Quaternary Geochronology 30 (2015) 275–281

Contents lists available at ScienceDirect

Quaternary Geochronology

journal homepage: www.elsevier.com/locate/quageo

Toward a luminescence chronology for coastal dune and beach deposits on Calvert Island, British Columbia central coast, Canada

Christina M. Neudorf [a, c, *], Olav B. Lian [a, b, c], Ian J. Walker [b, c], Dan H. Shugar [b, c], Jordan B.R. Eamer [b, c], Libby C.M. Griffin [a, c]

[a] Department of Geography and the Environment, University of the Fraser Valley, Abbotsford, BC, Canada
[b] Department of Geography, University of Victoria, Victoria, BC, Canada
[c] Hakai Institute, Calvert Island, BC, Canada

ARTICLE INFO

Article history:
Received 30 October 2014
Received in revised form
6 December 2014
Accepted 10 December 2014
Available online 11 December 2014

Keywords:
Optical dating
K-feldspar
Anomalous fading
Phototransfer
Coastal geomorphology
British Columbia central coast

ABSTRACT

The Quaternary geology of the central coast of British Columbia contains a rich and complex record of glacial activity, post-glacial sea level and landscape change, and early human occupation spanning the last ~10,000 years. At present, however, this region remains a largely understudied portion of coastal North America. This study describes the luminescence characteristics of quartz and K-feldspar from coastal dune and beach sands on Calvert Island and develops a suitable optical dating protocol that will allow for a more rigorous chronology for post-glacial landscape evolution and human occupation on British Columbia's central coast. Luminescence signals from Calvert Island quartz are dim, and appear to lack the so-called "fast" component that is most desirable for optical dating. K-feldspar signals are sufficiently bright for optical dating. We test and refine a single-aliquot regenerative-dose (SAR) protocol for K-feldspar specific to Calvert Island samples through a series of dose recovery and preheat plateau tests. Two approaches for correcting a sample age for anomalous fading are compared and a correction for phototransfer is introduced and applied. Measured fading rates vary from sample to sample implying that, in this region, it is not sufficient to rely on two or three representative fading rates as has sometimes been done elsewhere. Refined age estimates show consistency with independent radiocarbon dating control and help identify radiocarbon-dated organic-rich sediments that have been reworked.

1. Introduction

Recent research on the central coast of British Columbia (BC), Canada, suggests that it has a unique postglacial history as sea level has remained remarkably stable since deglaciation and archaeological evidence exists for continuous human occupation for at least the last 10,000 years (Shugar et al., 2014; McLaren et al., 2014). Calvert Island, located south of Hakai Pass, hosts a variety of coastal landforms including bluff- and dune-backed embayed beaches, tombolos, and stabilized dune complexes that contain important records of environmental change, landscape evolution, and human occupation during postglacial time. This part of the BC coast is a focus of the Hakai Institute, which supports several collaborative geographical, geological, biological, and archaeological research projects in the area. It is, therefore, important that a means of providing a reliable chronology for landscape change in the region be developed and tested.

Radiocarbon ages have provided a temporal framework for coastal landform development and human activity, but a more comprehensive and robust chronology can be achieved by combining them with optical ages, which provide a source of chronological information at sites where datable organic material is not present or where it may be reworked. In the past, optical ages from K-feldspar sediments have been used in palaeoenvironmental studies of BC's coast but until now, methods of determining an equivalent dose (D_e) and anomalous fading rates have been largely confined to multiple aliquot dating techniques (e.g., Huntley et al., 1985, Lian et al., 1995; Huntley and Clague, 1996; Huntley and Lamothe, 2001; Wolfe et al., 2008).

