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Preservation of hanging aeolian deposits in insular karst depressions: Sediment sources and implications for the Pleistocene palaeogeography of the SE Adriatic archipelago

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ABSTRACT

This study examines how and why the accumulation and preservation of aeolian sands are influenced by the character of karstic basement landforms. The studied examples are Late Pleistocene aeolian sands and underlying karstified carbonates of Southeastern Adriatic islands. To address this issue the spacial relationship between karstified bedrock and aeolian cover, aeolian and associated fluvial facies, as well as the petrography of sands, including heavy minerals and bioclasts (especially foraminifera) have been studied. Specific landforms of the carbonate basement originated as a consequence of deformation, karstification and locally with additional influence of fluvial processes. They are located at different elevations above today's sea-level, as well as above ancient sand pathways towards the islands, which are now below sea-level. The karst depressions critically influenced the accumulation and preservation of aeolian sands. The depressions represented traps for accumulation and shelters for preservation of these sands. The closed type karst depressions include large examples which contain successions displaying the most complete stratigraphic record, located in the approximate centre of the depression. The open type karst depression is characterised by a partial removal of sands which were exported down-valley.

The complex arrangement of the islands and closely located mainland coasts governed the location of primary sand transport paths. They included both aeolian and marine transport depending on the extent of exposed land versus submerged areas related to sea-level fluctuation. Marine settings along the sand pathways included shallow, sandy sea bottoms partly covered by sea-grass, as well as sand beaches and restricted environments. From low inter-island areas which hosted the primary sand pathways, the sands were uplifted and deposited over the islands by wind action thus producing hanging aeolian accumulations.

The most influential Pleistocene winds responsible for sand transport over ancient land surfaces were from the SE and E. They were also the main factor for generating marine currents responsible for sand transport in the shallow sea and along the beaches. Only close to the mainland coast, strong N to NE winds dominated.

1. Introduction

The main factors that promote preservation of accumulated aeolian sequences are subsidence and a rise of the water-table (reviews in Kocurek, 1996; Mountney, 2006b). The role of karstified, carbonate basement related to accumulation and preservation of overlying aeolian deposits has rarely been reported. Examples described by Cremaschi (1990a) refer to loess deposits which are found in caves and shelters of the underlying carbonate plateaus. Small-scale karstification features related to subaerial exposure of limestones may occur below "carbonate eolianites" (Abegg et al., 2001a), and the limestones underlying "eolianites" locally display sediment-filled caves and solution pipes (e.g. Blay and Longman, 2001). However, the importance of larger scale, karstic basement topography has only recently been presented by Luzón et al. (2012) who described a peculiar situation of aeolian and fluvial deposits overlying a gypsum karst. In their examples, gypsum dissolution locally increased subsidence rates, created dolines and provoked synsedimentary deformation of aeolian and fluvial deposits, which finally led to a specific preservation style of these deposits. The main objective of the present study is to describe

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features and processes related to the accumulation and preservation of aeolian sands in an area characterised by specific karst landforms developed in basement carbonates. This relationship has not been previously described and has turned out to be of critical importance. The study area is located in the Outer Dinarides and comprises the Southeastern Adriatic (SEA) archipelago which is largely characterised by thick, widespread Mesozoic carbonates and a patch-like cover of aeolian sands (Figs. 1–3). Also presented is how the arrangement of islands, channels and the mainland influenced the transport paths and distribution of sand before its final transport onto the islands.

2. Geological setting and previous work

The SEA archipelago mainly displays carbonate deposits formed on Mesozoic to Palaeogene carbonate platforms which otherwise characterised the evolution of the wider area and today make up the Outer Dinarides, i.e. the SW part of the Dinaric chain (reviews in Vlahović et al., 2005; Korbar, 2009). Tertiary deformation was responsible for generating the present-day tectonic structures of the islands. During the Neogene continental period, fluvial and karstic processes superimposed on the existing tectonic structures exerted a major impact on the present-day islands' morphology

