

國立臺灣海洋大學
海洋環境與生態研究所 專題討論

題目：透過熱裂解氣相層析質譜儀鑑定和定量地表水和地下水中的奈米塑膠
英文題目：Identification and Quantification of Nanoplastics in Surface Water and Groundwater by Pyrolysis Gas Chromatography–Mass Spectrometry
作者：Yanghui Xu, Qin Ou, Meng Jiao, Gang Liu, and Jan Peter van der Hoek
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報告人：郭佩華 環態所碩一
指導教授：許瑞峯 助理教授
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Abstract

Nanoplastics (NPs) are currently considered an environmental pollutant of concern, but the actual extent of NP pollution in environmental water bodies remains unclear and there is not enough quantitative data to conduct proper risk assessments. In this study, a pretreatment method combining ultrafiltration (UF, 100 kDa) with hydrogen peroxide digestion and subsequent detection with pyrolysis gas chromatography–mass spectrometry (Py-GC/MS) was developed and used to identify and quantify six selected NPs in surface water (SW) and groundwater (GW), including poly(vinylchloride) (PVC), poly(methyl methacrylate) (PMMA), polypropylene (PP), polystyrene (PS), polyethylene (PE), and poly(ethylene terephthalate) (PET). The results show that the proposed method could detect NPs in environmental water samples. Nearly all selected NPs could be detected in the surface water at all locations, while PVC, PMMA, PS, and PET NPs were frequently below the detection limit in the groundwater. PP (32.9–69.9%) and PE (21.3–44.3%) NPs were the dominant components in both surface water and groundwater, although there were significant differences in the pollution levels attributed to the filtration efficiency of riverbank, with total mass concentrations of 0.283–0.793 $\mu\text{g/L}$ (SW) and 0.021–0.203 $\mu\text{g/L}$ (GW). Overall, this study quantified the NPs in complex aquatic environments for the first time, filling in gaps in our knowledge about NP pollution levels and providing a useful methodology and important reference data for future research.

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中文摘要

奈米塑膠(NPs)目前被認為是一種關注的環境污染物，但環境水體中奈米塑膠污染之實際程度仍不清楚，也沒有足夠的定量數據來進行適當的風險評估。在這項研究中，開發了一種以超濾(UF, 100kDa)濃縮與過氧化氫消化相結合的預處理方法，隨後使用熱裂解氣相層析質譜儀(Py-GC/MS)進行檢測，並識別及量化地表水(SW)和地下水(GW)中的六種特定的奈米塑膠，包含：聚氯乙烯(PVC)、聚甲基丙烯酸甲酯(PMMA)、聚丙烯(PP)、聚苯乙烯(PS)、聚乙烯(PE)、聚對苯二甲酸乙二酯(PET)。結果表明，該方法可以檢測環境水體中的奈米塑膠。所選定的奈米塑膠幾乎皆可在所有採樣位置的地表水中被檢測出，而 PVC、PMMA、PS 和 PET 奈米塑膠在地下水中經常低於檢測極限。PP(32.9-69.9%)和 PE(21.3-44.3%)是地表水和地下水中主要的奈米塑膠種類，其總質量濃度為 0.283–0.793 $\mu\text{g/L}$ (SW) 和 0.021–0.203 $\mu\text{g/L}$ (GW)。總體而言，這項研究首次量化了複雜水生環境中的奈米塑膠，填補我們對奈米塑膠污染水平的知識空白，為今後的研究提供有用的方法論和重要的參考數據。