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Investigating the « ice mélange » in an ice-shelf coastal rift along the Princess Ragnhild Coast (Antarctica)

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This paper presents the first results of a glaciological investigation conducted in the vicinity of the new Belgian Antarctic research station "Princess Elisabeth" during the 2008-2009 Antarctic field season. The study is part of the BELISSIMA project which aim is to investigate the dynamics of transition zones at the grounding line and the interaction of the ice sheet and the ice-shelf with the ocean, with respect to the stability of the ice sheet.
The studied site is a conspicuous rift zone developed in a short floating ice shelf, a few kilometres downstream from the grounding line associated with the presence of a coastal ice dome. The rift, very close to the location of the old Belgian Station "Base Roi Baudouin", is about 10 km long and between 0.5 and 4 km wide. A natural ramp on the eastern apex of the rift allowed access to the rift base, from where a series of five, 10-38 m-long cores were recovered. Visual observation of these cores indicates that they consist of heterogeneous ice types, which is typical of what is often referred to as the "ice mélange". Wind-blown snow, firn and ice dominate outside the rift and within the rift's apex ramp. However, within the base of the rift proper, where episodic tensional stresses dominate, the ice is correspondingly more heavily crevassed and shows clear surface albedo contrasts, suggesting material heterogeneity. Ice cores from these areas show an abrupt transition within a few metres of the surface from surface-derived firn and ice to a sharply contrasting ice type that is translucent, greenish, and bubble-free –interpreted as marine ice. Such ice results from the consolidation of frazil ice crystals which are known to be forming in Ice Shelf Water through ice-ocean interactions in other regions of Antarctica (e.g. Filchner-Ronne Ice Shelf, Amery ice Shelf, Nansen Ice Shelf). One of our drill sites was located in a surface outcrop of marine ice, yielding 13 m of solid translucent ice, overlying $\sim$0.5 m of fragile and loosely consolidated ice before the sub-shelf interface was reached. Borehole images from below this interface reveal an additional thickness of at least 5 m of loose platelet ice crystals located below the shelf, suggesting an active thermohaline convection in the region.
The paper presents textural, structural, bulk salinity, bulk density and stable isotopes (DeltaD, Delta18O) results from the five ice cores and discusses origin and transformation of the various ice types forming the "ice mélange" and their potential impact on the welding efficiency of the rift.