

國立臺灣海洋大學
海洋環境與生態研究所 專題討論

中文題目：快速沉降以及慢速沉降顆粒對海洋碳輸出的相對貢獻

英文題目：The relative contribution of fast and slow sinking particles to ocean carbon export

作者：J. S. Riley, R. Sanders, C. Marsay, F. A. C. Le Moigne, E. P. Achterberg, and A. J. Poulton

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報告人：余泓睿 環態所碩一

指導教授：許瑞峯老師

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Abstract

Particulate organic carbon (POC) generated by primary production and exported to depth, is an important pathway for carbon transfer to the abyss, where it is stored over climatically significant timescales. These processes constitute the biological carbon pump. A spectrum of particulate sinking velocities exists throughout the water column, however numerical models often simplify this spectrum into suspended, fast and slow sinking particles. Observational studies suggest the spectrum of sinking speeds in the ocean is strongly bimodal with >85% POC flux contained within two pools with sinking speeds of <10 m day⁻¹ and >350 m day⁻¹. We deployed a Marine Snow Catcher (MSC) to estimate the magnitudes of the suspended, fast and slow sinking pools and their fluxes at the Porcupine Abyssal Plain site (48° N, 16.5° W) in summer 2009. The POC concentrations and fluxes determined were 0.2 mgC L⁻¹ and 54 mg C m⁻² day⁻¹ for fast sinking particles, 5 mgC L⁻¹ and 92 mgC m⁻² day⁻¹ for slow sinking particles and 97 mgC L⁻¹ for suspended particles. Our flux estimates were comparable with radiochemical tracer methods and neutrally buoyant sediment traps. Our observations imply: (1) biomineralising protists, on occasion, act as nucleation points for aggregate formation and accelerate particle sinking; (2) fast sinking particles alone were sufficient to explain the abyssal POC flux; and (3) there is no evidence for ballasting of the slow sinking flux and the slow sinking particles were probably entirely demineralized in the twilight zone.

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中文摘要

顆粒有機碳(POC)由初級生產力產生並傳輸至深處，是碳傳輸到深海的重要途徑，且可長久的被儲存。該過程是由生物碳幫浦所構成。水體中存在的一系列的顆粒沉降速度，然而大部分的模型經常簡化了懸浮、快速沉降和慢速沉降等顆粒。觀察研究證實海洋中超過 85% 的 POC 通量會具有沉降速度 $<10 \text{ m day}^{-1}$ 和 $>350 \text{ m day}^{-1}$ 之兩個峰值。該研究於 2009 年夏天時在 Porcupine Abyssal Plain(PAP, 48°N , 16.5°W)部屬了海洋雪捕捉器(MSC)用來評估懸浮、快速和慢速顆粒的沉降情形及其通量。快速沉降的 POC 的濃度和通量為 0.2 mgC L^{-1} 、 $54 \text{ mg C m}^{-2} \text{ day}^{-1}$ ，慢速沉降的 POC 的濃度和通量為 5 mgC L^{-1} 、 $92 \text{ mg C m}^{-2} \text{ day}^{-1}$ ，以及懸浮顆粒的 POC 濃度為 97 mgC L^{-1} 。該通量之估算亦與放射性追蹤法和自然浮力沉降沉積物收集器互相比對。我們的觀察顯示：(1) 生物礦化的原生生物有時會在顆粒形成並加速顆粒沉降中扮演關鍵的角色；(2) 僅快速沉降的顆粒適用於解釋深海 POC 的通量；(3) 沒有證據證明慢速沉降的壓載會導致慢速沉降顆粒在暮光層完全再礦化。