

行政院國家科學委員會專題研究計劃成果報告

東海有光層生物性碳循環：東海陸棚異營細菌與顆粒態有機碳

季節變異及其控制機制之研究 (III)

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整合型計劃： 總計劃主持人：魏慶琳

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前言

本計劃為黑潮與東海陸棚交換過程研究 (KEEP III) 整合型計劃中子計劃六。主要係研究水體細菌生產力(BP)、顆粒態有機碳(POC)在東海陸棚之季節-空間分布及其控制機制。在1999年夏季將執行船上 Mesocosm experiments, 以探究此貳參數之控制因子; 透過與其他子計劃整合研究之方式, 期對上層水體內各生物及化學因子間的細部運作及關聯性能有更細密之瞭解。此外在2000年春季進行航次調查, 繼續春季藻華現象之追尋。研究成果對於東海碳通量的深入瞭解及模式分析之依據皆能提供重要之參考。以下就細菌生產力在511, 515, 521及532航次中所測得之結果, 予以說明及討論。

結果與討論

東海陸棚最大的特色在於有著強烈對比的物理(如溫, 鹽度), 化學(如無機營養鹽與有機養分)及生物(如初級生產力)梯度(gradient); 異營細菌的生物量(biomass; 圖1), 置換率(turn-over rates; 圖2)及生產力(production; = 生物量 x 置換率; 圖3)因而呈現出極為明顯的季節(冷水期 vs. 暖水期)與空間(陸棚內區 vs. 中區 vs. 外區)。在冷水期(冬春二季)細菌置換率($0.06 - 0.23 \text{ d}^{-1}$)均呈現陸棚中區高而二側低之現象; 在暖水期($0.10 - 0.30 \text{ d}^{-1}$)則以內區為最高並向外區遞減。細菌生物量在暖水期($154 - 693 \text{ mgC m}^{-2}$)由內區向中區遞昇在向外區遞減; 但在夏季之中區最大值($450 - 700 \text{ mgC m}^{-2}$)遠高於秋季($300 - 400 \text{ mgC m}^{-2}$)。在冷水期, 春季的細菌生物量($209 - 668 \text{ mgC m}^{-2}$)則由內區向外遞減; 相形之下, 冬季之細菌生物量($186 - 301 \text{ mgC m}^{-2}$)則呈均勻狀態。細菌生產力在冷水期($24 - 60 \text{ mgC m}^{-2} \text{ d}^{-1}$)變化不大, 但在暖水期($25 - 166 \text{ mgC m}^{-2} \text{ d}^{-1}$)則呈現內區高外區低。在冷水期有機養分添加實驗中, 發現細菌生長率在陸棚中區及外區係受限於有機養分之供應速率; 但在陸棚內區則受水溫變化之操控(圖4)。

由以上之結果, 吾人可以推斷細菌生產力在微生物環及浮游生物的食階動

- 態平衡中的重要性勢必會因地因時而異。如欲解決此一問題，除了持續進行航次觀測外，在船上進行生態模擬槽(mesocosm)實驗亦是不可或缺之工作。後者已於1999年9月在東海做過先期實驗，結果尚在整理之中。

