

## A mixed fauna at the Permian-Triassic boundary, Tesero Section, Western Dolomites (Italy)

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ABSTRACT — Detailed paleontological research on the sequence at the Permian-Triassic boundary cropping out at Tesero (Western Dolomites) were carried out. A «mixed fauna», constituted by Permian-like Brachiopods, Ostracods, Foraminifers and Algae, and by Triassic-like Molluscs, here occurs in the lowermost beds of Werfen Formation.

RIASSUNTO — [Su una fauna mista al limite Permiano-Trias della sezione Tesero (Dolomiti)] — Il limite tra la Formazione a Bellerophon e l'Orizzonte di Tesero, unità basale della Formazione di Werfen in gran parte delle Alpi Meridionali, è tradizionalmente considerato coincidente con il limite cronostratigrafico tra Permiano e Trias. Ricerche paleontologiche di dettaglio relative alla classica sezione stratigrafica di Tesero (Dolomiti Occidentali), comprendente il tetto della Formazione a Bellerophon e la base della Formazione di Werfen, evidenziano la presenza nella parte inferiore dell'Orizzonte di Tesero di una interessante fauna mista permo-triassica. Elementi ad affinità permiana sono rappresentati da Alghe, Foraminiferi (inclusi i Fusulinidi), Brachiopodi ed Ostracodi, che si accompagnano (a partire da circa 2m sopra la base) a Molluschi di affinità triassica; gli elementi « permiani » scompaiono pochi metri sopra la base della Formazione di Werfen. Questa fauna mista, confrontabile con faune simili rinvenute in diverse località della Tetide orientale (Pakistan, Kashmir, Cina), riapre il problema cronostratigrafico del limite Permiano-Trias nelle Alpi Meridionali.

### STRATIGRAPHICAL SETTING

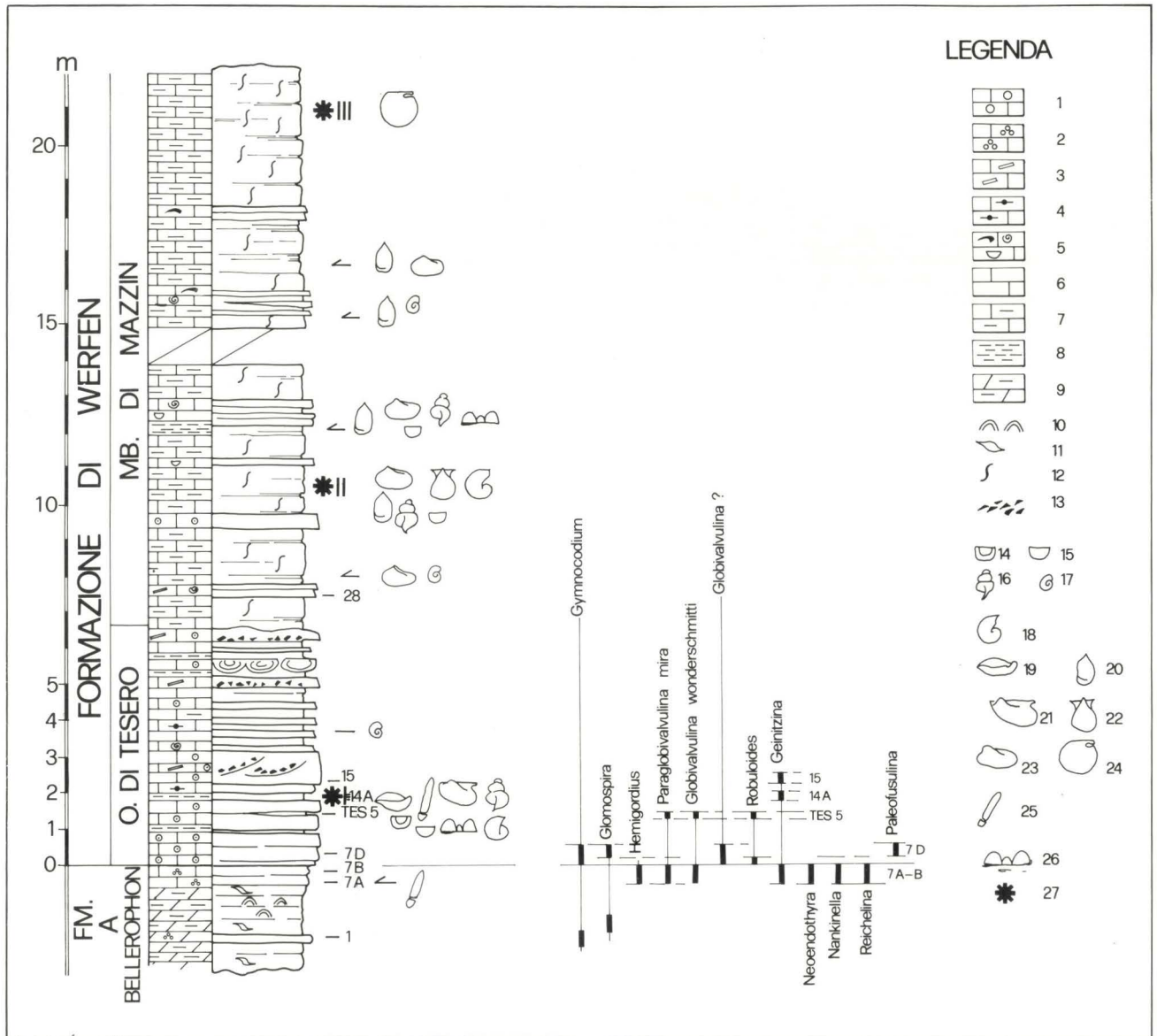
The Permian-Triassic sequence cropping out at Tesero in Val di Fiemme (Trento) is now considered as one of the most characteristic sequence for the Permian-Triassic boundary in the Western Dolomites.

