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PERSPECTIVE

Two lessons from the dolomites

Alfonso Bosellini*

Dipartimento di Scienze della Terra, Università di Ferrara, Via Saragat, 1 - 44122 Ferrara, Italy

ABSTRACT - Taking into account two stratigraphic relationships of the Dolomites, two basic stratigraphic concepts are discussed. In the first case, it is shown that the principle of superposition must be applied with care, specially when large depositional systems are considered. In the second case, it is demonstrated the practical impossibility to apply Milankovitch cyclostratigraphy to shallow-water carbonate successions because it is impossibile to know the temporal length of hiatuses bounding the various cycles.

KEY WORDS: principle of superposition, cyclostratigraphy, carbonate platforms, Triassic, Dolomites

INTRODUCTION

Two stratigraphic relationships, which, I believe, bear relevant significance on basic geologic concepts and stratigraphic procedures, are presented in this report. The successions considered are Triassic in age and occur in the Dolomite region (Fig. 1), an area of eastern Southern Alps well known for its spectacular exposures (Bosellini et al., 2003).

Fig. 1 - Location map of the Dolomites, with indication of the mountain groups cited in the text.

FIRST LESSON

The principle of superposition and its limits

The principle of superposition states that each layer of sedimentary rock in a tectonically undisturbed sequence is younger than the one beneath it and older the one above it.

*Corresponding author: *bos@unife.it*

Geological common sense tells us that a younger layer cannot slip beneath one that has already been deposited (Press and Siever, 1994, pag.189). This principle, which is undoubtedly valid at the scale of a single bed, if applied to large scale systems (formations) cannot be maintained. In fact, it implies that the process of sedimentation is a kind of vertical fall, but this is true only for the "pelagic rain" of the oceans. Normally, pile up of sediments is the result of lateral progradation, a process which takes place from the smaller scale of ripples and dunes to the large one of beaches, deltas and many other depositional systems.

Here I present the case of a Middle Triassic buildup (the Catinaccio platform) which prograded over the coeval basinal deposits of the Livinallongo formation. The spectacular outcrop of the Rosengarten (Fig. 2) is a natural section which shows the stratigraphic relationships between the overlying clinostratified carbonate platform and the underlying basinal sediments: the two lithologic units are one on top of the other but they have the same age (Fig. 3).

Conclusions

Strictly speaking, the principle of superposition is valid only for pelagic sediments which accumulated by a process of vertical gravity fall. In all other cases, the principle, theoretically, is not valid and must be applied with care, specially when large depositional systems are considered.

SECOND LESSON

Inapplicability of Milankovitch cyclostratigraphy to carbonate platform successions

It has been recognized since the mid-1960s (Fischer, 1964) that successions of shallow-water carbonate platforms are commonly composed of meter-scale lithologic cycles. Moreover, these cyclical successions have been interpreted in terms of orbital forcing (Milankovitch cyclostratigraphy) in numberless reports. But the most famous case is probably that of the Latemar buildup (Triassic of the Dolomites) where a number of orbital and time interpretations have been

