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Postglacial relative sea-level history of the Prince Rupert area, British Columbia, Canada

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ABSTRACT

This paper presents a history of relative sea level (RSL) change for the last 15,000 years in the Prince Rupert region on the northern coast of British Columbia, Canada. One hundred twenty-three radiocarbon ages of organic material from isolation basin cores, sediment sequence exposures, and archaeological sites having a recognized relation to past sea levels constrain postglacial RSL. The large number of new measurements relating to past sea-level provides a well constrained RSL curve that differs in significant ways from previously published results. After deglaciation following the Last Glacial Maximum, the region experienced an isostatically-induced rapid RSL drop from as much 50 m asl to as low as −6.3 m asl in as little as a few centuries between 14,500 BP and 13,500 BP. After a lowstand below current sea level for about 2000 years during the terminal Pleistocene, RSL rose again to a highstand at least 6 m asl after the end of the Younger Dryas. RSL slowly dropped through the Holocene to close to its current position by 2000-1500 BP, with some potential fluctuations between 3500 and 1500 BP. This study highlights variation in RSL histories across relatively short distances, which must be accounted for by local RSL reconstructions such as this one. This RSL curve aided in the identification of an 8000–9000 year old archaeological site on a 10–12 m asl terrace, which is currently the earliest dated archaeological site in the area, and it provides guidance for searching for even older archaeological remains. We highlight the utility and potential of this refined RSL history for developing surveys for other archaeological sites associated with paleoshorelines.

1. Introduction

Several decades ago, pioneering regional compilations of radiocarbon dated relative sea level (RSL) data by Mathews et al. (1970) and Clague et al. (1982) demonstrated the variability of RSL histories on the west coast of North America since the end of the Fraser Glaciation, largely related to the location and thickness of ice sheets, the timing of their retreat, and the net result of subsequent isostatic adjustments, eustatic sea level change, neotectonic movements, and sedimentation processes. New compilations have highlighted and re-emphasized this variability (Engelhart et al., 2015; Shugar et al., 2014). RSL histories are key components of paleoenvironmental and landscape reconstructions, and are intimately tied to understanding geomorphological and biological (both human and non-human) change on coastal landscapes through the Holocene. Knowing how RSL changes transform coastal landscapes is a key component for identifying and interpreting the archaeological record along coasts, particularly for the terminal Pleistocene and early Holocene. To date, RSL studies on the northern Northwest Coast mainland have been limited in scope compared to other parts of the region (see summaries in Engelhart et al., 2015; Shugar et al., 2014).

This paper presents new data refining our understanding of the postglacial RSL history of the area around Prince Rupert, on the north coast of British Columbia, Canada (Fig. 1). We use diverse methods for studying RSL change to generate a robust RSL curve based on a large dataset of limiting and index points. We discuss what this information tells us about postglacial dynamics and coastline change through the Holocene, demonstrate its utility for

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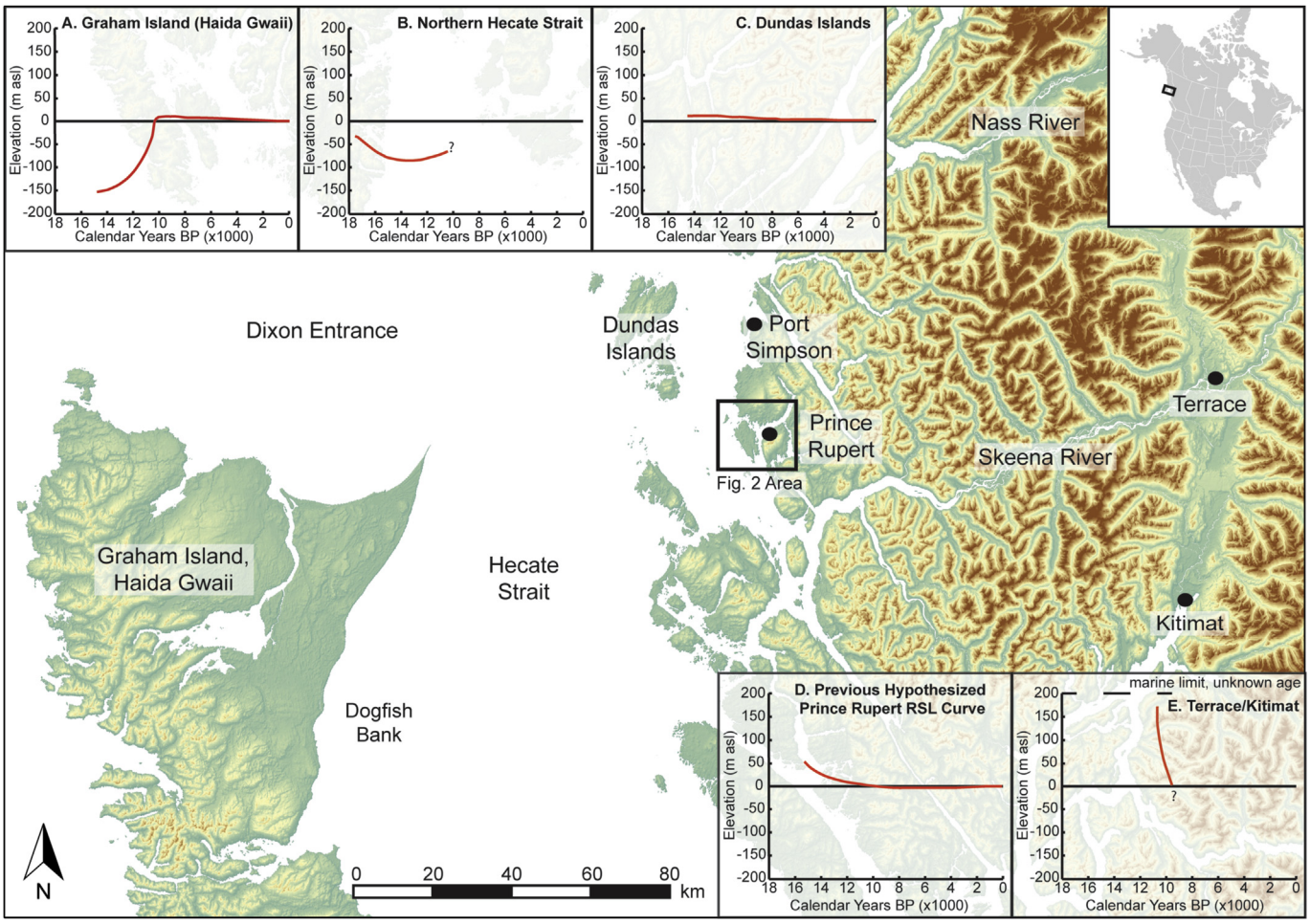

