國 立 臺 灣 海 洋 大 學
海洋環境與生態研究所 專題討論#

英文題目：Are mangroves drivers or buffers of coastal acidification? Insights from alkalinity and dissolved inorganic carbon export estimates across a latitudinal transect

中文題目：紅樹林會驅動或緩衝沿岸酸化？從跨緯度鹼度與溶解性無機碳輸出通量得到的啟示

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Abstract

Mangrove forests are hot spots in the global carbon cycle, yet the fate for a majority of mangrove net primary production remains unaccounted for. The relative proportions of alkalinity and dissolved CO_2 [CO_2*] within the dissolved inorganic carbon (DIC) exported from mangroves is unknown, and therefore, the effect of mangrove DIC exports on coastal acidification remains unconstrained. Here we measured dissolved inorganic carbon parameters over complete tidal and diel cycles in six pristine mangrove tidal creeks covering a 26° latitudinal gradient in Australia and calculated the exchange of DIC, alkalinity, and [CO_2*] between mangroves and the coastal ocean. We found a mean DIC export of 59 mmol m^{-2} d^{-1} across the six systems, ranging from import of 97 mmol m^{-2} d^{-1} to an export of 85 mmol m^{-2} d^{-1}. If the Australian transect is representative of global mangroves, upscaling our estimates would result in global DIC exports of 3.6 ± 1.1 Tmol C yr^{-1}, which accounts for approximately one third of the previously unaccounted for mangrove carbon sink. Alkalinity exchange ranged between an import of 1.2 mmol m^{-2} d^{-1} and an export of 117 mmol m^{-2} d^{-1} with an estimated global export of 4.2 ± 1.3 Tmol yr^{-1}. A net import of free CO_2 was estimated (-11.4 ± 14.8 mmol m^{-2} d^{-1}) and was equivalent to approximately one third of the air-water CO_2 flux (33.1 ± 6.3 mmol m^{-2} d^{-1}). Overall, the effect of DIC and alkalinity exports created a measurable localized increase in coastal ocean pH. Therefore, mangroves may partially counteract coastal acidification in adjacent tropical waters.

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中文摘要

紅樹林是全球碳循環的研究熱點，但大多數紅樹林生態系淨初級生產力的命運和該系統輸出的鹼度(TA)及溶解態 CO_2 ($[CO_2^*]$)的相對比例都尚未被清楚量化。因此，紅樹林生態系 DIC 輸出對沿海酸化的影響仍屬未知。本研究測量了澳洲六個橫跨 26 個緯度的原始紅樹林於完整潮汐及日夜週期中無機碳化學參數的變化，並計算了紅樹林和沿海地區之間的 DIC、TA 和$[CO_2^*]$的交換通量。研究結果發現這六個系統中的 DIC 交換通量的分布範圍介於淨輸入 97 mmol m^{-2} d^{-1} 到淨輸出 85 mmol m^{-2} d^{-1}，平均為淨輸出 59#mmol m^{-2} d^{-1}。假設澳洲這六個不同緯度紅樹林系統所得之結果具有全球代表性，則全球紅樹林 DIC 輸出量估計會達到 3.6 ± 1.1 Tmol C yr^{-1}，此量約佔先前研究無法說明紅樹林碳匯總量的 1/3。TA 交換通量的分布範圍介於淨輸入 1.2 mmol m^{-2} d^{-1} 到淨輸出 117 mmol m^{-2} d^{-1}；全球 TA 輸出量估計則會達到 4.2 ± 1.3 Tmol C yr^{-1}。$[CO_2^*]$的輸入量為-11.4 ± 14.8 mmol m^{-2} d^{-1}，大約相當於海氣 CO_2 交換通量的 1/3 (33.1 ± 6.3 mmol m^{-2} d^{-1})。整體而言，紅樹林生態系中 DIC 和 TA 的輸出會導致沿海海水 pH 局部增加。因此，紅樹林生態系可能會部分抵消相鄰熱帶海域的沿海酸化現象。

參考資料

Sippo, J. Z., Maher, D. T., Tait, D. R., Holloway, C., and Santos, I. R. (2016). Are mangroves drivers or buffers of coastal acidification? Insights from alkalinity and dissolved inorganic carbon export estimates across a latitudinal transect. *Global Biogeochem. Cycles* 30: 753–766.