

DISTRIBUTION OF TRACE METALS AND EARTH ELEMENTS  
IN ROCKY SHORE ORGANISMS ALONG THE EAST COAST  
OF PENINSULAR MALAYSIA

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Distribution of trace metals and rare earth elements in rocky  
shore organisms along the east coast of Peninsular Malaysia /  
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IN ROCKY SHORE ORGANISMS ALONG THE EAST COAST OF  
PENINSULAR MALAYSIA**

**MOHD FUAD MISKON**

**Thesis Submitted in Fulfillment of the Requirement for the  
Degree of Master of Science in Institute of Oceanography  
Universiti Malaysia Terengganu**

**July 2011**

*Dedicated to*

*Miskon Bin Kasmal*

*&*

*Zaiton Bt Talkah*

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu  
in fulfillment of the requirement for the degree of Master of Science.

**DISTRIBUTION OF TRACE METALS AND RARE EARTH ELEMENTS  
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**MOHD FUAD BIN MISKON**

**July 2011**

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Interspecies, inter-tissue and interspatial variations of trace metals and rare earth elements (REEs) in selected body parts of *Saccostrea cucullata*, *Thais clavigera* and *Nerita chameleon* along the east coast of Peninsular Malaysia were determined. Significant interspatial variations ( $p < 0.05$  and  $p < 0.01$ ) in trace metals and REEs were recorded. Significant positive correlations ( $p < 0.01$ ) were found among all REEs concentration. A few significant correlations were found among trace metals and REEs. Bivalve mollusc *S. cucullata* proved to be a good bioindicator for Zn and Cu while the two gastropod molluscs, *T. clavigera* for Cd and Se, and *N. chameleon* for Pb, Mn, Fe and Sr. The metal accumulation patterns indicate consistent enrichment of essential metals in soft tissue. Filter feeder *S. cucullata* is highly potential as bioindicator for REEs due to its feeding behaviour that is much related to particulates as REEs sources. Locations with relatively high concentrations of the contaminant metals Hg, Cu, Pb and Zn are related to their close proximity to industrial activities and urban sites. Johor state has the highest concentrations of all metals compared with Pahang and Terengganu states, except for Pb and Cu. The

pollutant levels observed on the east coast are still lower than certain highly polluted locations around the world. The REEs fractionation patterns normalized to chondrite or shale were remarkably similar indicating a common source of the REEs for the whole east coast region. Typical deviations from this pattern were found for Ce and Eu and could be explained by their redox chemistry. Pb and Cd concentrations are strongly and significantly correlated with the REES indicating generally that the source of Pb and Cd are derived from the rocks (geogenic) and probably not anthropogenic in origin. The ratio of light to heavy REEs, La/Yb in the *S. cucullata* of 27.3 and *T. clavigera* of 29.47 are remarkably similar to Terengganu River basin soil of 33.00 and of Terengganu River sediment of 27.60 while *N. chameleon* shows slightly lower ratios (22.29). Comparison of metal concentration with maximum permissible limits of toxic metals in food indicated the values were well within safety levels, except for Cu and Zn in *S. cucullata*. Along with its wide distribution on rocky shore area along the east coast of peninsula, the present results of trace metals and REEs recorded in selected body parts of *S. cucullata*, *T. clavigera* and *N. chameleon* collected from 17 sites along the east coast of Peninsular Malaysia may serve as baseline data for future reference.

Abstrak tesis yang dikemukakan kepada Senat Universiti Malaysia Terengganu sebagai memenuhi keperluan untuk ijazah Master Sains.

**TABURAN LOGAM SURIH DAN UNSUR NADIR BUMI DALAM ORGANISMA PANTAI BERBATU DI SEPANJANG PANTAI TIMUR SEMENANJUNG MALAYSIA**

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Variasi antara spesies, antara tisu dan antara kawasan bagi logam surih dan unsur nadir bumi dalam tisu badan terpilih spesies *Saccostrea cucullata*, *Thais clavigera* dan *Nerita chameleon* di sepanjang pantai timur Semenanjung Malaysia telah ditentukan. Perbezaan logam surih dan unsur nadir bumi yang signifikan antara lokasi ( $p < 0.05$  dan  $p < 0.01$ ) telah direkod. Hubungan yang positif antara kepekatan unsur nadir bumi yang signifikan ( $p < 0.01$ ) telah dijumpai. Beberapa hubungan antara logam surih dan unsur nadir bumi turut dijumpai. Bivalvia moluska *S. cucullata* terbukti merupakan biopenunjuk yang baik bagi logam Zn dan Cu manakala dua gastropoda moluska, *T. clavigera* bagi logam Cd dan Se, dan *N. chameleon* bagi logam Pb, Mn, Fe dan Sr. Corak pengumpulan logam dalam spesies yang dikaji menunjukkan pengkayaan logam perlu yang konsisten dalam tisu lembut berbanding logam tidak perlu. Pemakan secara penapisan *S. cucullata* memiliki potensi yang tinggi sebagai biopenunjuk bagi unsur nadir bumi berhubung cara pemakanannya yang lebih berhubungkait dengan partikulat-partikulat sebagai sumber unsur nadir bumi. Lokasi yang secara relatifnya mempunyai kepekatan

logam tercemar yang tinggi seperti Hg, Cu, Pb dan Zn adalah berhubungkait dengan persekitaran lokasi yang berhampiran dengan aktiviti industri dan kawasan perbandaran. Negeri Johor mempunyai kepekatan logam-logam yang paling tinggi berbanding negeri Pahang dan Terengganu, kecuali logam Pb dan Cu. Tahap pencemaran yang diperhati di kawasan pantai timur masih rendah berbanding lokasi tertentu yang tinggi tahap pencemarannya di serata dunia. Corak pecahan unsur nadir bumi yang dinormalisasikan dengan chondrite atau shale yang hampir sama menunjukkan ianya berasal dari sumber yang sama di seluruh kawasan pantai timur. Lencongan unsur Ce dan Eu yang tipikal pada corak ini boleh dijelaskan melalui tindakbalas redoks. Logam Pb dan Cd yang mempunyai hubungkait yang kukuh dan signifikan dengan unsur nadir bumi menunjukkan bahawa secara umumnya sumber logam Pb dan Cd adalah bersumberkan dari batuan dan mungkin bukan berpunca dari pencemaran oleh aktiviti manusia. Nisbah La/Yb iaitu 27.30 dalam *S. cucullata* dan 29.47 dalam *T. clavigera* menunjukkan persamaan dengan nisbah tanah dasar Sungai Terengganu iaitu 33.00 dan sedimen Sungai Terengganu iaitu 27.60, manakala *N. chameleon* menunjukkan nisbah yang sedikit rendah iaitu 22.29. Perbandingan kepekatan logam dengan paras logam toksik maksimum di dalam makanan yang dibenarkan menunjukkan bahawa nilai di dalam kajian masih di bawah paras selamat, kecuali logam Zn dan Cu dalam *S. cucullata*. Dengan taburan yang tinggi di perairan pantai berbatu di sepanjang pantai timur Semenanjung Malaysia, keputusan terkini kajian mengenai logam surih dan unsur nadir bumi yang direkod dalam tisu badan terpilih dalam *S. cucullata*, *T. clavigera* dan *N. chameleon* dari 17 kawasan sepanjang pantai timur Semenanjung Malaysia sedia dijadikan data asas bagi sumber rujukan di masa hadapan.