A 1300 YEAR RECORD OF TOTAL ORGANIC CARBON, BLACK CARBON, AND OTHER BURNING TRACERS FROM A NORTHEAST GREENLAND ICE CORE

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Open burning and fossil-fuel combustion emit black carbon (BC), organic carbon (OC), and other radiatively important chemical compounds but at very different mixing ratios; the climate impact depends on those ratios. Ice core chemical and elemental records offer the possibility of reconstructing detailed, very precisely dated information on burning emissions and mixing ratios extending decades to millennia into the past. Biomass burning tracers such as vanillic acid, levoglucosan, organic acids, and ammonium, as well as industrial emissions tracers such as toxic heavy metals and non-sea-salt-sulfur, have been used to interpret ice-core BC records and develop understanding of past emissions sources as well as climate and other drivers of those emissions. However, various issues largely related to very low concentrations as well as contamination during sample collection, handling, and storage have precluded quantitative use of total organic carbon (TOC) or dissolved organic carbon (DOC) measurements in ice cores to reconstruct past mixing ratios and so assessment of overall climate impacts.

Here we present and discuss a 1,300 year record of TOC, BC, ammonium, and other biomass burning and industrial tracers from northeast Greenland. The 210 m ice core was collected in 2013 without the use of organic drilling fluids and the samples transported and stored in foil bags specifically to avoid TOC contamination, with measurements made using new protocols and methods for very low level, continuous TOC determinations. To our knowledge, this is the first reliable, centuries-long record of TOC developed from ice cores.