

## Digital 3Dmodelling of cross-bedded Chattian calcarenites by laser-scanning technique (Majella, Apennines, Italy)

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### Introduction

This study presents a laser scan acquisition of the sedimentary structures of the Chattian *Lepidocyclina* limestone outcropping in the Majella mount along a 200 m long transect.

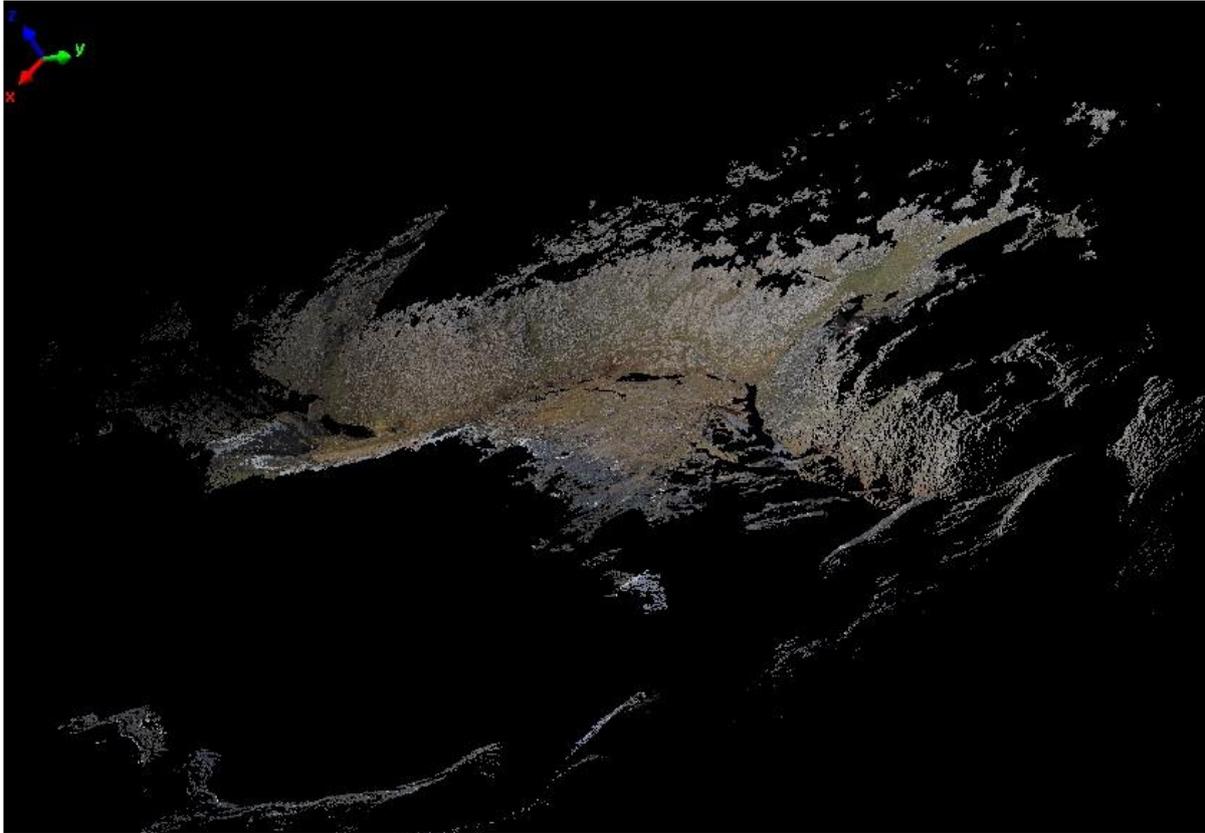
The *Lepidocyclina* limestone represents a 40 m thick informal member of the Bolognano Formation (Chattian to Messinian in age). This Formation, which has been subdivided into various informal members (Vecsei and Sanders, 1999; Brandano et al 2012). Three depositional sequences, including shallow water to deeper-water sediments, can be recognized in the northwestern sector of the Majella. The first shallow water-sequence, represented by the *Lepidocyclina* Limestone, unconformably overlies Eocene deposits and consists of up to 40m of cross-bedded bioclastic grainstones/ rudstones formed by larger benthic foraminifera, bryozoans, red algae, and molluscs. This unit is overlain by up to 20 m of strongly bioturbated siliceous hemipelagic marls and marly limestones. The second shallow water-sequence, represented by the Upper Bryozoan Limestone, ranges in thickness from 3 to 40m and consists of a monotonous succession of crossbedded grainstones. The skeletal assemblage of this limestone is characterized by planktonic and small benthic foraminifera, bryozoan, mollusc, and echinoid fragments, and rarely by larger benthic foraminifera. The upper part of this second sequence consists of planktonic *Orbulina* Marls up to 90 m thick. The third sequence is represented by the *Lithothamnion* Limestone, unconformably overlies the Upper Bryozoan Limestone. This unit consists of up to 30 m of limestones to marly limestones (dominated by red algal-nodules and bivalves) and is overlain by 30 m of hemipelagic marls.

