Geomorphology 268 (2016) 146–158

Contents lists available at ScienceDirect

Geomorphology

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

The subtidal morphology of microtidal shore platforms and its implication for wave dynamics on rocky coasts

David M. Kennedy

School of Geography, The University of Melbourne, Parkville, Vic, 3010, Australia

ARTICLE INFO

Article history:
Received 14 December 2015
Received in revised form 31 May 2016
Accepted 5 June 2016
Available online 6 June 2016

Keywords:
Shore platform
Seaward edge
Rocky coast
Waves
Microtidal
Australia

ABSTRACT

The subtidal portions of shore platforms are important geomorphic features as they can modify deep-water wave energy before it impacts the intertidal platform edge. In this study an integrated marine and terrestrial aerial LiDAR dataset is used to analyse the morphology of the subtidal portion of shore platforms. Semi-horizontal intertidal platforms on an 85 km along stretch of microtidal, open-ocean, rocky coast in Victoria, Australia are investigated and described quantitatively. Three distinct types of subtidal morphology occur; (i) a steep cliff with a mean slope of 8–18°, (ii) a gently sloping ramp with a mean slope of <3°, and (iii) a subtidal terrace/reef. It is inferred that the type of subtidal morphology present on a platform will determine the relative impact of marine and subaerial processes in the intertidal and supratidal zones.

1. Introduction

Shore platforms are the result of the interaction between marine and subaerial erosional processes (Stephenson et al., 2013) which are concentrated in the intertidal zone (Stephenson and Kirk, 2000a; Kanyaya and Trenhaile, 2005). In microtidal settings the vertical extent of the intertidal zone is narrow, especially when compared to meso- and macrotidal shores and this favours the formation of near-horizontal shore platforms (Trenhaile and Layzell, 1981). In such settings, the seaward edge of the platform is a key zone for wave breaking which determines the amount of energy that impacts the intertidal surface (Ogawa et al., 2011, 2012; Ogawa, 2013).

In the often used definition of Sunamura (1992), platforms in microtidal settings are described as being characterised by a vertical seaward cliff and this morphology is commonly inferred to occur in Australasia, Japan and Korea (Choi and Seong, 2014; Dickson and Stephenson, 2014; Kennedy, 2014; Sunamura et al., 2014). However, the seaward edge of microtidal platforms is not always vertical. For example in Lorne, Australia (Jutson, 1949; Kennedy and Milkins, 2015) or South Shetland Islands (Hansom, 1983) the edge is an intertidal sloping ramp. In fact the rocky platform surface can extend to tens of metres depth as a slope such as in the limestone and mudstones of Kaikoura, New Zealand (Stephenson and Kirk, 2000a, 2000b) and Cretaceous sandstones of California (Young et al., 2013). Such variations in shape led Stephenson et al. (2013) to suggest that platforms should not be defined on the basis of a specific geomorphic element such as a seaward cliff.

Kennedy (2015) suggested that the seaward edge should be taken to occur at “the point where active erosion of the bedrock ceases” (p 99). This will occur at some distance seaward of the low tide mark and commonly occurs close to wave base (Sunamura, 1991). It is however rare for studies of shore platforms to quantitatively explore morphology below low tide. The morphology of the seaward cliff, when described, is most often derived from qualitative diver observations (e.g. Dickson, 2006; Furlani et al., 2014a) or single line profiling (Stephenson and Kirk, 2000a, 2000b; Allan et al., 2002). The question therefore arises as to what is the morphology of the subtidal portion of a shore platform and how variable is it along sections of coastline composed of the same geology. This knowledge is critical as the seaward edge of a shore platform is a key factor in determining how waves interact with the intertidal platform surface (Marshall and Stephenson, 2011; Ogawa et al., 2012); yet very little is known about the morphology of this landscape. Such a lack of knowledge limits the ability to compare results from differing locations. For example, if the seaward edge morphology is not included in a study it is difficult to apply any obtained wave transformation information to a different location. This study explores the sandstone shore platforms of central Victoria, Australia. It aims to quantitatively prove whether a vertical seaward cliff is the key morphology in microtidal settings and if not, what other platform

E-mail address: davidmk@unimelb.edu.au.

