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Assessing the structures and dynamics of Bach ice shelf, Antarctic Peninsula, 1973-2009

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Bach ice shelf is situated in the Webber Inlet of Alexander Island on the Antarctic Peninsula, and covers an area of ∼6000 km2. Over the 26-year period investigated here, 330 km2 of ice calved from the margin, with the two largest retreats occurring between November 1989/January 1990 and December 2001/February 2003. Since March 2005, the ice front has entered a cycle of steady calving followed by steady growth. A structural assessment of Bach ice shelf has been conducted using a combination of Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and Landsat images from 1973 to 2009. Mapped surface features include longitudinal and transverse flow structures, crevasses and rifts, meltwater ponds and channels and ice marginal position and ice-shelf spatial extent. Much of the ice-shelf interior is void of visible surface structures. However, meltwater features are well distributed in northern and western regions of Bach ice shelf, typically forming elongated, interconnecting channels in topographic lows that are associated with longitudinal flow structures. ASTER derived DEMs show that meltwater ponds form at the base of the land/ ice-shelf margin, and in distinct zones in the central-shelf region where ice-shelf topography is more uniform. The formation of these melt ponds into an interconnecting-arc suggest a change in sub-glacial/ sub-marine topographic relief, possibly linked to the grounding zone position. Between February 2003 and March 2004 a large rift appeared ∼9 km from the retreating ice margin. A second rift appeared ∼8 km from the ice margin between March 2004 and March 2005. These rifts are ∼17 km in length and run sub-parallel to the ice margin. Optical feature tracking of Landsat imagery details a uniform velocity across the length of these rifts with an increase of flow speeds from 78 ma-1 between March 2004 and March 2005, to 130 ma-1 between March 2005 and January 2006. It is suggested that rift propagation in this region is due to a combination of internal glaciological stress factors and an increase in flow velocity. Initial interferometric analysis of ERS-1 and ERS-2 SAR images also suggests that ice-shelf velocities have increased over the period from 1995 to 2004.