Late Quaternary sedimentary trace element response to productivity changes on the Vancouver Island Margin, British Columbia, Canada

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Chalcophile (Ag, Cd) and redox-sensitive (Re, Mo, U) trace elements have been examined alongside productivity proxies from a 50-kyr long sediment record from the Vancouver Island margin (core MD02-2496, 48˚58.47' N and 127°02.14' W, 1243 m water depth). The study site is located in a highly productive area at the northern extent of the California Current system and within the modern oxygen minimum zone.

The trace element records show similar structure with marine organic carbon and opal records. Increases in trace element concentrations occur during the early Holocene, the Bølling/Allerød warm interval, and during submillennial warm intervals in marine isotope stage 3 that are interpreted to be synchronous with Greenland Dansgaard-Oeschger oscillations. Lower concentrations occur during the cooler Younger Dryas interval and the last glacial maximum. The similarities of the Ag and Cd records with the productivity records, and the fact that Ag and Cd are known to show nutrient-like distributions in the water column, suggest that these elements are associated with phytoplankton growth. These elements are precipitated in the sediments in the presence of trace amounts of porewater sulphide. On the other hand, Re, Mo and U respond to changes in oxidant demand in the near-surface sediments. The concentrations of these elements are observed to increase when concentrations of marine organic carbon are high. This suggests that increased productivity in the surface waters translates into increased export production, which in turn taxes the oxygen content in the surface sediments, resulting in precipitation of these elements in progressively reducing near-surface sediments.

Warm intervals over the last 50 kyr appear to be conducive to increased fertility over the Vancouver Island margin. The similarity of the trace element records with the productivity records suggests that productivity in the surface waters is intimately coupled with redox conditions in the surface sediments, with the export of phytoplankton remains providing the connection. The similarity of the trends in these collective records to trends in various productivity records from around the world suggests a large-scale ocean-atmospheric teleconnection.

Testing "self-shielding" model for the early solar nebula with laboratory experiment

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We propose a laboratory experiment of photodissociation and photoionization (PD/PI) of carbon monoxide (CO) molecules at ~8K at vacuum-ultraviolet (VUV) wavelength (90-110 nm). The purpose is to test the recently revived "self-shielding" model advanced to explain non-mass dependent oxygen isotope fractionation observed in the early Solar System materials [1-5]. The limitation for having to use LiF windows (wavelength cutoff at 105 nm) for the CO reaction cell has limited the relevance of recent efforts [6].

We will show detailed experimental set-up and procedures that would ensure the experimental conditions are more relevant to the solar nebular photochemistry of CO. The unique VUV laser photodissociation-photoionization mass spectrometry facilities at UC Davis [7] will allow VUV photodissociation study of CO + $h\nu$(VUV) → C + O in the 90-110 nm region in a windowless environment. The ultrahigh-resolution VUV laser will make possible the selective excitation of individual predissociative rovibronic states of the $^{12}C^{16}O$, $^{12}C^{17}O$, $^{12}C^{18}O$, and $^{13}C^{16}O$ isotopomers in the latter VUV range. The resulting oxygen atoms (^{18}O, ^{17}O, and ^{16}O) and carbon atoms (^{12}C and ^{13}C) will be directly detected by photoionization using a second VUV laser, such that the oxygen isotopic composition due to CO photodissociation can be measured *in situ* by the time-of-flight (TOF) mass spectrometer.

The success of this experiment, together with the highly anticipated GENESIS solar wind oxygen isotope measurements, will provide a crucial piece of information for understanding the puzzle of the observed oxygen isotope anomalies in the solar system known for over three decades but defied consensus explanation as of today [8].

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