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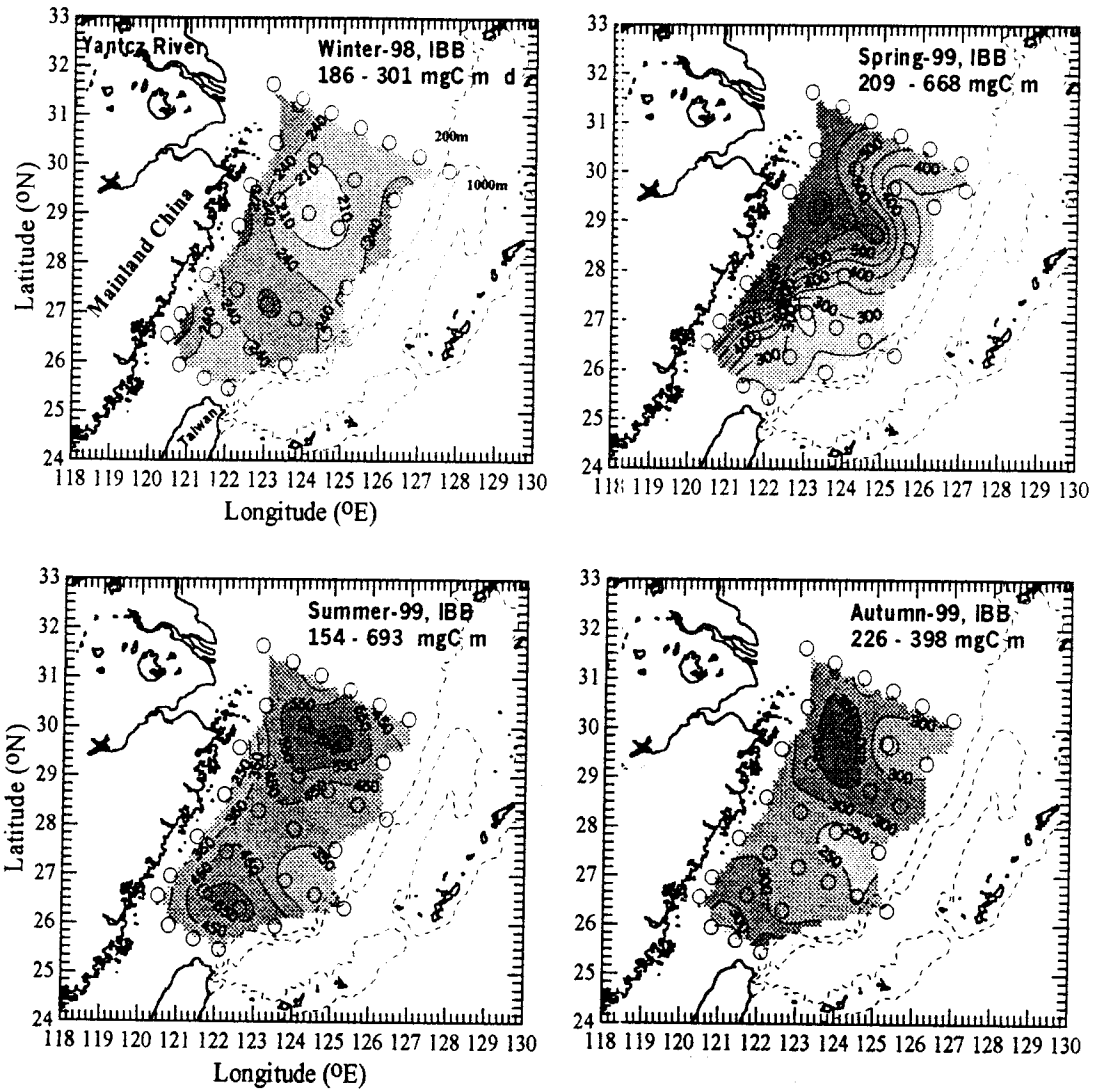


Figure 1. Spatial contours for the euphotic zone integrated values of bacterial biomass during the four different seasons in the continental shelf of the East China Sea.