The Upper Permian is represented by Bellerophon Formation here occurring in « fiammazzo » facies (Accordi 1958); the upper part of this formation was dated back to the Djulfian-Lower Dorashamian according to the Brachiopods fauna (*Comelicania*) found in Cadore (Assereto *et al.*, 1973; Leven 1981).

Werfen Formation (Lower Triassic) is generally thought to be transgressive on Bellerophon Formation (Bosellini 1964; Assereto *et al.*, 1973; Broglio Loriga *et al.*, 1983). In the Western Dolomites its base consists of an oolitic unit few meters thick, the so called Tesero Horizon (Bosellini 1968), after the type loca-

lity. This oolitic horizon gradually goes to the overlying Mazzin Member, dated back to Griesbachian pp. (Broglio Loriga *et al.*, 1980, 1983; Mostler *et al.*, 1982). The occurrence of Permian microfossils in Tesero Horizon already observed in the thin sections by some authors, has always been ascribed to reworking.

The narrow time-gap between Permian and Triassic sediments, suggested by the former authors, and the new fossil material found in this region have fostered a thorough research into this classical sequence for two reasons: 1) to make a contribution to biostratigraphy at the Permian-Triassic boundary in the Dolomites (to-date not well known in details); 2) to gain new data in view of evolutionary evaluations on the persistence of some taxa and the extinction of others in a stage of the geological history of Tethys, characterized by a strong biological crisis.



Text-fig. 1 - Stratigraphic section at Permian-Triassic boundary, Tesero, Western Dolomites. 1) Oolitic grainstones and packstones; 2) Algae and Foraminifers packstones; 3) intraclastic grainstones and packstones; 4) peloidal packstones; 5) bioclastic (Pelecypods, microgastropods, Ostracods) grainstones and packstones; 6) mudstones; 7) marly mudstones; 8) marls; 9) marly dolomites; 10) stromatolites; 11) fenestrae; 12) bioturbation; 13) intraformational breccia; 14) Permian Ostracods; 15) Triassic Ostracods; 16) *Coelostylina* cfr. *werfensis* Wittenburg; 17) microgastropods; 18) *Bellerophon vaccki* Bittner; 19) articulate Brachiopods; 20) *Lingula* sp.; 21) *Towapteria* sp.; 22) Aviculopectinidae; 23) *Unionites*; 24) *Claraia*; 25) Echinoids remains; 26) «*Spirorbis*»; 27) main macrofauna occurrences.