The *Lepidocyclina* limestone unit is interpreted deposited in a wide middle ramp environment where the oligophotic biota (larger benthic foraminifera and coralline algae) were produced and reworked by strong, basinward-flowing currents. The taphonomic analysis implies a parautochthonous origin for an important part of the sediments in a middle ramp environment, and an increase with depth of autochthonous sediments in the outer ramp (Brandano et al 2012).

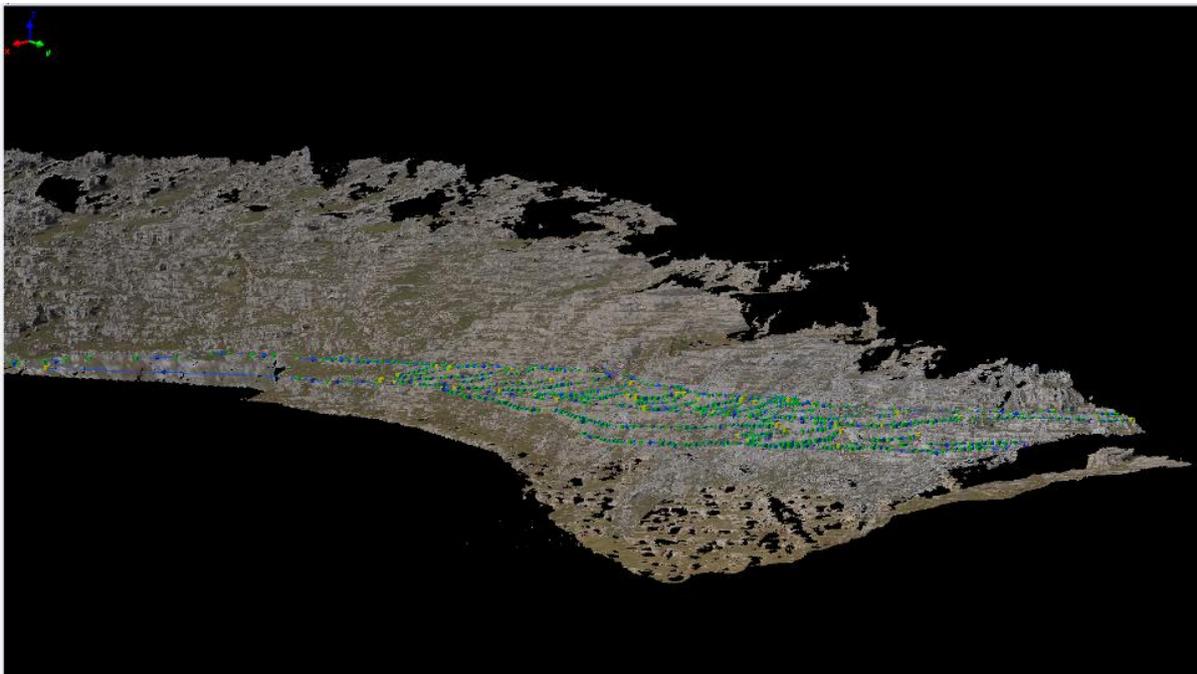
This work focuses on the sedimentary structures and geometries of the downslope-migrating dunes. Generally the study and the reproduction of may be based on drawings, supplied by photographs. However drawings and photographs present and cause different problems, for example the accuracy of drawings as well as photographs are dependent on the direction and intensity of light

### Method

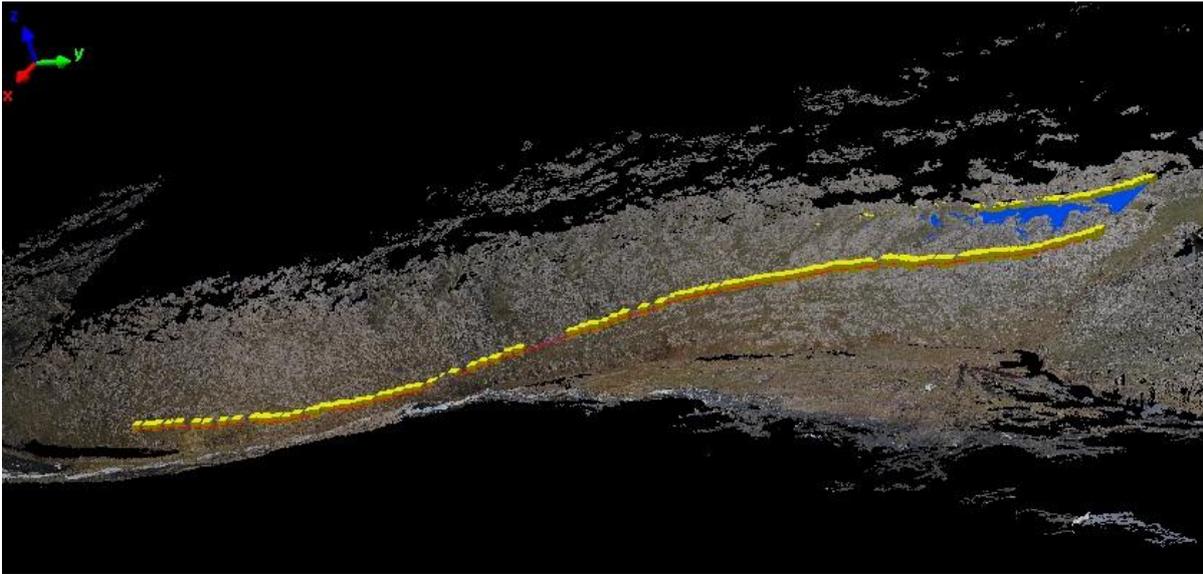
In this work we used a laser scanner methodology. the acquisition has been performed with Riegl VZ 400 laser scanner from a distance of approximately 90 m, setting a mean point to point spacing of 0,005 m., along a 200 m long transect. Laser scanners produce a “point cloud” giving an accurate and precise three dimensional representation of a considered target. The 3D models were processed and restituted with a line-drawing using IMedit and IMview modules of the PolyWorks® 10 software.



