

Century-Long Black Carbon Record in Marian Cove Sediment Core, Western Antarctic Peninsula (1912– 2024)

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Black carbon (BC), a byproduct of incomplete biomass burning and fossil fuel combustion, exists from partially carbonized material to inert graphitized structures. Due to its stability, BC accumulates in marine sediments through soil erosion and aerosol deposition. BC constitutes approximately 6% of the total carbon in marine sediments, with a portion persisting as inert graphitic material. This study examines BC deposition in a sediment core collected from Marian Cove, West Antarctica, in 2021. Sediment chronology was established using ²¹⁰Pb dating, applying the Constant Flux Constant Sedimentation (CFCs) model. The calculated sedimentation rates averaged 0.41–0.46 cm yr⁻¹, corresponding to a depositional history spanning approximately 110 years (1912–2020). BC concentrations ranged from 0.17 to 0.50 mg C g⁻¹ between 1912 and 1956, 0.46 to 1.45 mg C g⁻¹ from 1957 to 1994, and 0.95 to 2.4 mg C g⁻¹ from 1995 to 2024 (with 2019 and 2024 data obtained from surface sediments). The significant increase in BC concentrations since the 1990s has been associated with increased human activity in the Antarctic Peninsula and wildfires in nearby areas. Notably, a significant correlation between Antarctic tourism growth and BC deposition from 1960 to 2024 demonstrates the influence of anthropogenic factors ($r^2=0.43$, $p<0.001$). These results highlight the need for policy measures to address the influence of increasing human activities in the Antarctic Peninsula.