#### MICROPALAEONTOLOGY

Bellerophon Formation mainly consists of vacuolar, marly and greyish dolomites with stromatolithic horizons, collapse breccia layers and rare intercalations of bioclastic dolomitic limestones; as a result, the fossil content is somewhat low, just restricted to *Gymnocodium* remains and some small *Glomospira* sp. The samples, as shown in Text-fig. 1, were taken from the

upper 3 to 4 m of the unit. Just at the top of the formation, dark bioclastic limestones about 50 cm thick occur; they contain a rich Foraminifers assemblage (sample 7A and 7B in Text-fig. 1), including several taxa until recently unknown in the Southern Alps and just lately reported by Pasini (1982).

They are:

*Reichelina minuta* Erk, *Paraglobivalvulina mira* Reitlinger, *P. gracilis* Zaninetti and Altiner, *Neo-*

*endothya bronnimani* Bozorgnia, *Nankinella* cf. *quasibunanensis* Sheng

in association with *Hemigordius*, *Geinitzina*, Nodosaridae, Ostracods, Echinoderms remains.

In the lowermost oolitic layers of Tesero Horizon, besides *Gymnocodium*, *Hemigordius* etc., Fusulinids which can be referred to small *Paleofusulina* (sample 7D) are found; regardless the fact that these Fusulinids are autochthonous or displaced from the underlying Bellerophon Formation, they still prove the occurrence of *Paleofusulina* zone in the Southern Alps. Such zone is known to be the last Fusulinids zone before the total extinction of these Foraminifers, which approximately coincides with the end of the Permian.

About 1.5 m above the base of the horizon, a thin marly layer intercalated between the oolitic bodies (sample TES 5) contains a microfauna characterized by: *Paraglobivalvulina mira* Reitlinger, *P. septulifera?* Zaninetti and Altiner, *Globivalvulina wonderschmitti* Reichel, *G. bulloides* Brady and a considerable number of small and very small Biseriamminids ascribable to immature forms of *Globivalvulina* and *Paraglobivalvulina*; in addition, small *Geinitzina* spp., *Robuloides* and Ostracods which can be ascribed to Permian Paleocopids. Some of the Foraminifers mentioned above are still present in the washing of sample 14A, about 50 cm higher, where, however, together with Permian Ostracods other undoubtedly Mesozoic-like taxa are found; it is to be noted that this sample comes from levels containing the first important macrofauna of the section (macrofauna I) where Permian Brachiopods occur in association with Triassic-like fossils.

A number of Tesero Horizon calcarenitic layers is made up of spathic granules with a diameter from 0.5 to 1 mm and a surface cover consisting of 1 to 2 envelopes. In many cases these granules have internal structures which may be referred to small Biseriamminids and/or Fusulinids in the early stages of growth, as in the case of sample TES 5. The last occurrence of these forms is to be found in sample 28, almost 8 m above the Tesero Horizon base.

To complete the micropaleontological picture, Ostracods, Conodonts and Sporomorph assemblages will be studied.

#### MACROFAUNA

Up-to-date no macrofossils in the Bellerophon Formation at Tesero were found, the depositional environment of which was characterized by peritidal and evaporitic conditions very adverse to life. How-

ever, a research work in Tesero and Cavalese area should be carried out in order to verify the presence and the precise stratigraphic setting of Permian Brachiopods faunas, formerly reported by Leonardi (1930, 1937) in this area.

In Tesero section, the first macrofauna (I) occurs about 2 m above the base of Werfen Formation in a marly 40 cm thick layer where some bioclastic centimetric intercalations can be observed. Gastropods (*Bellerophon* cf. *vaceki* Bittner and «*Coelostylyna*» cf. *werfensis* Wittenburg), Bivalves (*Towapteria* sp. as well as unclassifiable Aviculopectinidae), spines and plates of Echinids, articulate Brachiopods, «*Spirorbis*» are present. Besides Echinids remains, representing the first finding of this type in Werfen Formation of the Southern Alps, Brachiopods are undoubtedly the most interesting macrofauna components. No less than 5 to 6 different species are present, a couple of which occurs in a large number, to such extent that some of the bioclastic intercalations within the marly horizon are true Brachiopods «*coquinas*».

