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Late Pliocene margin development and mega debris flow deposits on the Antarctic continental margins: evidence of the onset of the modern Antarctic Ice Sheet?

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Polar areas exert a major influence on global climate and sea level and understanding ice sheet behavior in the past is essential to predict future climate changes. The directly record of the ice cores extends only to the recentmost evolutionary stages, but previous past ice sheet regimes are recorded by the sediments of the polar margins. The latest major step in the evolution of polar continental margins, that from temperate to polar conditions, is still poorly known.

Recently, increasing evidence for a late Pliocene temperate to polar evolution of the Antarctic continental margins suggests that the high sediment input from focused ice streams produces a phase of margin instability characterized by enhanced margin progradation. The aim of this study is to review these evidences and provide a comprehensive model.

The major evidence is the striking similarity in the architecture of last depositional stage in different sectors of the Antarctic margin: 1) focused erosion on the continental shelf; 2) enhanced progradation of the shelf edge and downlap on the continental slope; 3) major mass wasting deposits on the continental rise and subsequent sediment starvation within a trend of decreasing accumulation rates.

We infer that at the temperate/polar transition the initial widespread glacial erosion on the shelf is substituted by focused erosion within a few troughs at the base of large

dynamic ice streams, where the presence of abundant meltwater is most likely. The previous evenly spread progradation of the shelf edge is replaced by enhanced deposition within the fan at the mouth of the troughs. We infer that the largest margin slope failures occur during the temperate/polar transition,. The successive downlap of the glacial prograding wedges on the lower continental slope and the associated sediment starvation of the continental rise result from a lower efficiency in the downward sediment transport, which in turn is related to the reduced presence of meltwater at the base of the ice. All these changes are in apparent broad synchronism in the late Pliocene (nearly 3 Ma) as observed in different sectors of the Antarctic margins, and especially in Antarctic Peninsula and Prydz Bay margins.