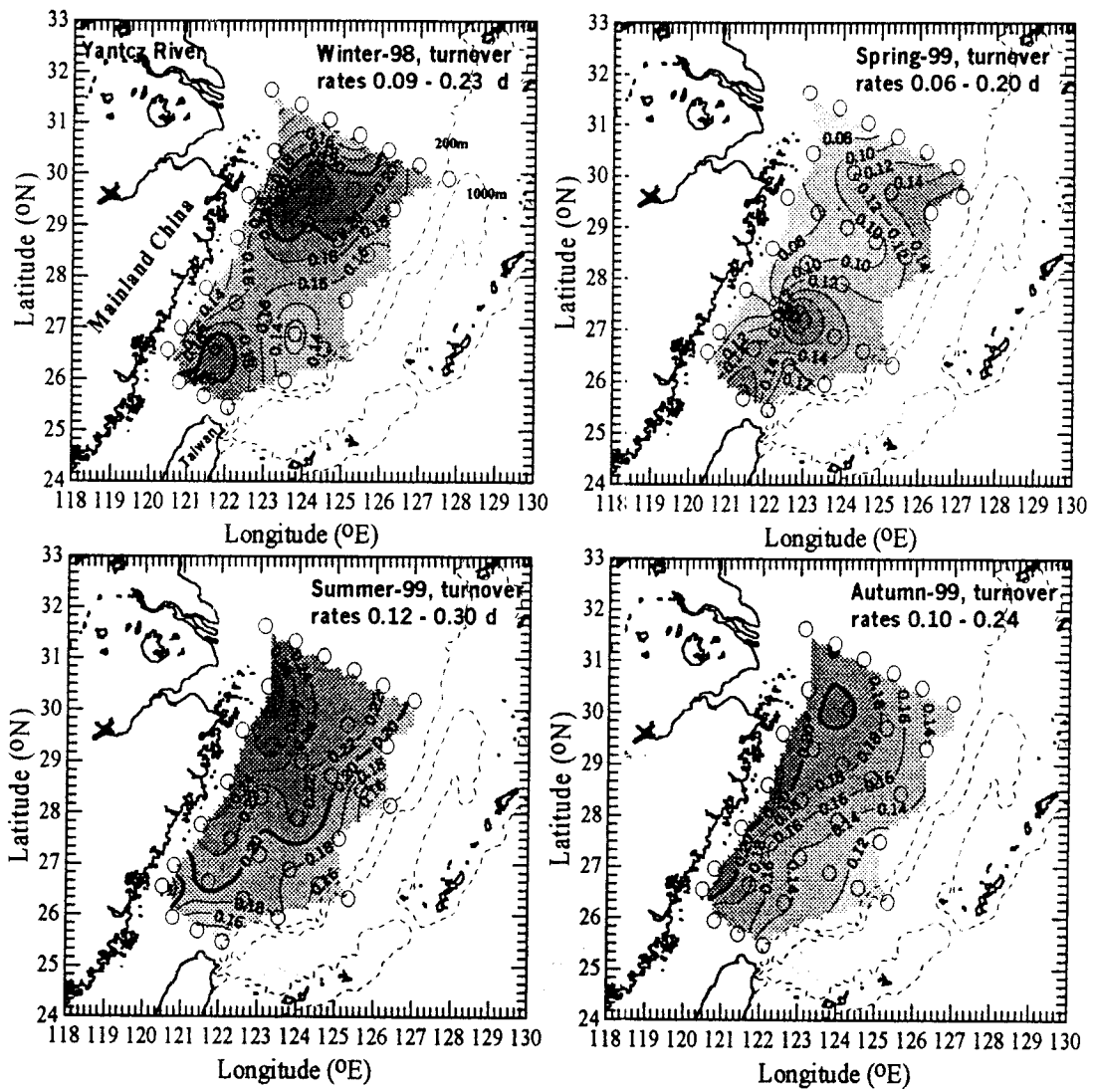


Figure 2. Spatial contours for the euphotic zone average values of bacterial turnover rates during the four different seasons in the continental shelf of the East China Sea.

