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Variability in Cenozoic sedimentation and paleo-water depths of the Weddell Sea basin related to pre-glacial and glacial conditions of Antarctica

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The Weddell Sea basin is of particular significance for understanding climate processes, including the generation of ocean water masses and their influence on ocean circulation as well as the dynamics of the Antarctic ice sheets. The sedimentary record, preserved below the basin floor, serves as an archive of the pre-glacial to glacial development of these processes, which were accompanied by tectonic processes in its early glacial phase. Three multichannel seismic reflection transects, in total nearly 5000 km long, are used to interpret horizons and define a seismostratigraphic model for the basin. We expand this initial stratigraphy model to the greater Weddell Sea region through a network of more than 200 additional seismic lines. Data from available few boreholes are used to constrain sediment ages in this stratigraphy, supported by magnetic anomalies that show the decrease in oceanic basement ages from southeast to northwest. Using these data, we calculate grids to depict the depths, thicknesses and sedimentation rates of pre-glacial (145-34 Ma), transitional (34-15 Ma) and full-glacial (15 Ma to present) units. The grids allow us to compare the sedimentary regimes of the pre-glacially dominated and glacially dominated stages of Weddell Sea history. The pre-glacial deposition with thicknesses of up to 5 km was controlled by the tectonic evolution and sea-floor spreading history interacting with terrigenous sediment supply. The transitional unit shows a relatively high sedimentation rate and has thicknesses of up to 3 km, which may attribute to an early formation of the East Antarctic Ice Sheet, which was partly advanced to the coast or even inner shelf. The main deposition center of the full-glacial unit lies in front of the Filchner-Ronne Ice Shelf and has sedimentation rates of up to 140-200 m/m.y., which infers that ice sheets grounded on the middle to outer shelf and that bottom-water currents strongly impacted the sedimentation. We further calculate paleobathymetric grids at 15 Ma, 34 Ma, 120 Ma by using a backstripping technique. Our results provide constraints for an improved understanding of the paleo-ice sheet dynamics and paleoclimate conditions of the Weddell Sea region.