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THE DISCOVERY OF AMMONOIDS IN THE CUNARDO FORMATION (VARESE).
A NEW CHRONOSTRATIGRAPHIC INTERPRETATION

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Riassunto. La scoperta di Ammoniti al tetto della Formazione di Cunardo consente la revisione della posizione cronostratigrafica dell'unità. *Detoniceras*, *Argolites* e *Anolcites* documentano la Zona Archelaus. L'età della formazione è quindi ladinica e non carnica, come sostenuto in letteratura.

Abstract. The discovery of ammonoids at the top of the Cunardo Formation allows the revision of the chronostratigraphic position of the unit. *Detoniceras*, *Argolites* and *Anolcites* testify the Archelaus Zone. The age of the unit is then Ladinian instead of Carnian, as reported in literature.

Previous studies.

The Middle and Upper Triassic formations of western Varese province founded their dating on determinations of Anisian-Ladinian fossils ("*Ceratites*" *luganensis*: Mariani, 1901; Frauenfelder, 1916; Zorn, 1971; "*Ceratites*" *felsorensis* Airaghi, 1935) in the San Salvatore Dolomite and Norian fossils (*Isognomon exilis*, *Neomegalodon gumbeli*, *Whortenia escheri*, *Gyroporella vesiculifera*: Frauenfelder, 1916; De Sitter, 1939) in the "Dolomia Principale".

The placing in the time scale of the marls, marly limestones, and thin-bedded dolostones, lying between the dated strata (Pizzella Marl and Cunardo Formation by Allasinaz, 1968a, 1968b and 1968c) relied on geometrical and lithostratigraphic criteria because of the lack of significant fossils.

Most of authors agreed in ascribing marls and marly limestones to the Carnian and particularly to the Late Carnian, because the lithological features and the position of these strata, below the "Dolomia Principale", connected intuitively this terrigenous-calcareous deposit to the typical generalized Late Carnian sedimentation.

In chronostratigraphic reconstructions, most of divergences were associated to the dating of the thin-bedded dolostones, lying on the San Salvatore Dolomite:

Taramelli (1880) thought these layers were passing through the Ladinian and the Carnian; most of following authors assigned them to the Middle Carnian (Frauenfelder, 1916; Senn, 1924; Bernoulli, 1964; Allasinaz, 1968a and 1968b; Zorn, 1971) and a minority considered that they were a San Salvatore Dolomite's vertical facies variation and then an Upper Ladinian deposit (Van Houten, 1929; De Sitter, 1939) (Fig. 1).

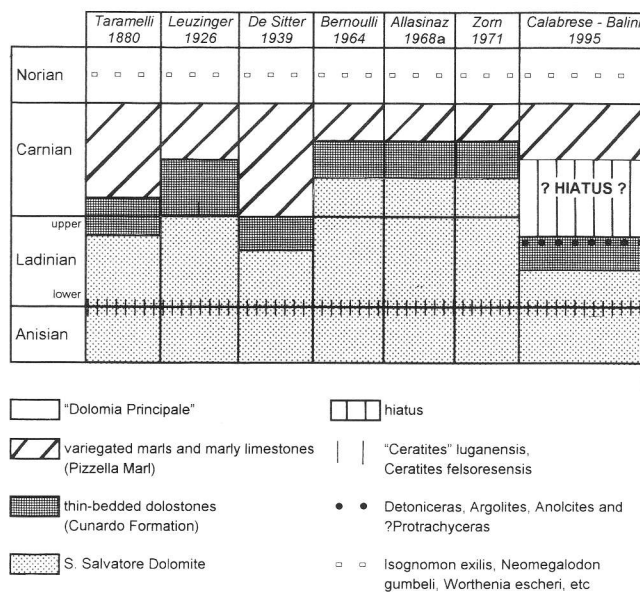


Fig. 1 - Summary of the chronostratigraphic interpretations of the Anisian-Norian interval in the west of Varese.

Rio Cosarivo's fossiliferous horizon.

During the geological survey relative to Calabrese's graduation thesis, a fossiliferous horizon has been found out at the top of the Cunardo Formation.

The fossiliferous locality is placed in the west of Cassano Valcuvia (Varese), along the Rio Cosarivo's northern affluent (480-460 m altitude) (Fig. 2a). There, the Pizzella Marl and the Cunardo Formation's strata

have got a different lying (Fig. 2b). This different lying could be explained as angular unconformity (onlap type), or as a stratigraphic boundary affected by a light faulting. An accurate observation is not possible due to covering upon the boundary.

