Abstract

During the Late Triassic, a climate change known as the Carnian Pluvial Event resulted in a major crisis for carbonate producers. The change in carbonate production led to a dramatic modification in depositional geometries. Steep clinoforms of the high relief pre-crisis carbonate platforms were replaced by low angle ramps.

To investigate how the changes in shallow water carbonate precipitation influenced the depositional geometries of carbonate platforms, a quantitative three dimensional acquisition (laser scanner, photogrammetry) and modeling of the geometry of sedimentary bodies deposited before, during and after the Carnian crisis, coupled with facies analysis, was performed. Depositional architectures and facies suggest that a phase of intermediate sedimentation, in which carbonate mounds and detrital processes coexisted, characterized the turnover of carbonate factory across the Carnian Pluvial Event. The subsequent ramps developed in a tidal dominated environment. Moreover, the use of three dimensional techniques enabled the succession to be placed in a sequence stratigraphic frame.

Introduction

In the Late Anisian and Early Carnian, the carbonate platforms of the Dolomites were mainly isolated and characterized by high relief (Bosellini 1984; Bosellini et al., 2003). Their carbonate production was mainly dominated by microbes (microbial sensu Schlager 2003; Blendinger 1994; Russo et al. 1997; Keim and Schlager 1999; 2001, Marangon et al. 2011). Those platforms developed characteristic depositional geometries, with carbonate slopes steeper than the angle of repose of gravel (i.e., even more than 35°), and often lacking clear clinoform bedding, because the slope itself was the site of primary carbonate production.

At the end of the Early Carnian, a climatic event, known as the Carnian Pluvial Event (CPE, Simms and Ruffel 1989; Preto et al. 2010; Dal Corso et al. 2012), caused a strong decrease in carbonate production. Shallow water carbonate systems of the Dolomites switched from microbial dominated to carbonates with skeletal associations and geometries typical of ramps (i.e. mainly molluscs dominated and slope angle < 1°; Preto and Hinnov 2003).

Aim

Investigate the impact of the CPE on the sedimentary environment of the Dolomites. In particular the focus is on changes in calcium carbonate precipitation style in shallow water systems in terms of facies and depositional geometries using a standard sedimentological approach combined with a quantitative three dimensional acquisition (laser scanning and photogrammetric techniques) and 3D geo-modeling.

Outcrops and applied techniques

The studied outcrops are located in the Cortina d'Ampezzo area (central Dolomites, NE Italy). Sedimentological analysis and stratigraphic section measurements were performed. The Tofana di Rozes and the Dibona Hut are the key areas to constrain both the sedimentology and the depositional geometries of the studied stratigraphic interval. According to outcrop conditions the geometry of the Tofana di Rozes was acquired through photogrammetry (Fig. 1a), while at Dibona Hut a terrestrial laser scanner (LiDAR) was used (Fig. 1b).

Data and results

On the southern walls of the Tofana di Rozes (Figs. 1a) a platform to basin transect is exposed (Preto and Hinnov 2003; Breda et al. 2009). Here, the boundary between pre- and post-CPE deposits was identified. It is constituted by a sharp by-pass surface on top of the last slope clinoform of the youngest generation of Triassic high relief platforms. This surface is overlain by a series of lenticular shaped carbonate bodies (mounds) made up of mainly microbial boundstone (Figs. 2a), interlayered and laterally onlapped by dm
thick beds of arenaceous grainstones with bivalves, gastropods, peloids, plant remains (Gattolin et al., in prep).

At Dibona Hut, arenaceous grainstones become dominant toward the top of the interval (Fig. 2b). The complete disappearance of mounds followed the fall of sea level. This event is here documented by the presence of a ca. 30 m thick clinostratified body (Fig. 1b), consisting of arenaceous grainstones and presenting a series of stair stepping topsets, progressively lowered toward the basin. Its offlapping geometry evidences an overall progradation of the shoreline along a descending, low angle trajectory (Gattolin et al., in prep). In the neighboring, more proximal areas, the sea level fall is testified by the presence of karstic surfaces.
The paleotopography that developed following the sea level fall was characterized by heights (i.e. the demised high relief carbonate platform) and basins. In the study area the presence of an elongated marine strait, bounded by two demised carbonate platforms, triggered tide amplification and so the onset of a tide dominated depositional environment (Figs. 3a, b; Gattolin et al., 2013). Because of the overlap of both climatic and eustatic events, this Triassic interval of the Dolomites was considered one of the most challenging to interpret in terms of sequence stratigraphy. The use of virtual 3D modeling techniques enabled to carry out observations on stratal patterns and sedimentary bodies geometries of inaccessible outcrops without the perspective distortion bias. These observations, together with the detailed study of facies and the identification of the key stratigraphic surfaces, led to a sequence stratigraphic interpretation of the studied succession.

References


DAL CORSO, J., MIEITTO, P., NEWTON, R.J., PANCOAST, R.D., PRETO, N., ROGHI, G., WIGNALL, P.B. 2012. Discovery of a major negative delta C-13 spike in the Carnian (Late Triassic) linked to the eruption of Wrangellia flood basalts. *Geology*, **40**, 79-82.


SUMMARY OF ACTIVITIES

Courses:
MASELLI V. “Seismic and sequence stratigraphy”, Dipartimento di Geoscienze, Università degli Studi di Padova, 2013.
PRETO N. “Petrologia dei Carbonati Avanzata”, Dipartimento di Geoscienze, Università degli Studi di Padova, 2011.
DANIELETTO E., BOESSO S. “Corso introduzione alla biblioteca” e “Gestire le bibliografie con Refworks”, Biblioteca del Dipartimento di Geoscienze, Università degli Studi di Padova, 2011.

Communications:
GATTOLIN, G. 2013. The geometry of geologic bodies reconstructed by 3D modeling techniques. The University of Newcastle, Australia.
Posters:


Publications:


Congresses and Workshops:

2013: AAPG European Regional Conference, Barcelona.
2011: Workshop on the Cassian beds (Upper Triassic), Bozen.

Teaching activities:

Teaching assistant: 1 week, “Field Course in Carbonates Environments”, School of Environmental and Life Sciences, The University of Newcastle, Australia, 2013.


Other:

Visiting student at University of Newcastle, Australia, 2013.

Editor of the Rendiconti Online della Società Geologica Italiana 20th vol., 2012.


Organizer of the 10th GeoSed meeting, 2012.

Awarded of the “Geosed Contributo Giovani”, 2011.