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Isothermal metamorphism of snow at different temperatures

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Isothermal metamorphism is based on the fundamental process of snow sintering. However, the physical processes responsible for sintering are still debated. Probable processes are grain-boundary diffusion or sublimation-condensation, but no conclusive experiments were conducted until now which support unequivocally one or the other theory. We observed the changes in porosity, shape factor, specific surface area, and trabecular number during one year at intervals of 1 months at temperatures of -3, -10, -20 and -50°C of undisturbed metamorphing snow samples using x-ray microtomography. The results showed a first phase of very rapid initial change in porosity and specific surface area during the first month and rapid change of trabecular number and shape factor and a second phase where trabecular number and shape were constant but a decrease in porosity and specific surface area following a power law was observed. Our measurements and observations indicate that grain-boundary diffusion is the dominating process during isothermal metamorphism. At -50°C the changes in porosity were slow, and specific surface area changed by only 10% from the inital value after 1 year. The initial phase of snow metamorphism from new snow to a more rounded shape require data at higher temporal resolution than available.