The Cunardo Formation, in western Varese province, is about 100 m thick and consists of thin bedded grey and brown dolostones, sometimes laminated and with marly drapes. Fig. 2c shows lithological features of the Cunardo Formation-Pizzella Marl boundary.

From bottom to top the section is as follows:

- 1) flat bedded fine dolostones, white-yellow on weathered surface, grey to brown or hazel brown in fracture; beds are 2 to 5 cm thick with parallel laminations. Layers and laminations sometimes

- are wavy (wave ripple marks) and there are thin marly drapes. Beds are thicker on the top (10 cm about) with more irregular surfaces (4 m);
- 2) light hazel brown to brown dolostones in 1 to 15 cm thick beds with wavy and much irregular surfaces. There are bioturbations and cavities with millimetric dolomite crystals on the surface (12 m);
- 3) hazel brown to brown dolostones; layers are 7 to 20 cm thick with plane-wavy surfaces. Grey to brown dolostones follow in the upper part in 15 to 30 cm thick beds; there is a bed 40 cm thick of dark grey dolostones at the top with black chert nodules and silicified fossils on the upper surface (8 m). Top of Cunardo Fm. Not exposed: about 3.5 m.
- 4) calcareous dolostones, dolomitic limestones and limestones, white to grey on weathered surface, grey to hazel brown in fracture; layers are laminated, flat bedded, 2 to 12 cm thick. There are thin marly drapes between layers; grey to brown limestones follow in 2 to 7 cm thick beds, plane-parallel stratified and with thin marly levels, alternated to laminated layers of marly limestones (10 m). Lower Pizzella Marl.