In this study, we examine luminescence signals from both quartz and K-feldspar from Calvert Island to confirm that K-feldspar is the most suitable mineral for optical dating in this region. We

* Corresponding author. Department of Geography and the Environment, University of the Fraser Valley, Abbotsford, BC, Canada.
E-mail address: Christina.Neudorf@ufv.ca (C.M. Neudorf).

http://dx.doi.org/10.1016/j.quageo.2014.12.004
1871-1014/

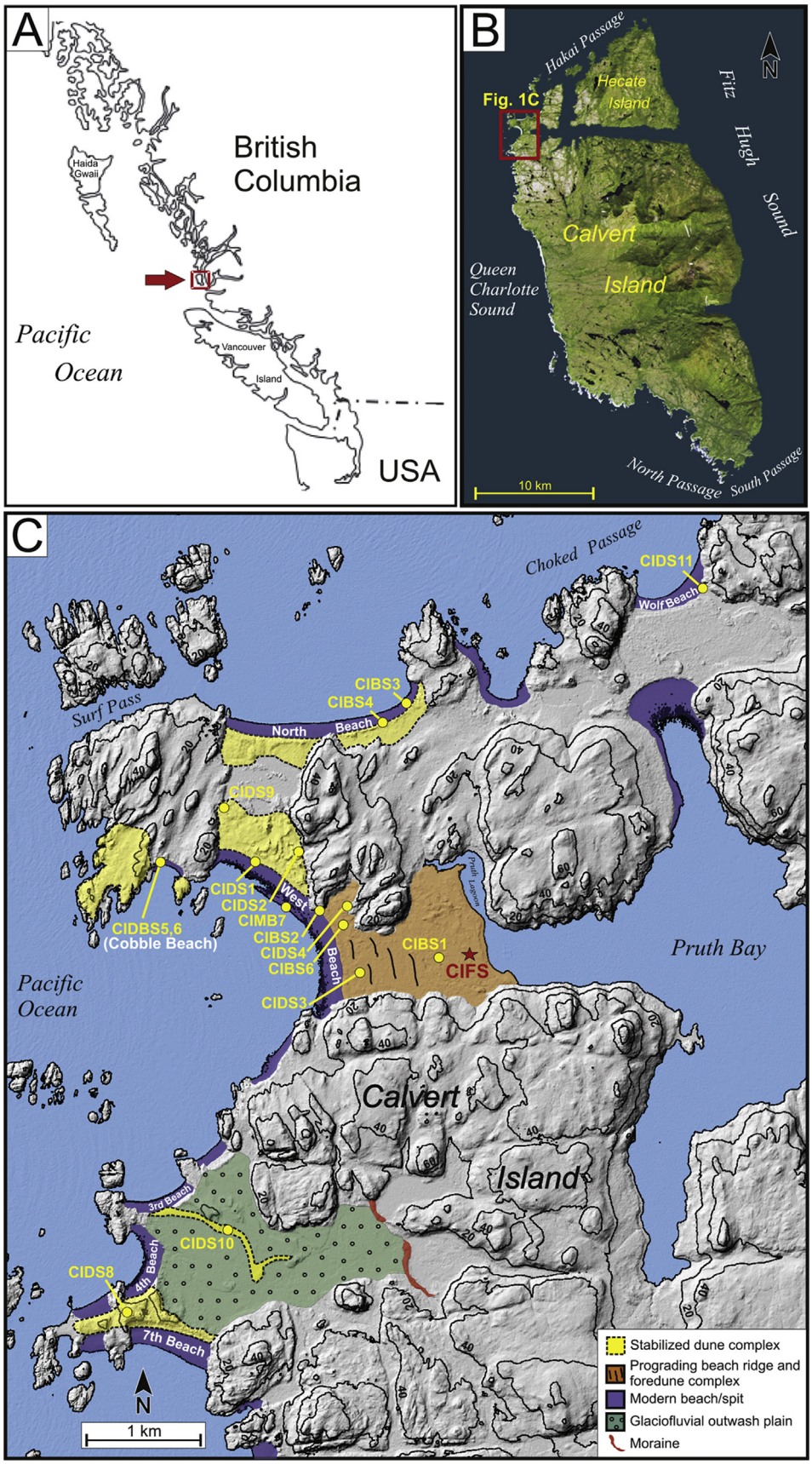

Fig. 1. A) Location of Calvert Island, BC central coast. B) Calvert and Hecate Islands, south of Hakai Pass. C) Prominent glacial features, modern beach deposits, and dune and beach ridge complexes superimposed on a 2 m LiDAR hillshaded DEM of northwest Calvert Island. Optical dating sample sites are shown as yellow dots. CIFS = Calvert Island Field Station of the Hakai Institute. Contour interval is 20 m. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)