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Environmental variations and glacial history of Isfjorden, Spitsbergen, during the last 7000 years

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The sedimentary records of Arctic fjords can provide insights on the impact of natural variations and anthropogenic forcing on the glacier ice dynamics, notably in relation to ocean waters changes. The fjords of western Svalbard are characterized by large temperature and salinity gradients, which are determined by the relative inflow of warm and saline North Atlantic waters and the cold freshwater discharge from continental glacier runoff waters and Arctic coastal waters. In this context, the ice margin dynamics of the last ∼7000 years was studied from a core collected in central Isfjorden, W. Spitsbergen, where rapid sediment accumulation rates allowed high temporal resolution recordings. In this core, dinocyst assemblages provide indication on oceanographical conditions whereas the physical and geochemical properties of sediments relate to the dynamics of the terminal glaciers in the fjord.
The results show high frequency variations in sea surface conditions reconstructions throughout the sequence, in particular in temperature (SST), and sea ice cover. However, a general trend toward a cooling is observed in all conditions, SST decreases from 2,5 to 1,5°C and primary productivity decreases from 750 to 650 gC/m^2/year. Although the reconstructions show noisy variations, smooth curve reveals medium frequency suggesting millennial oscillations in sea ice cover, summer temperature and salinity. Near the bottom of the core, an interval encompassing from 7000 to 6500 cal. yrs BP is marked by a peak of abundance of Pentapharsodinium dalei, which reflects particularly high primary productivity. This peak corresponds to high calcium and strontium content which would come from glacial erosion from the inner part of the fjord. The reconstructions suggest that this interval was also marked by low SSS of 31 psu and high sea ice cover of 8 months/year. At ∼4000 cal. yrs BP, the grain size distribution and manganese content suggest a change in sedimentary regime, related to a glacial environment. This change is followed at ∼3600 cal. yrs BP by an increase in sea ice cover of 2 months/yr. At ∼2000 cal. yrs BP, the geochemical and dinocyst records are characterized by large amplitude variations in all elements as well as an increase in Impagidinium pallidum and Spiniferites elongatus, suggesting changes in the Atlantic water input. Principal component analysis made on sea surface conditions and geochemical data shows that sea ice cover and calcium and strontium are covariant. This would indicate a direct correlation between sea surface conditions and glacial activity since these elements come from glacial erosion.