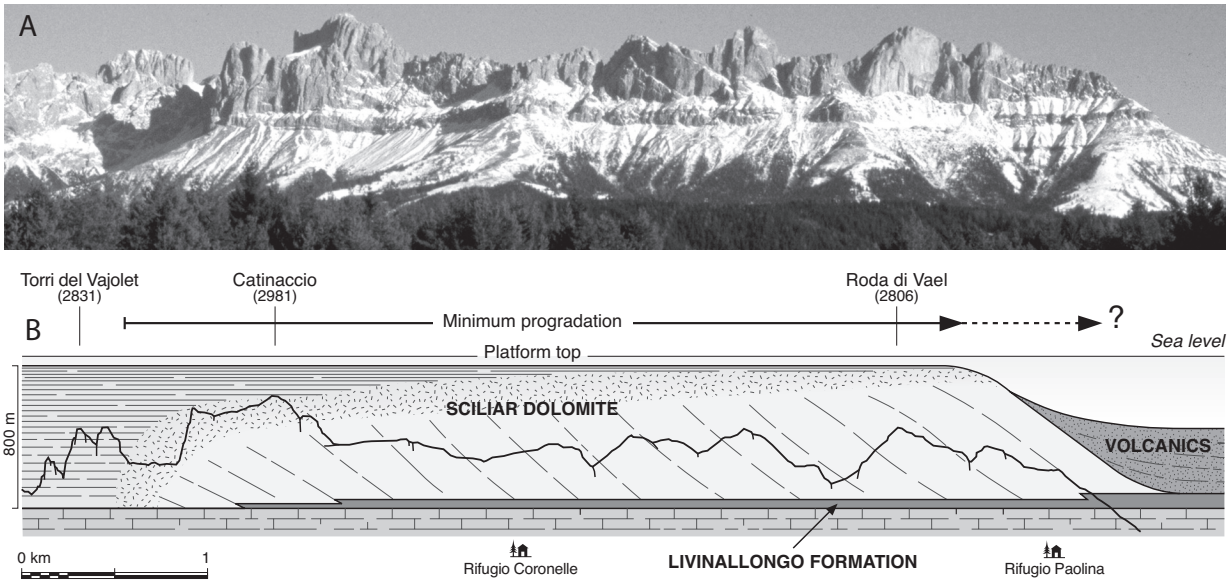

Fig. 2 - A. Panoramic view of the Rosengarten section (western side of the Catinaccio platform), exposing the stratigraphic relationships between the prograding carbonate platform (Sciliar Dolomite) and the underlying tabular beds of the basinal Livinallongo Formation. B. Graphic synthetic reconstruction of the carbonate system before the erosion.

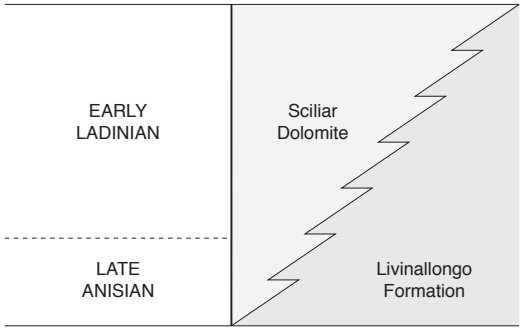

Fig. 3 - Time relationships between the Sciliar Dolomite and the underlying Livinallongo Formation.

proposed for the cyclical succession of the interior platform (see Meyers, 2008 and numerous references herein). Here I present evidence that it may be quite difficult, and probably wrong, to apply Milankovitch cyclostratigraphy to shallow-water carbonate successions.

The Dolomia Principale is a Late Triassic (Norian) peritidal formation composed of hundreds of lithologic cycles (Bosellini, 1967; Bosellini and Hardie, 1988). Thickness of the Dolomia Principale is about 270 m in the Sella massif (Bosellini, 1965a) (Fig. 4), whereas a short distance to the east the same formation has a thickness of 500 m at Croda di S.Croce (Val Badia) and 900-1000 m in the Altipiani Ampezzani and in the Tofane (Fig. 5). This different thickness of the formation is not due to erosion but it is the result of

Fig. 4 - The Sella massif and its cap of Dolomia Principale (DP); its thickness is 270 meters.

Fig. 5 - The huge succession (1000 m) of Dolomia Principale in the Tofana di Rozes.