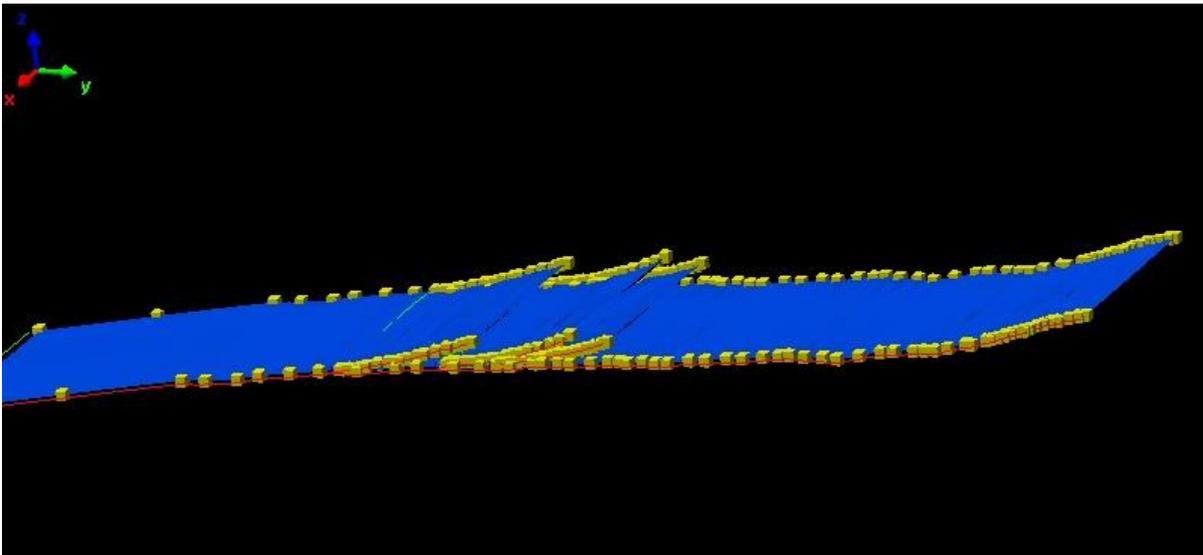
*Figure 1 Point cloud, high resolution 3D image of outcrop.*



*Figure 2 The resulting geometries indicate the presence of simple and compound dunes. 3D modelling reveal a planar lower bounding-surface shape, dunes migrated on flat surface*



*Figure 3 The internal set of progradation have straight shape.*



*Figure 4 The resulting geometries indicate the presence of simple and compound dunes. 3D modelling reveal a clino-shaped lower bounding-surface shape.*

## Conclusions

The result of sedimentological analysis and 3D modelling evidence that the cross bedding of the *Lepidocyclina* limestone represents the staking of the migration of large (7–9 m thick), 3-D, simple and compound dunes with slight variations in flow strength and direction.

These cross-beds have sigmoidal shapes and are inclined between 10 and 22°. The dip is generally toward WNW. The sets (first order) are 20–60 cm thick and can be traced laterally for up to 70m . The sets are characterized by bedding-parallel lamination (bedding- plane concordant). Foresets are generally tangential, with angles that dip about 20° but decrease to 10° toward the bottomset. The

cosets (second order) are up to 5 m thick and are bounded by large-scale sigmoidal discontinuities that can be traced laterally for up to 200 m.

### **Acknowledgements**

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### **References**

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- Vecsei, A., Sanders, D.G.K. (1999). Facies analysis and sequence stratigraphy of a Miocene warm-temperate carbonate ramp, Montagna della Maiella, Italy. *Sedimentary Geology*, 123, 103-127.