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Antarctic Sedimentary Basins: defining crucial constraints on ice-sheet and solid-earth dynamic interactions

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Subglacial and ice-sheet marginal sedimentary basins have very different physical properties to crystalline bedrock and, therefore, form distinct conditions that influence the flow of ice above. Sedimentary rocks are particularly soft and erodible, and therefore capable of sustaining layers of subglacial till that may deform to facilitate fast ice flow downstream. Furthermore, sedimentary rocks are relatively permeable and thus allow for enhanced fluid flux, with associated impacts on ice-sheet dynamics, including feedbacks with subglacial hydrologic systems and transport of heat to the ice-sheet bed. Despite the importance for ice-sheet dynamics there is, at present, no comprehensive record of sedimentary basins in the Antarctic continent, limiting our capacity to investigate these influences. Here we develop the first version of an Antarctic-wide spatial database of sedimentary basins, their geometries and physical attributes. We emphasise the definition of in-situ and undeformed basins that retain their primary characteristics, including relative weakness and high permeability, and therefore are more likely to influence ice sheet dynamics. We define the likely extents and nature of sedimentary basins, considering a range of geological and geophysical data, including: outcrop observations, gravity and magnetic data, radio-echo sounding data and passive and active-source seismic data. Our interpretation also involves derivative products from these data, including analyses guided by machine learning. The database includes for each basin its defining characteristics in the source datasets, and interpreted information on likely basin age, sedimentary thickness, surface morphology and tectonic type. The database is constructed in ESRI geodatabase format and is suitable for incorporation in multifaceted data-interpretation and modelling procedures. It can be readily updated given new information. We define extensive basins in both East and West Antarctica, including major regions

in the Ross and Weddell Sea embayments and the Amundsen Sea region of West Antarctica, and the Wilkes, Aurora and Recovery subglacial basins of East Antarctica. The compilation includes smaller basins within crystalline-bedrock dominated areas such as the Transantarctic Mountains, the Antarctic Peninsula and Dronning Maud Land. The distribution of sedimentary basins reveals the combined influence of the tectonic and glacial history of Antarctica on the current and future configuration of the Antarctic Ice Sheet and highlights areas in which the presence of dynamically-evolving subglacial till layers and the exchange of groundwater and heat with the ice sheet bed are more likely, contributing to dynamic behaviour of the Antarctic Ice Sheet.