range from 0.02 to 0.23 for pre monsoon and 0.11 to 0.44 for post monsoon. Meanwhile for the correlation between mean size and heavy metals, almost all the metals show negligible

relationship expect for Pb in pre monsoon season and Zn in post monsoon season which shows a strong correlation, with r value of 0.22 for Pb and 0.10 for the post monsoon metal respectively. The range for r value is 0.01 to 0.22 and 0.02 to 0.10 for the pre monsoon and post monsoon season.

The enrichment factor (EF) indicates that most metals were originated from natural sources or unpolluted except for Pb which shows moderate enrichment. The concentration of heavy metals decreases after the monsoon season. This might be caused by the river runoff or the bottom current during the monsoon season. However from studies which had been conducted, the lower EF values do not conclude that there is no pollution. A few stations near the coastal zone show a higher level of heavy metal concentration. These sources might have come from the sewage, sea dumping, industrial runoff, sand mining, waste disposal and other anthropogenic activities.

In conclusion, the sedimentological and geochemical profile in the coastal Johor Waters is still in secure level. However, monitoring should be carried out annually especially in the coastal zone which has a higher accumulation of pollutants. The study also discovered that the transition seasons between the pre monsoon and post monsoon indicates a beneficial effect to the coastal and nearshore environment where it shows an overall reduction of the resident time of pollutants in the sediment of the South China Sea.