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Grain size analysis using the FlowCAM® and its application to marine and lacustrine sediments

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The measurement of grain sizes is a standard method in lacustrine and marine sediment analysis in order to understand sedimentation processes. For grain sizes smaller than 63 μm two of the most commonly used analytical devices are Micromeritics Sedigraph® and Malvern Mastersizer®. Both devices measure particle diameters considering the particles as perfect spheres. Furthermore, the Sedigraph assumes equal density of all grains, whereas the Mastersizer uses the same refractive index. This is, however, not true for natural sediments of, e.g., lacustrine or marine origin. The assumptions lead to the results that the Sedigraph assigns the same grain size to particles that have the same settling velocity, whereas the Mastersizer allocates the same size to all particles that produce the same refraction pattern. In order to minimize misinterpretations of grainsize measurements, we here present a comprehensive experiment using a Fluid Imaging Technologies FlowCAM®. It is an optical instrument that was developed for the analysis of biological particles such as pollen and plankton. The FlowCAM photographs every individual particle and directly determines its size from the picture without any further assumptions. Furthermore, numerous geometric properties of each particle are measured and can be used to sort and count particles automatically. After using standard particles for calibrating the FlowCAM, we used the silt fraction of lacustrine and marine sediments in order to test its applicability for grain size measurements. The samples were prepared with standard procedures for grain size analysis and measured in parallel using FlowCAM, Mastersizer and Sedigraph. The comparison of the three methods has shown that the FlowCAM successfully measures reproducible grain size distributions that are in agreement within the differences usually encountered between different methods. The experiment thus revealed that the FlowCAM offers the opportunity to measure, visualize and characterize grain size distributions in a fast, inexpensive way. Further, the analysis uses only a very small amount of sample material which can be reused.