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Developing a chronology for former subglacial Hodgson Lake, Antarctic Peninsula

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At retreating margins of the Antarctic Ice Sheet, there are a number of locations where former subglacial lakes are emerging from under the ice, but remain perennially ice-covered. Here, we summarise the key chronological data that led us to define Hodgson Lake, situated on southern Alexander Island, west of the Antarctic Peninsula (72 00.549' S, 068 27.708' W) as a former subglacial lake. Chronological, geomorphological and isotopic methods were used to determine the local ice sheet deglaciation history. The emergence history of the lake and its catchment was reconstructed using a combination of cosmogenic isotope dating of glacial erratics, optically stimulated luminescence (OSL) dating of raised lake shoreline deltas formed during ice recession, and radiocarbon, OSL and relative palaeomagnetic intensity dating of a lake sediment core. We also undertook isotopic analysis of current, and relic, lake ice and water to determine its source. Cosmogenic exposure dating results show that the ice mass over Hodgson Lake was at least 300 m thick at 13.5 ka, and has progressively thinned through the Holocene with the lake ice cover reaching the raised delta altitude of c. 6.5 m above the present lake ice sometime after 4.6 ka. Based on an age-depth model constructed from radiocarbon and valid OSL ages, we assign a well-defined magnetic polarity reversal event at c. 165 cm in the lake sediments to the Mono Lake excursion (c. 30-34 ka). We cannot rule out the Laschamp excursion (c. 40-42 ka) as an explanation for the c. 165 cm reversal, however, because it has been has been more consistently identified in terrestrial and marine sediments around the world then the Mono Lake excursion. Nevertheless, the low RPI from c. 165 cm to the base of the core likely represents a period of reduced palaeointensity in the geomagnetic field in the c. 50-28 ka time period and/or a change in sediment source. Our age-depth model suggests that sediments deeper than 165 cm are older than at least 27 ka. Material incorporated into the basal sediment might date to as old as c. 90-100 ka (OSL), but these sediments are not well-bleached, and could be younger. Thick perennial ice cover persists over the lake and the waters have remained isolated from the atmosphere. Its isotopic composition is consistent with being derived from subglacial melt of ice derived from meteoric precipitation acquired from the ocean. Nutrients are at levels within the ranges of those found in the accreted lake ice of Lake Vostok and total organic carbon and dissolved organic carbon are present, but at lower concentrations than typically recorded in continental rain, and possibly indicative of a subglacial origin. Combined, these studies have tested some of the methodologies that will be used to explore deep continental subglacial lakes.