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Grain-size analysis of lacustrine sediments: a comparison of pre-treatment methods

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Abstract. This study presents the results of an experimental investigation of five different pre-treatment methods for measuring the grain-size distribution of allochthonous siliclastic matter in cohesive organic-rich sediments and some comparisons with mineral-rich sediments. The loss on ignition (LOI) methods were the fastest for eliminating organic matter but here a problem of aggregate formation may arise. Oxidation with H_2O_2 was time and resource consuming. Getting reproducible results was hard and the reaction was not completed for grain-size analysis. Therefore the samples were also treated and carbonates were removed with HCl. It was also very important to remove biogenic silica by alkali treatment. The median values in grain-size spectra had trends towards finer grain size after treatment with KOH and observations with light microscope showed changes during treatments. The grain-size distribution measured by a laser particle sizer differed considerably between the five pre-treatment methods studied.

Key words: allochthonous siliclastic matter, biogenic silica, cohesive sediments, lake sediments, particle size, organic matter, pre-treatment methods.

INTRODUCTION

In an aquatic environment different compounds are incorporated within or absorbed on mineral matter depending on the physical, chemical, and biological processes that may change substantially the sediment texture. Extra difficulties arise in analysing fine-grained materials (clay and silt). Fine-grained sediments in an aquatic environment may aggregate into larger, porous aggregates commonly called flocs (Van Rijn, 1993; Roberts et al., 1998; Kim et al., 2005). These sediments are cohesive by definition (Hayter & Pakala, 1989; Paterson, 1997) and their composition and structure are temporally very changeable. The organic matter as well as different micro- and macrocomponents in the aquatic environment will be closely associated with suspended mineral particles, e.g. adsorbed on single particles, forming complexes with metal (usually iron) oxides on the surface of particles, become aggregates and are deposited or transported in this form within the lake. The large specific surface area, surface energy, and electrostatic charge of small and colloidal particles mainly drive coagulation (Gu et al., 1996).

Thus sediment texture gives very diverse information about the sedimentation environment. Depending on the aims of research, different methods are used to describe sediment texture. For example, electron microscopic research enables