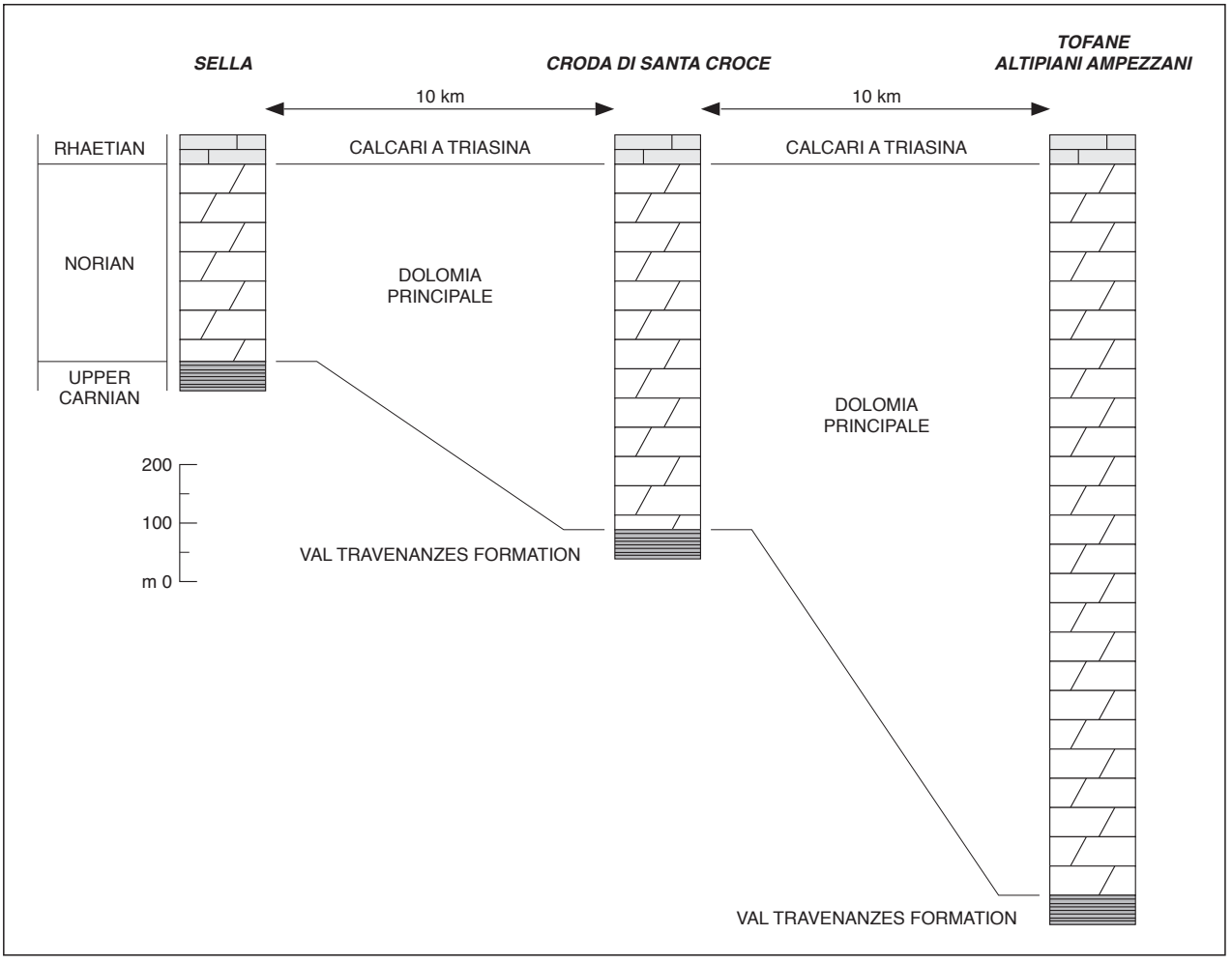

Fig. 6 - Correlation between the Dolomia Principale sections of Sella, Croda di S.Croce and Tofana di Rozes. The Dolomia Principale is confined by the same chronostratigraphic units, therefore it represents the same time interval (Norian) in all three sections: the time missing in the thinner sections is represented by hiatuses occurring between the numerous lithologic cycles.

differential subsidence between western and eastern Dolomites, a process which lasted for the entire Mesozoic (Bosellini, 1965b).

In both sections the Dolomia Principale lies on the Val Travenanzes Formation (former Raibl Formation) (Neri et al., 2007) and is overlain by the socalled Calcari a Triasina (Bosellini, 1967; Neri et al., 2007) of Rhaetian age (Fig. 6).

It is clear that the two sections, being confined by the same chronostratigraphic units, represent the same time interval, but it is equally evident that the thinner succession (250-300 m) represents only one third of the Norian time, if we assume that the thicker one (about 1000 m) represents the entire Norian stage; the remaining two thirds consist of depositional hiatuses (erosion or non deposition).

Conclusions

Analysis of the thickness variability of the Dolomia Principale in the Dolomite region confirms the practical impossibility to estimate the duration of lithologic cycles because it is impossibile to know the temporal length of the hiatuses represented by the diastemic surfaces bounding them.

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