Physical and chemical predictors of diatom dissolution in freshwater and saline lake sediments in North America and West Greenland

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ABSTRACT: Diatom dissolution in surface sediment samples from two regional lake datasets in the Northern Great Plains (NGP; n = 64) and West Greenland (n = 40) is assessed using a morphological approach categorizing valves during routine diatom analysis. Two dissolution indices are derived to parameterize diatom dissolution, and, when compared between two analysts in a blind test, show good correspondence and are closely correlated to diatom fragmentation. We explore the relationships between hydrochemical and physical lake parameters (including meromixis) on dissolution within both lake regions using multivariate methods and modeled with logistic regression. Salinity is the sole significant predictor of dissolution in West Greenland but salinity, carbonate concentration ($[CO_3^{2-}]$) and meromixis are significant predictors in the NGP. Limnological parameters explain 40-59% of variation in dissolution in both regions for both dissolution indices. The dissolution index methodology is applied to a short sediment sequence from Devils Lake (North Dakota), where diatom-inferred salinity inferences can be compared with a historical record of salinity fluctuations over the 20th century. Absolute errors in paleosalinity estimates are strongly correlated with diatom dissolution, with salinity overestimated in 8 out of 11 poorly preserved samples. Preservation does appear to constrain the reliability of the inferred paleosalinity at this site and may also affect the quality of diatom-based paleoenvironmental inferences elsewhere (including estimates of biogenic silica), where preservation state is often not explicitly considered.

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