http://dx.doi.org/10.1016/j.geomorph.2016.06.003
0169-555X/

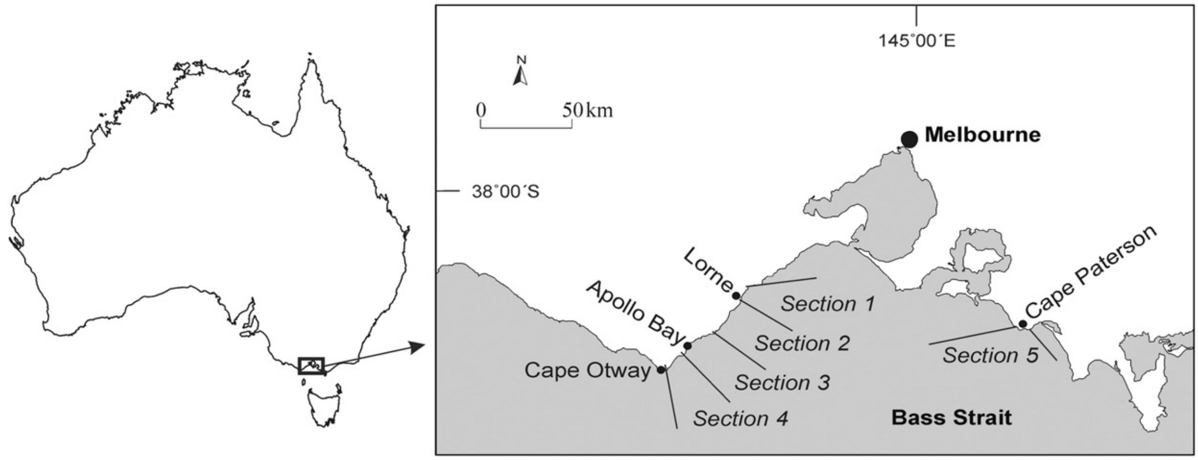

Fig. 1. Location of study areas on the Victorian Coast which are dominated by Cretaceous non-carbonate sandstones.

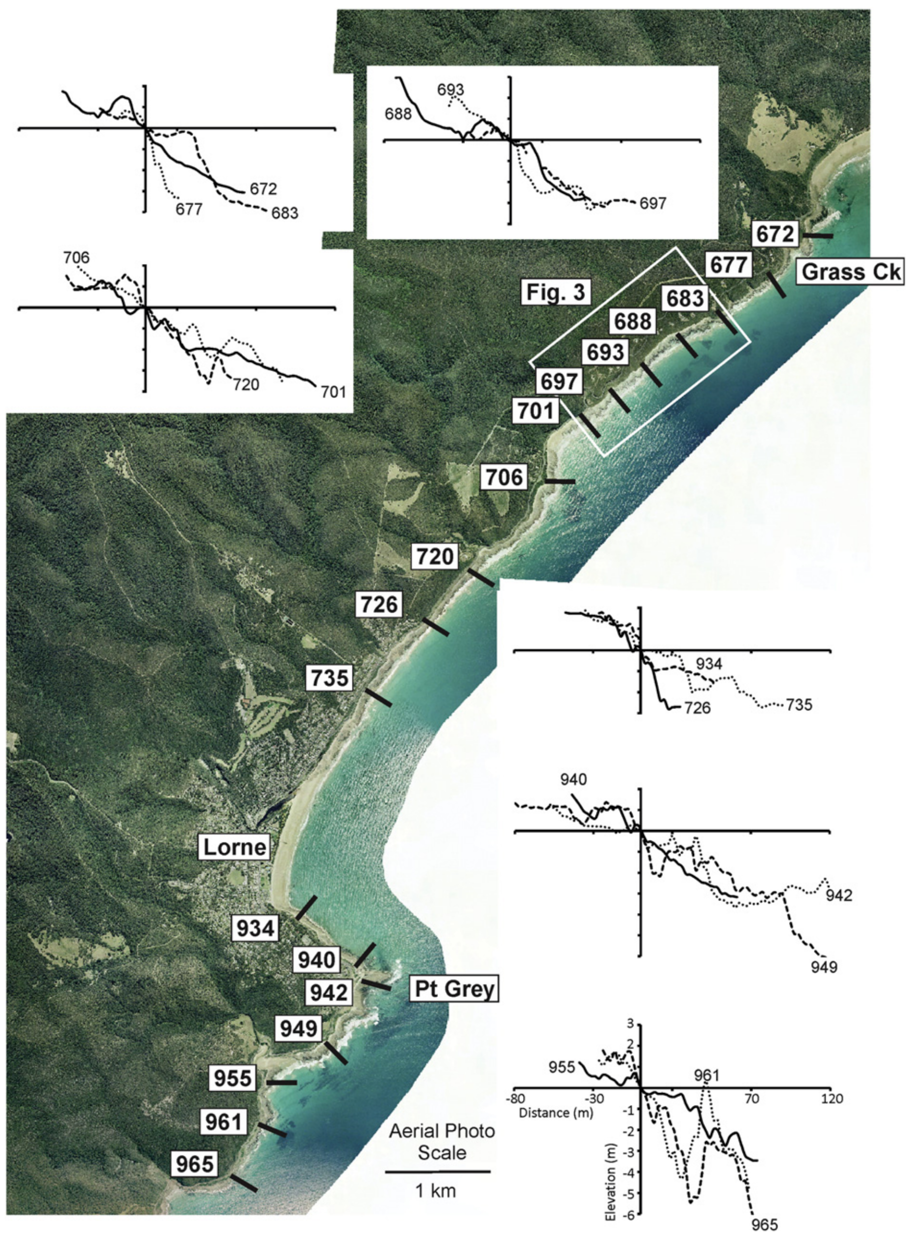

Fig. 2. Aerial photo of the Lorne segment of the Victorian coast (Section 1) showing representative shore platform profiles. See online PDF for a colour version of this diagram.