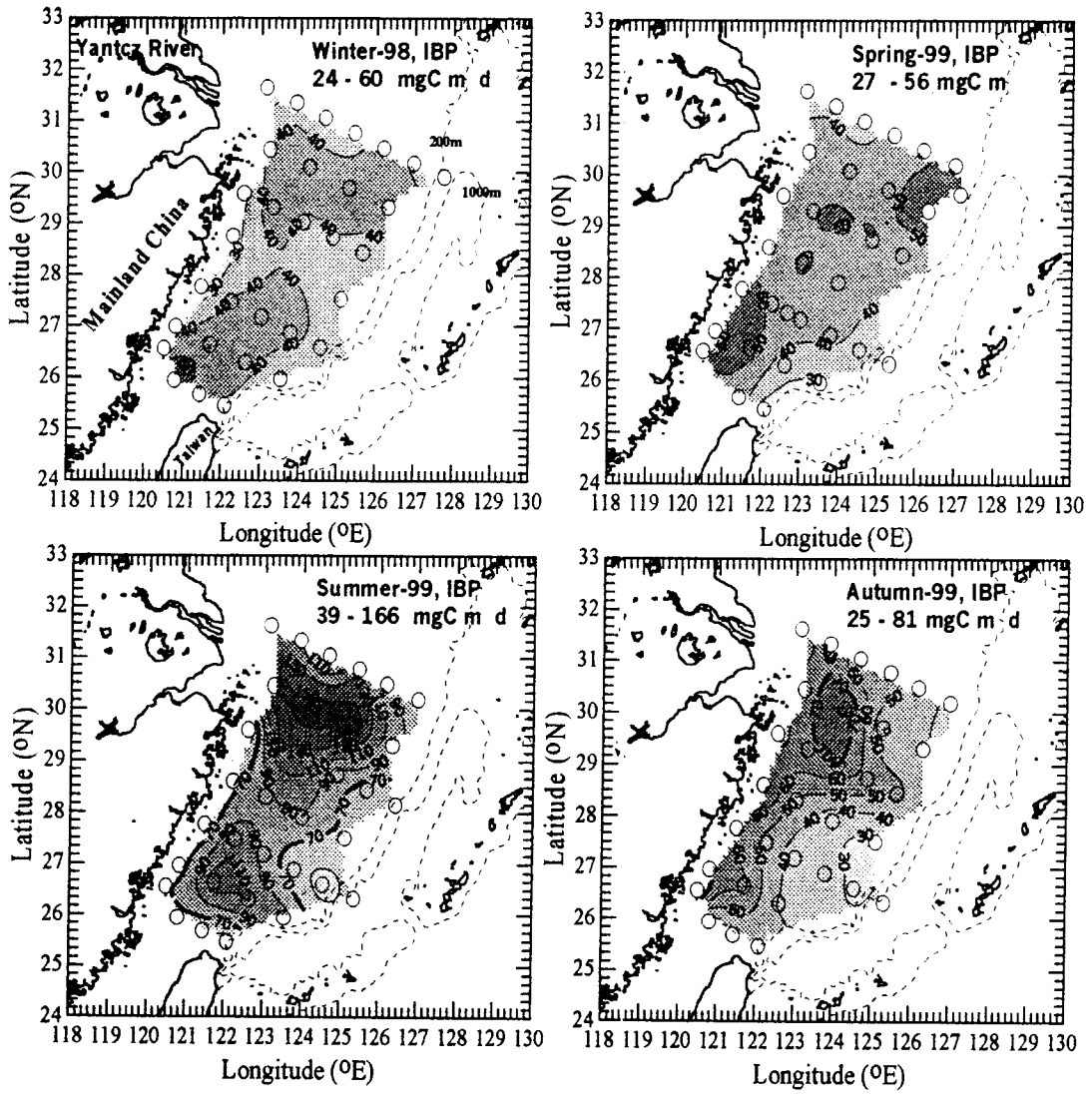


Figure 3. Spatial contours for the euphotic zone integrated values of bacterial production during the four different seasons in the continental shelf of the East China Sea.

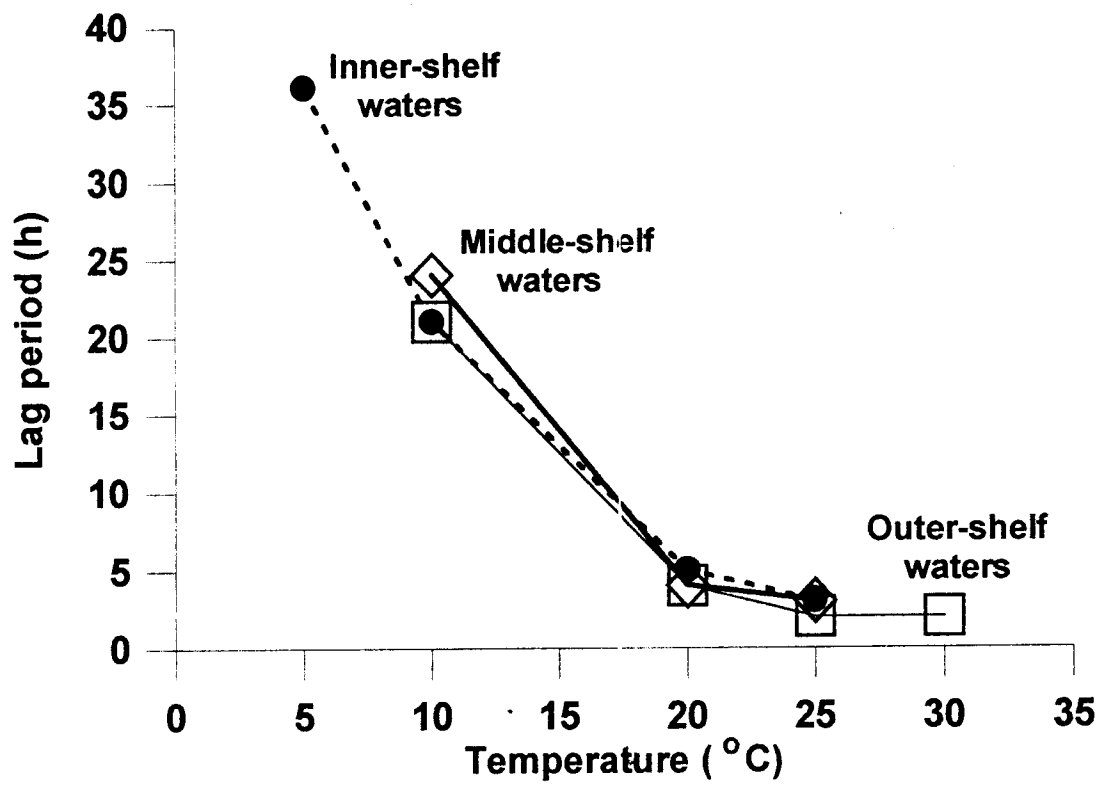


Figure 4. Temperature effects on the lag period required for bacteria to respond to the enrichment of dissolved free amino acids. The inner-shelf waters, solid circles; the middle-shelf mixed waters, open diamonds and the outer-shelf waters, open squares.