

Kerguelen glacier fluctuations in pace with changes in $\delta^{18}\text{O}$ and snow accumulation from the west Antarctic Ice core record over the last 25 000 years

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Abstract

The Kerguelen Islands located in the Indian Ocean constitute the largest currently glaciated archipelago (520 km² glaciated in 2010) in sub Antarctic regions with several marine and land terminating margins from the Cook Ice Cap (CIC). Constraining the timing of glacier changes in Kerguelen offers a unique opportunity to investigate the regional climate mechanisms driven and links with Antarctic and related SAM fluctuations.

Here, we present the first direct dating of glacier fluctuations at Kerguelen from 21 ³⁶Cl CRE ages obtained from roche moutonnée surfaces, erratics and boulders collected on moraines from CIC outlet glaciers. The earliest evidence of CIC retreat comes from erratic boulders dated to 24.4 ± 2.7 ka ago. The exact extent of the CIC during the global LGM is unknown, but it probably exceeded the location of the erratics deposited about 30 km away for the cook ice cape indicating that retreat likely started earlier. During the Late Glacial, the glaciers from CIC experienced a major advance or stillstand at about ~13 ka ago, most likely during the ACR chronozone. Deglaciation continued during the Holocene probably until 3 ka with evidence of minor advances during the last millennium. Our glacier record at Kerguelen depicts a remarkable phasing with temperature changes recently documented by $\delta^{18}\text{O}$ variations in the West Antarctica ice core (WAIS divide) and an antiphasing with snow accumulation rate change resulting from variations in moisture-bearing storms penetrating into West Antarctica, due to a shift of the mid-latitude storm track mainly driven by the Southern Annular Mode phases (SAM). This influence of the SAM on glaciers at Kerguelen in the past is supported by recent observations revealing that the unprecedented SAM+ situation over the last millennium was the main driver of recent dryness at Kerguelen and of the resulting dramatic wastage of CIC over the last five decades (Favier et al., 2016).