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Raman spectroscopy on ice cores from Greenland and Antarctica

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Ice cores are invaluable archives for the reconstruction of the climatic history of the earth. Besides the analysis of various climatic processes from isotopes and chemical signatures they offer the unique possibility of directly extracting the past atmosphere from gaseous inclusions in the ice. Many aspects of the formation and alterations of these inclusions, e.g. the entrapment of air at the firn-ice-transition, the formation of crystalline gas hydrates (clathrates) from the bubbles or the structural relaxation during storage of the cores, need to be better understood to enable reliable interpretations of the obtained data. Modern micro Raman spectroscopy is an excellent tool to obtain high-quality data for all of these aspects. It has been productively used for phase identification of solid inclusions [1], investigation of air clathrates [2] and high-resolution measurements of N_2/O_2 mixing ratios inside individual air bubbles [3,4].

Detailed examples of the various uses of Raman spectroscopy will be presented along with practical information about the techniques required to obtain high-quality spectra. Retrieval and interpretation of quantitative data from the spectra will be explained. Future possibilities for advanced uses of Raman spectroscopy for ice core research will be discussed.

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[3] T. Ikeda-Fukazawa et al., 2001, Variation in N_2/O_2 ratio of occluded air in Dome Fuji antarctic ice. Journal of Geophysical Research, 106, 17799-17810.

[4] C. Weikusat et al., Raman spectroscopy of gaseous inclusions in EDML ice core: First results - microbubbles. Journal of Glaciology, accepted.