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Evolution of the anisotropic structure of ice and pore spaces in firn at NEEM

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The evolution of the structure of firn core recovered at NEEM camp was investigated in order to improve our understanding of firn densification and bubble formation processes. The relative dielectric permittivities in both the vertical and horizontal planes were measured at ˜35 GHz. The results were compared with those of firn at Dome Fuji in East Antarctica. Results are summarized as follows. Down to ˜20 m, permittivity exhibited a positive correlation with the strength of dielectric anisotropy along the vertical. In contrast, the correlation is negative in deeper firn. This is a feature of the density crossover. We found that the crossover density is almost the same at NEEM and at Dome Fuji, confirming earlier studies of the polar firn. A remarkable difference between two sites is that strength of dielectric anisotropy at NEEM is only two thirds of that at Dome Fuji. In addition, negative correlation between permittivity and dielectric anisotropy is much more developed at NEEM. This fact suggests that the 3-D vertical anisotropic structure decreases rapidly in firn at NEEM and that limited layers deform rapidly by some factor. In contrast, at Dome Fuji, 3-D vertical anisotropic structure is preserved much longer period of time than NEEM. We speculate that at NEEM impurity plays a major role for selective deformation and that at Dome Fuji texture plays a major role for selective deformation.

Keywords: Greenland, ice sheet, firn, metamorphism, densification, NEEM