Fig. 1. Northern coast of British Columbia with study area highlighted. RSL curves for locations across a west-east transect are shown (modified from Shugar et al., 2014), including the previously hypothesized curve for the Prince Rupert Harbour area. Modern communities are indicated by black dots.

locating evidence for early human occupation in the study area, and outline the importance of this new data for modelling of glacio-isostatic changes in northern British Columbia.

1.1. Study area

The study area (Fig. 2) is on the northern margin of the Hecate Lowlands, a 15–60 km wide area of low relief that extends about 600 km along the northern mainland coast between an offshore coastal trough and the Coast Mountains, and includes many low islands close to the mainland. The surficial geology of the study area is primarily organic (usually peat) veneers or blankets over patches of glaciomarine sediments (clays, silts and dropstones) which in turn overlie metamorphic bedrock (Clague, 1984; Massey et al., 2005). In a few areas there are massive deposits of glacial till. Shorelines are crenulated, particularly along the northern shore of Prince Rupert Harbour and through Venn Pass, where there are many sheltered bays, small inlets, and tidal channels. These shorelines often have sand and mud flats extending hundreds of meters at low tides. The Prince Rupert Harbour itself is a deep waterway, one of many glacially carved inlets and valleys in the wider region, the largest of which are Portland Inlet and the Nass River valley to the north and the Skeena River valley to the south.

Today the two principal communities in the study area are the city of Prince Rupert and the reserve town of Metlakatla, but prior to European contact the area included dozens of contemporaneously occupied villages inhabited by the ancestors of the Tsimshian peoples (MacDonald and Inglis, 1981; Ames, 2005). Archaeological remains of these villages dot the shorelines along bays and passes. These ancient inhabitants had an intimate relation with the sea, and understanding how shorelines have changed through time is important for locating and interpreting past peoples' material remains. The rich archaeological record indicates that Prince Rupert Harbour was one of the most densely occupied areas of the Northwest Coast by around 3000 years ago (Ames and Martindale, 2014). However, even with a century of archaeological research that includes intensive radiocarbon dating (e.g. Ames, 2005; Archer, 1992, 2001; Coupland, 1988, 2006; Coupland et al., 1993, 2001, 2003, 2009, 2010; Drucker, 1943; MacDonald, 1969; MacDonald and Cybulski, 2001; MacDonald and Inglis, 1981; Smith, 1909), no archaeological sites dating earlier than 6000 years BP had been identified prior to our research. Elsewhere on the northern coast, terminal Pleistocene and early Holocene archaeological remains are being found with increasing frequency on paleoshorelines in the wake of detailed RSL reconstructions (Carlson and Baichtal, 2015; Fedje and Christensen, 1999; Fedje et al., 2005a, 2011; Josenhans et al., 1997; Mackie et al., 2011; McLaren et al., 2011). Our research objectives are similar, and include using RSL data to survey for evidence of earlier occupation in this archaeologically-important place. We also seek to refine the understanding of postglacial landform dynamics in northern British Columbia, which we review next.