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Comparison of different measurement techniques of micro-particles in polar snow and ice

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Water-insoluble micro-particles in ice cores have been extensively analysed to investigate the past climatic and environmental changes. Temporal and spatial variations of size distribution and flux have been discussed in many papers. Definition of particle size, however, is not always straightforward. Flux of particles is calculated from particle volume, particle density and snow accumulation rate, thus affected by the definition of particle size, which depends on the measurement technique. Comparison of the size distribution and flux data from different measurement techniques requires caution. Here we compare the measurement results from traditionally used three types of micro-particle analysers: (1) Coulter Multsizer 4, which directly measures volume of each particle; (2) Klotz Abakus, which detects shading of laser light caused by each particle; and (3) Met One Model 211, a laser scattering type particle analyser. We also show the results from a newly introduced micro-particle analyser JASCO IF-200nano, which is based on image processing technique. The new analyser indicated that Abakus and Met One Model 211 gave size distribution different from Coulter Multisizer 4 when particle shape departed greatly from spherical shape.

Our results suggest that dust particles in Antarctic Dome Fuji core have spherical shape during glacials, while they have irregular shapes during inter-glacials. Changes in particle shape would give additional information on the past climate and environment. Our results also indicate that comparison of size distribution and flux data obtained with different measurement techniques requires much more caution than previously thought.

Keywords: micro-particles, analytical techniques, polar snow and ice