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Optical televiewer imaging of ice facies within and around an Antarctic ice shelf rift

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Five 10-40 m-long boreholes has been cored through snow and ice in and around a rift near the seaward edge of the Roi Baudouin Ice Shelf, Dronning Maud Land, Antarctica, as part of the BELISSIMA research programme. Deployment of a digital optical televiewer (OPTV) in four of these holes has resulted in the first complete borehole images of several ice shelf and rift facies. Outside the rift, the uppermost tens of metres of the shelf is composed of snow, progressing to firn at depth. Here, the snow and firn contain frequent mm- to cm- thick horizontal ice layers, presumably reflecting surface firnification frequently disrupted by seasonal or shorter-term melting events. In contrast, snow within the rift's apex ramp is homogeneous to depths of tens of metres, containing only very occasional ice layers. These properties are consistent with this facies being formed predominantly from wind-blown snow deposited in the lee of the rift's steep edges. Within the rift itself, boreholes intersect translucent ice with a greenish hue that shows no apparent layering but which contains occasional aggregated clusters of irregularly-shaped gas bubbles. This ice commonly extends to the surface of the rift and can be only metres to tens of metres thick before the base of the rift is intersected. This visually-distinctive ice is interpreted as marine ice that has formed within the rift and now crops out at the rift surface. The rift base was penetrated at a depth of $\sim$13 m by one borehole, revealing the presence of an unknown (but at least 5 m) additional thickness of unconsolidated ice platelets. While these platelets could not be retrieved by coring, OPTV images from below the base of the borehole indicate that these 'sub-shelf' platelets are layered in a highly irregular and contorted manner. We believe these OPTV images are the first that have been reported of the structure of in situ sub-shelf platelet ice.