

Arctic Sea Ice Reconstruction for the Past 500 Years Using Palaeo-Based Proxies: A case study of PIP₂₅ Biomarker

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Arctic sea-ice is an important element of the Earth system. It controls the overall temperature on Earth's surface by reflecting incoming solar radiation, directly and indirectly influencing climate change in the Polar Regions and globally. There has been a dramatic decline in the thickness and extent of sea-ice in the Arctic Ocean over past three decades, reflected in distortions in climatic conditions, permafrost thawing, coastal erosion and increased precipitation. To deduce paleoclimatic changes attributable to variability in the sea ice, a long-term record of sea-ice is required, beyond the time period covered by direct instrumental monitoring. A recent proxy for Arctic Ocean sea-ice has been developed based on the analysis of an isomer of C₂₅, also known as IP₂₅ (Ice Proxy with 25 carbon atoms). In addition, other phytoplankton-derived biomarkers such as brassicasterol (Phytoplankton marker - IP₂₅ index; PIP₂₅) are employed to confirm sea ice change deductions. To reconstruct the past of Arctic sea ice, IP₂₅ and brassicasterol have been extracted from a push core sample retrieved from a low Arctic region in Coronation Gulf and quantified by Gas Chromatography-Mass Spectrometry (GC-MS). Calculated annual fluxes in IP₂₅, brassicasterol, and PIP₂₅ have been determined for this core record and illustrate annual to decadal variations in the duration of sea-ice season for the past 500 years. Good agreement with other records of sea-ice change from the same core (biogenic silica, dinoflagellate cysts, and total organic carbon) confirms that PIP₂₅ represents an excellent proxy for sea-ice.