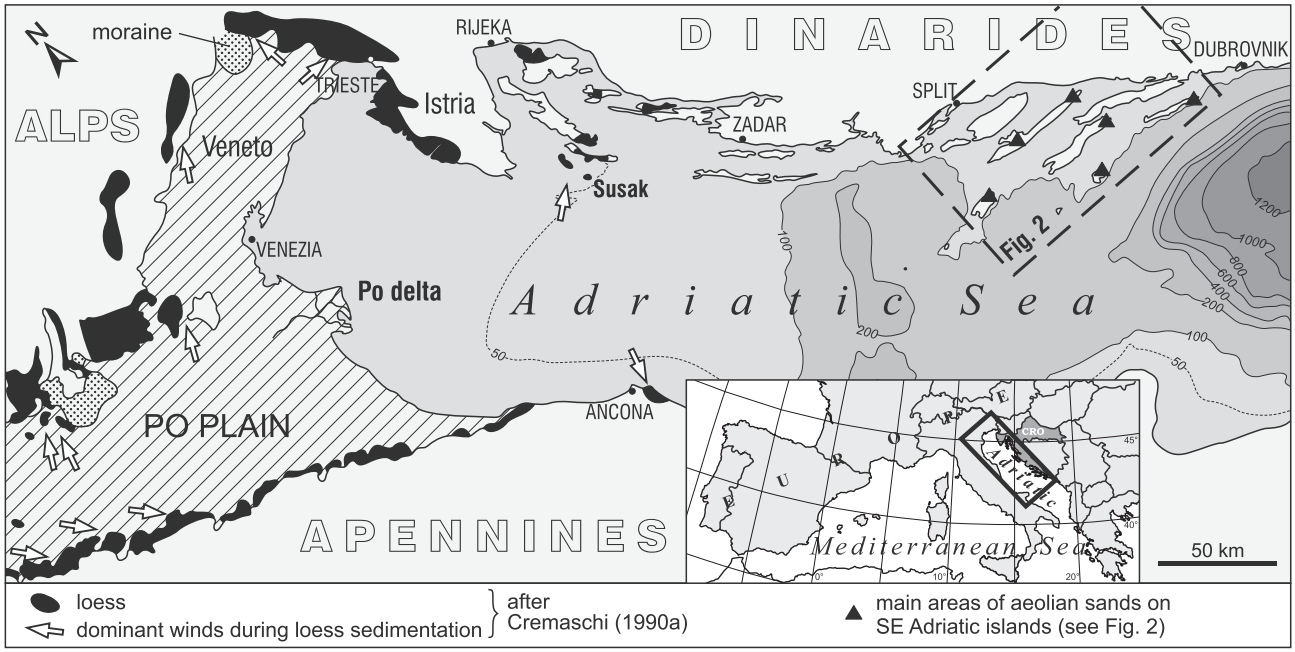

Fig. 1. Situation of SEA archipelago (framed) and North Adriatic-Padane aeolian province. Note the position of the famous Susak Island which exhibits a 90 m thick succession of loess, dune sand and palaeosols. Depth contours (from Pigorini, 1968) illustrate the difference between the N Adriatic shelf and the deeper part of the Adriatic Sea.

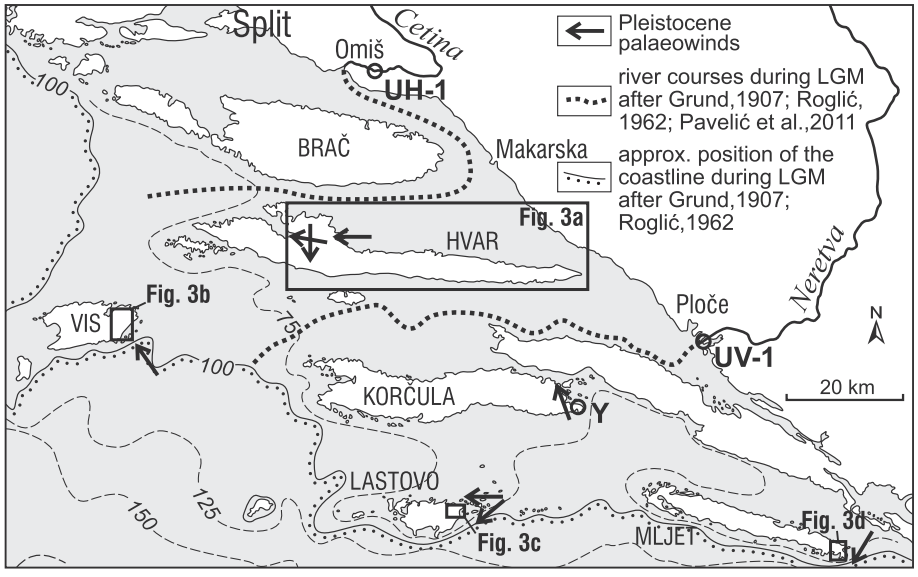

Fig. 2. SEA islands with location of detailed maps (framed), exposure Y, sample locations UV-1 and UH-1, as well as aeolian palaeotransport data. Crossed arrows on Hvar Island are two average directions based on data from Pavelić et al. (2011). Depth contours are from Pigorini (1968). Also shown are approximate positions of the coastline and courses of the main rivers during LGM as envisaged by the authors cited in the legend.