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Gas properties of EPICA Dronning Maud Land (EDML) basal refrozen water

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Gas composition and total gas content are studied and discussed for different samples of refrozen water retrieved from the bottom of the EPICA Dronning Maud Land (EDML) drilling site. At the end of this deep Antarctic drilling (2774.15 m), some water of subglacial origin went up the borehole. This water, mixed with the drilling liquid and the densifier forming a new ice in the drill hole. The ice clearly differs from ice of meteoric origin. It doesn't look as compact, has irregular shape and an opaque whitish aspect similar to clathrate ice.

Total gas content measurements were carried out using two different methods. The first one consists in a Toepler pump extraction line under vacuum conditions. We show that the presence of the drilling liquid and of the densifier makes this method inadequate because of the very high vapor pressure of the densifier. The other method is inspired from early days techniques for collecting gases from ice, melting it in a closed water environment at atmospheric pressure. The amount of gas collected, up to 3 liters per kilo of melted ice, could be explained by dissolution of air in water under high overburden pressure, compatible with the local ice thickness.

Analysis of the gas composition was also carried out applying various extraction methods: melting in a closed water environment (as described above), dry-crushing under vacuum at low temperature and melting-refreezing. Results clearly indicate the presence of a water/drilling fluid mixture. Although atmospheric-type gases are present, their characteristics differ from usual atmospheric. The O_2/N_2 ratio suggests that their composition is intermediate between atmospheric and air dissolved in water. CO_2, however, although much higher in concentration than in atmospheric air, is clearly

undersatured. The same is valid for methane. These results also differ from basal ice values measured in the GRIP, Camp Century and Dye-3 deep ice cores. Potential explanations are discussed.