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COMPOSITION OF BASAL ICE IN THE RHONE AND TAYLOR GLACIERS, MCMURDO DRY VALLEYS, ANTARCTICA

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The study of ice composition sheds light on the processes operating at the ice-bedrock interface by inferring the processes of basal ice formation and deformation. This paper compares the isotopic and solute composition of basal ice from the Rhone and Taylor glaciers located in the McMurdo Dry Valleys, Antarctica. Rhone Glacier is a small cold-based glacier with a basal ice temperature of -17^{o}C. Its basal zone is characterised by a 4.0 m thick basal sequence of stratified and amber ice that rests below 18 m of clean englacial ice. Taylor Glacier is a large outlet glacier that flows from Taylor Dome, an independent dome within the East Antarctic Ice Sheet. At the terminus, Taylor Glacier has a basal temperature of -18^{o}C but upstream it is believed to be at pressure melting point. The basal zone of the Taylor Glacier is characterised by a 4.0 m thick sequence of relatively clean ice, laminated and dispersed debris facies. In the laboratory ice from the basal zone was sub-sampled and the stable isotopes (δ^{18}O and δD) and solutes were analysed. The englacial ice from both glaciers is characterised by very low solute concentrations and isotopic values that plot on the local meteoric water line. The amber ice has a distinct yellow-greenish colour, debris concentrations between values for the englacial and stratified facies, and relatively high solute concentrations, yet plots on a co-isotopic slope of 8.4 which is indistinguishable from the meteoric water line. In the Rhone Glacier, it appears that melt water has played a role in the formation of the stratified facies. In contrast, the laminated facies from the Taylor Glacier has a very high solute loading, relatively high debris concentrations, compared to the clean and dispersed facies, yet plots on a co-isotopic slope of 8.2 which is consistent with a meteoric water line. The combination of entrained debris, high solutes and laminations is consistent with interaction at the glacier bed and regelation, however, co-isotopic analysis shows that the ice plots on a slope that is indistinguishable from a meteoric water line. Clearly, there is a conflict between inferring ice formation from physical characteristics, and the statistically-derived interpretation of co-isotopic analysis.