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Paleoglaciation of the Tibetan Plateau based on exposure ages and ELA depression estimates

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The Tibetan Plateau holds a major part of all glaciers outside the polar regions and an ample record of past glaciations. The glacial history of the Tibetan Plateau has attracted significant interest, with a large body of research investigating the extent, timing, and climatic implications of past glaciations. Here I present an extensive compilation of exposure ages and equilibrium line altitude (ELA) depression estimates from glacial deposits across the Tibetan Plateau to address the timing and degree of past glaciations. I compiled Be-10 exposure age data for a total of 1877 samples and recalculated exposure ages using an updated (lower) global Be-10 production rate. All samples were organized in groups of individual glacial deposits where each deposit represents one glacial event enabling evaluation of the exposure age clustering. For each glacial deposit I estimated the ELA depression based on a simple toe to headwall ratio approach using Google Earth. To discriminate good (well-clustered) from poor (scattered) exposure age groups the glacial deposits were divided into three groups based on exposure age clustering. A major part of the glacial deposits have scattered exposure ages affected by prior or incomplete exposure, complicating exposure age interpretations. The well-clustered exposure age groups are primarily from mountain ranges along the margins of the Tibetan Plateau with a main peak in age between 10 and 30 ka, indicating glacial advances during the global last glacial maximum (LGM). A large number of exposure ages older than 30 ka indicates maximum glaciation predating the LGM, but the exposure age scatter generally prohibits accurate definition of the glacial chronology. The ELA depression estimates scatter significantly, but a major part is remarkably low. Average ELA depressions of 333 $\pm$ 191 m for the LGM and 494 $\pm$ 280 m for the pre-LGM exposure indicate restricted glacier expansion and limited glacial cooling.