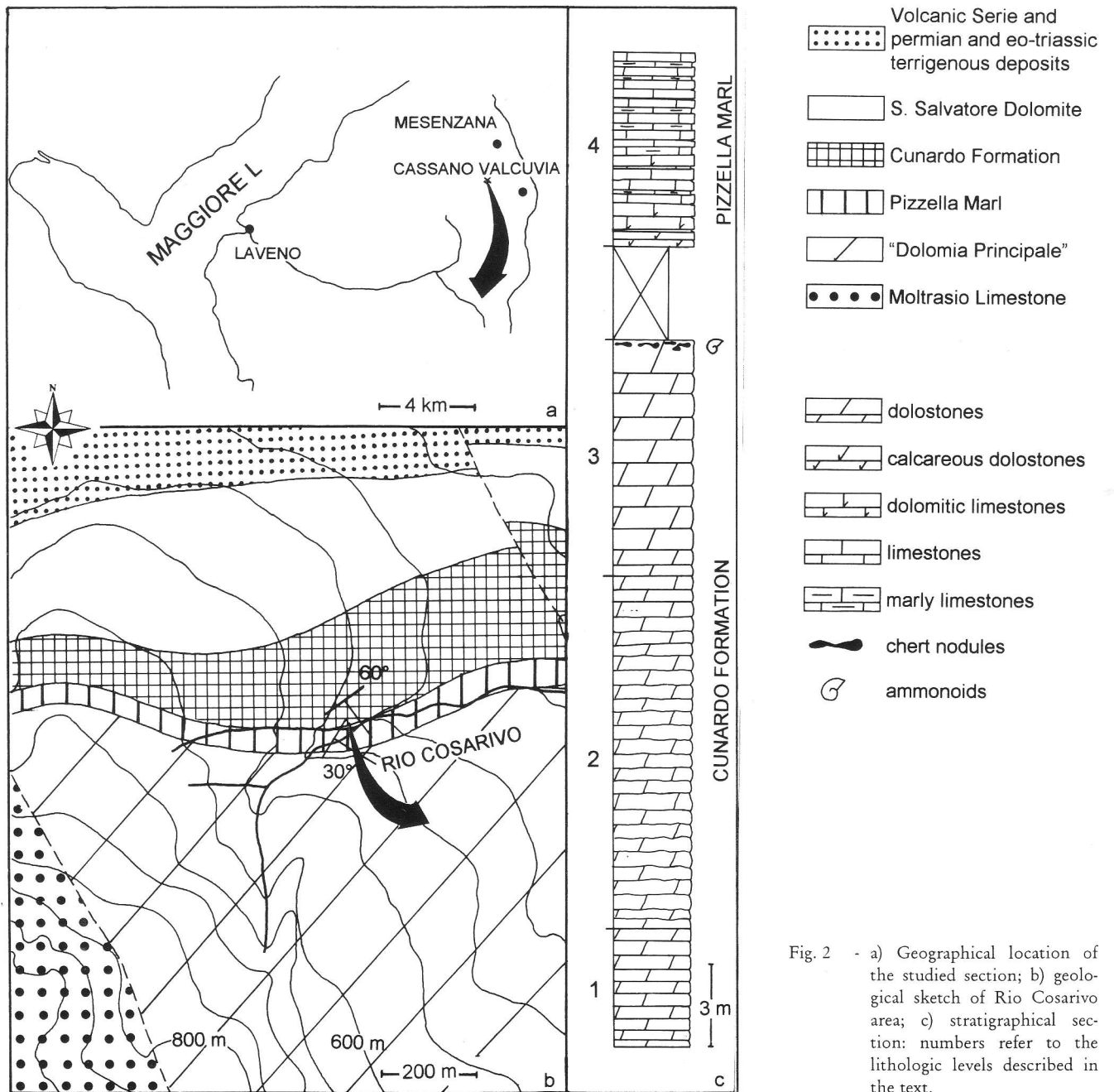


Fig. 2 - a) Geographical location of the studied section; b) geological sketch of Rio Cosarivo area; c) stratigraphical section: numbers refer to the lithologic levels described in the text.

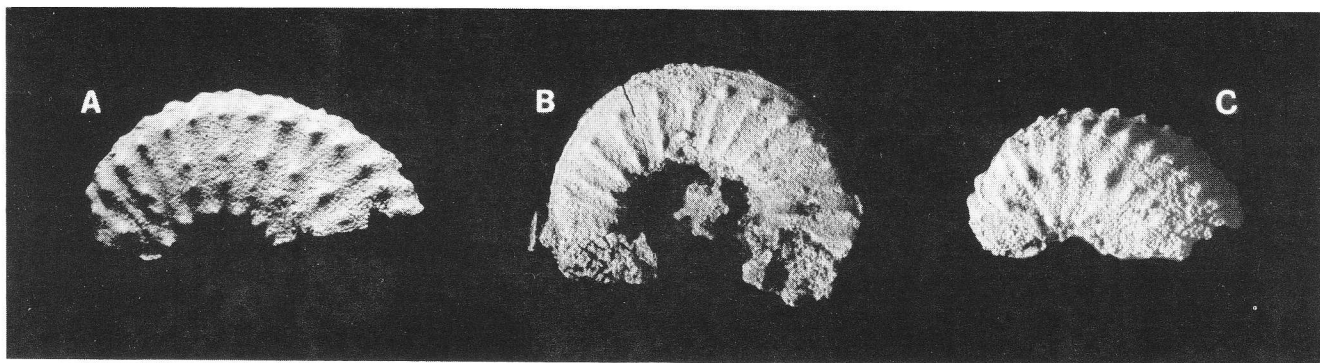


Fig. 3 - Ammonoids of Rio Cosarivo section. A) *Detoniceras* sp., x1; B) *Argolites* sp., flattened specimen, x1; C) *Anolcites* sp., x1. The full description of the fauna will be done in a forthcoming paper.

The fossiliferous layer is a dolomitic microsparite with pelagic bivalves (also hinged), bioturbation (burrowing), fine shreds of organic matter and local submillimetric concentrations of phosphatic compound. Authigenic quartz and feldspars are also present.

Fossils are common and mostly consist of ammonoids. However, bivalves can also be found. All fossils are flattened and silicified. Usually just the upper surface of the specimens is preserved, while the lower is included in chert nodules and overprinted by diagenesis. Among the rich ammonoid fauna the genera *Detoniceras* Manfrin & Mietto, 1991 (Fig. 3A), *Argolites* Renz, 1939 (Fig. 3B), and *Anolcites* Mojsisovics, 1893 (Fig. 3C) have been recognized. Probably *Protrachyceras* Mojsisovics, 1893 is also present, but the identification is uncertain due to strong flattening of the specimens..

Revision of the age of the Cunardo Formation.

On the basis of the recognized ammonoids a chronostratigraphic classification of the fossil-bearing level is possible. The genus *Detoniceras* s.s. is reported from the Archelaus Zone (early Late Ladinian) by Manfrin & Mietto (1991). More recently *Detoniceras* and *Argolites* have been also recognized in the same interval by Fantini Sestini (1994). *Anolcites* and *Protrachyceras* are not significant, at least at the level of genus, for a more refined attribution. In the assemblage there are no typical elements of the Regoledanus Zone (latest Ladinian).

In conclusion we may demonstrate that the Cunardo Formation is not Carnian in age, but Ladinian. The problem of the age of the Pizzella Marl is still opened. If we accept that the boundary between the Cunardo Formation and the Pizzella Marl is represented by an angular unconformity, then the inferred age of the Pizzella Marl could be Carnian. If the sedimentary sequence is continuous the base of the Pizzella Marl is Upper Ladinian (?Regoledanus Zone).

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