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Titolo	SEDIMENTOLOGICAL ANALYSIS AND STATISTICAL ELABORATION OF THE FACIES DISTRIBUTION IN A NORIAN BASINAL CALCAREOUS SUCCESSION (ZORZINO LIMESTONE, SOUTHERN ALPS, ITALY). [Tesi di dottorato]
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Sommario	Statistical analysis on the bed-thickness and facies distributions have been carried out on a Norian calcareous basinal succession (Zorzino Limestone, up to 1000 m thick) fed by a fault-controlled Norian T factory (Dolomia Principale), in the central Southern Alps (Lombardy, Northern Italy). Four stratigraphic logs (Val Taleggio, Val Bracca, Val Cavallina and Iseo Lake sections), corresponding to a total thickness of approximately 1100 m and located in different parts of the basin (from the slope to the more distal depocentral zone) have been measured bed by bed. The studied sections stratigraphically belong to the upper part of the Zorzino Limestone, close to the boundary with the Riva di Solto Shale. Sedimentological analysis allowed establishing seven main lithofacies categories in the Norian basinal sediments of the Zorzino Limestone, according to grain size (from carbonate mudstones to microconglomerates), composition of sediments, sedimentary structures (presence of grading, type of laminations, erosional bases, tractive features, bottom structures and bioturbation) and microscopic analysis. A lithofacies can represent an entire single bed (that is defined in this way by one lithofacies) or a homogeneous portion of it. The identified lithofacies are: Matrix supported breccias (1), Calcarenite supported breccias (2), Massive non-graded calcarenites (3), Massive graded

calcarenites (4), Laminated graded calcarenites (5), Massive calcisiltites (6) and Calcilutites (7). Each bed (one depositional event, sensu Campbell, 1967) or a group of beds with the same internal lithofacies architectures is referred to a single facies. More than 4000 beds have been measured in the resedimented Zorzino Limestone deposits, allowing to recognize eleven facies that have been classified using a specific letter code as follows: Matrix-supported breccias (Br1), Calcarenites supported breccias (Br2), Homogenous calcarenites (Rd), Cobbles to fine graded calcarenites (Cl1), Coarse-medium to fine graded calcarenites (Cl2), Laminated medium to fine graded calcarenites (Cl3), Laminated fine to very fine graded calcarenites (Cl4), Thin bedded graded calcarenites (Cl5), Homogeneous calcisiltites (M1), Laminated calcisiltites (M2) and Dark-gray laminites (LS). The eleven facies characterizing the Zorzino Limestone are the expression of three main depositional processes; these are: 1) Freezing from cohesive flows (mud debris flows, sandy debris flows and silty-mud debris flows), 2) deposition from turbulent flows (high-density turbidity currents and low-density turbidity currents) and 3) grain-by-grain settling from mud suspension during periods of low sedimentation rate. Chaotic bodies and slump deposits are the product of gravity-driven resedimentation. The facies distribution analysis shows that the calcarenitic facies (Br2, Rd, Cl1, Cl2, Cl3, Cl4 and Cl5) prevail in the slope settings, whereas the calcisiltitic facies (M1 and M2) in the basinal settings, suggesting that facies distribution is strongly related to paleogeography. The microfacies analysis of the several lithofacies highlights that two kinds of components characterize the resedimented deposits of the Zorzino Limestone: bioclastic components and intraclastic components originated by the disruption of the facies Ls and/or constituted by clear-light gray micrites from the top of the platform. Based on the distinction between these components and on their different quantitative distribution in the lithofacies, different typologies of deposits have been recognized: (1) predominantly bioclastic (Cl2, Cl3, Cl4 and Cl5 in the slope settings); (2) deposits characterized by a variable proportion between bioclasts and intraclsts (Br2, Rd, Cl1 Cl2, Cl3, Cl4 and Cl5 in the slope settings); and (3) predominantly intraclastic (facies M1, M2, Cl2 and Cl4 in the basinal settings). The type of bioclasts indicates an origin of the sediments from the top of the platform for the resedimented deposits of the slope, whereas the composition of the intraclasts indicates an origin from the slope for the calcarenites of the depocentral area. The facies and their related thicknesses have been used to perform statistical analysis. The transitional frequency analysis and the bed thickness distribution analysis were selected in order to evaluate analogies and differences between the facies and the possible geological implications. The Markov chain analysis has been applied on the marginal successions, where a higher variability of facies is present. This analysis shows the absence of cyclic patterns in the successions suggesting that the vertical occurrence of facies is connected to processes acting randomly on the slope. A bed thickness distribution analysis for the calcarenitic and calcisiltitic beds has been performed for each of the measured series in each depositional setting in order to recognize the possible changes in their distribution across the basin. Data have been processed both on the total population and on the single facies grouped according to the grain size. The identification of the kind of distribution allows proposing hypothesis on the triggering processes controlling the sedimentation in the basin; the log-log exceedence plots as well as

	linear histogram values highlighted that the bed thickness distribution follows a gamma and/or exponential model suggesting a non-fractal property (no power law distribution). The gamma/exponential distributions describe populations of events that are independent from each other and can be related to different triggering mechanisms operating both on the slope and along the margin that are affected by different factors of control (earthquakes, sea level changes etc.). The observations based on the sedimentological analysis and on the statistics suggest that different source areas and depositional processes were distributed in the basin where the Zorzino Limestone was deposited, evidencing differences in composition and facies distribution from slope to the depocentre.
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