The study of the taxonomic composition of this Brachiopods fauna is still under progress; the preliminary data show the presence of Permian taxa ascribable to *Crurithyris?* *extima* Grant, *Spinomarginifera* sp., *Ombonia* spp. as well as one «*Streptorhynchid*» and one «*Crurithyrid*» whose species or genus have not yet been determined. While the presence of the genus *Ombonia* Caneva is widely recorded in Bellerophon Formation (Merla 1930), at least a part of the other forms was formerly unknown in the Southern Alps:

Of a certain importance is the occurrence in fauna I of *Towapteria* and *Bellerophon*. Both genera occur to the greatest extent in the Permian but are also found in the Triassic with two undoubtedly scythian species: *Towapteria scythica* (Wirth), present in the Mazzin Member of the Dolomites together with *Claraia* and *Bellerophon vaccki* Bittner, the range of which reaches at least the base of *Claraia aurita* layers, more than 100 m above the base of Werfen Formation (Broglia Loriga *et al.*, 1983). As a result, within fauna I there is the concomitance, also confirmed by microfossils, of Permian elements and elements which will be still present in Triassic fauna, while not being, in some cases, typical Triassic elements.

Mixed faunae with Permian Brachiopods and Triassic Molluscs, sometimes with Ammonoid, are recorded in South China (Liao 1980; Zhao *et al.*, 1981, etc.), Kashmir (Teichert *et al.*, 1970, etc.), Pakistan (Grant 1970, etc.) and gave rise to opposite interpretations on the stratigraphic meaning of the fossils involved (survived or displaced?), the possible presence of a hiatus at the Permian-Triassic boundary and its extent as well as, and, of course, the boundary

position between the two systems in the different sequences.

We do not intend to deal with these problems here and will just make the first stratigraphically significant report of the presence of a Permian-Triassic mixed fauna in the Southern Alps.

In the subsequent Mazzin Member, real Permian elements can hardly be found in macrofauna.

Attention should be drawn to fauna II, about 10 m above the base of the formation, characterized by a very high number of individuals and by a relatively high diversity in comparison to « standard » faunas of the lower part of Werfen formation (Broglia Loriga *et al.*, 1980). This fauna is mainly composed by: *Unionites cf. canalensis* (Catullo), *U. cf. fassaensis* (Wissmann) (two species with a range reaching the whole Werfen Formation), *Bellerophon vaceki* Bittner, microgastropods (including « *Coelostylina* » *werfensis* Wittenburg), mesozoic-like Ostracods; *Lingula* sp. and unclassifiable Aviculopectinidae are also present, even if rare.

The first occurrence of genus *Claraia* with *C. gr. wangi-griesbachi* in fauna III, about 20 m above the base, completes the faunal setting, already showing a Triassic « facies ».

#### CONCLUSIONS

The occurrence of a Permian-Triassic mixed marine fauna in the typical Tesero Horizon sequence and the attribution of the top of Bellerophon Formation to a very high Permian (Lower Dorashamian) make it possible to compare the sequence of the Southern Alps with the few Asian sequences (Transcaucasia, Salt Range, South China) which are now regarded as the most complete, in the Tethyan area, at the Permian-Triassic boundary.

As a result, the Southern Alps are an area of great interest both from a chronostratigraphic and paleontological standpoint with respect to the history of biological evolution between the end of the Paleozoic and the beginning of the Mesozoic at the outermost western border of Tethys.

Clearly, to carry on this study, a significant comparison between the faunas of Bellerophon Formation and the Permian-like faunas of Tesero Horizon should be based on a good knowledge of the vertical distribution of the fossils of Bellerophon Formation. To this purpose some sections of Bellerophon Formation, representative of peritidal « fiammazza » facies and open-marine « badiota » facies are being studied.

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