NOTA BREVE - SHORT NOTE

DISCOVERY OF PARATIROLITES FROM THE BELLEROPHON FORMATION (UPPER PERMIAN, DOLOMITES, ITALY)

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Riassunto. Viene descritto il ritrovamento, il primo della Tetide occidentale, di un esemplare di *Paratirolites*. L'ammonoide, raccolto nel detrito della Fm. a Bellerophon nei pressi di Santa Cristina Valgardena (Bolzano, Dolomiti), è contenuto in una piccola lastrina di calcare marnoso, nerastro, della Facies Badiota, con una microbiofacies dominata da ostracodi. Sulla base del litotipo e della biofacies si presume che esso possa derivare dai livelli dell'Associazione ad Ostracodi, situati pochi metri sotto a quelli dell'Associazione a *Comelicania* e *Nankinella*. Non si può escludere tuttavia una provenienza da livelli più bassi, sempre comunque appartenenti alla Facies Badiota. Questo ritrovamento consente di stabilire, contrariamente a quanto sostenuto da alcuni autori, che l'Associazione a *Comelicania* e *Nankinella* è più recente della Zona a *Phisonites - Comelicania* (= *Gruntallina*) della Transcaucasia e che essa è correlabile o è più giovane della Zona a *Paratirolites* del Dorashamiano sup.

Abstract. The first discovery of *Paratirolites* in the western Tethys is here described. The ammonoid was collected in the debris of the Bellerophon Fm. near Santa Cristina Valgardena (Bolzano, Dolomites). The specimen is contained in a small slab made of marly dark grey limestone with a biomicrofacies dominated by ostracods. It probably comes from the Ostracod Assemblage beds (Badiota Facies), which are situated few metres below the *Comelicania* beds. The occurrence of *Paratirolites* allow us to date this segment of the upper Bellerophon Fm. to the late Dorashamian, and to define the *Comelicania* and *Nankinella* beds of the Dolomites as younger than the *Phisonites - Comelicania* (= *Gruntallina*) beds of the Transcaucasia (basal Dorashamian). These Dolomite beds are equivalent to or younger than the *Paratirolites* Zone (late Dorashamian).

Introduction.

In the Dolomites, the Upper Permian is represented by the Bellerophon Formation which was formed in a shallow marine environment, mostly inhabited by benthic organisms. Ammonoids of the Bellerophon Formation of the Dolomites are thus very rare. To date, only few specimens of *Paraceltites sextensis* (Diener) have been found at the end of the last century in the Sesto

(*Sexten*) area (Diener, 1897). Unfortunatly, such an endemic species does not allow a direct correlation with the ammonoid standard zonation of the Late Permian. The chronological framework of the Bellerophon Fm. has therefore been made using other taxa, mainly forams and brachiopods, by means of which a correlation with the ammonoid-bearing sequences has been attempted. However, the ages obtained from these fossils are often approximative and lack a general consensus, among different authors, on their precise chronostratigraphical position.

The majority of authors consider the Bellerophon Fm. Dzhulfian/Changxingian in age, even if the position of the boundary between these two stages has not been detected, as most of the formation was deposited in a restricted shallow marine environment in which fossils are rare, and represented by long-ranging taxa. Only in the uppermost metres of the formation did more open marine conditions allow the presence of fusulinids and brachiopods, which have a greater chronostratigraphical value. However, the ages inferred from these taxa are also uncertain. For instance, the age proposed for the *Comelicania* beds ranges from topmost Dzhulfian-basal Changxingian (Kozur, 1989), to lower Dorashamian (Assereto et al., 1973), to upper Dorashamian (Broglio Loriga et al., 1988; Posenato, 1988; etc.).

Stratigraphic position of the ammonoid.

The ammonoid described here was discovered by one of us (H.P.) on the blocks of a large landslide which fell several tens of years ago from Pic Mt. (*Pizza Cuecena* in the Ladinian language, *Pitschberg* in the German language). This locality (Jmuëia da Insom), about 2 km northward of Santa Cristina Valgardena (Fig. 1), is the same as that in which the fish *Archaeolepidotus leonardii* Accordi was found.

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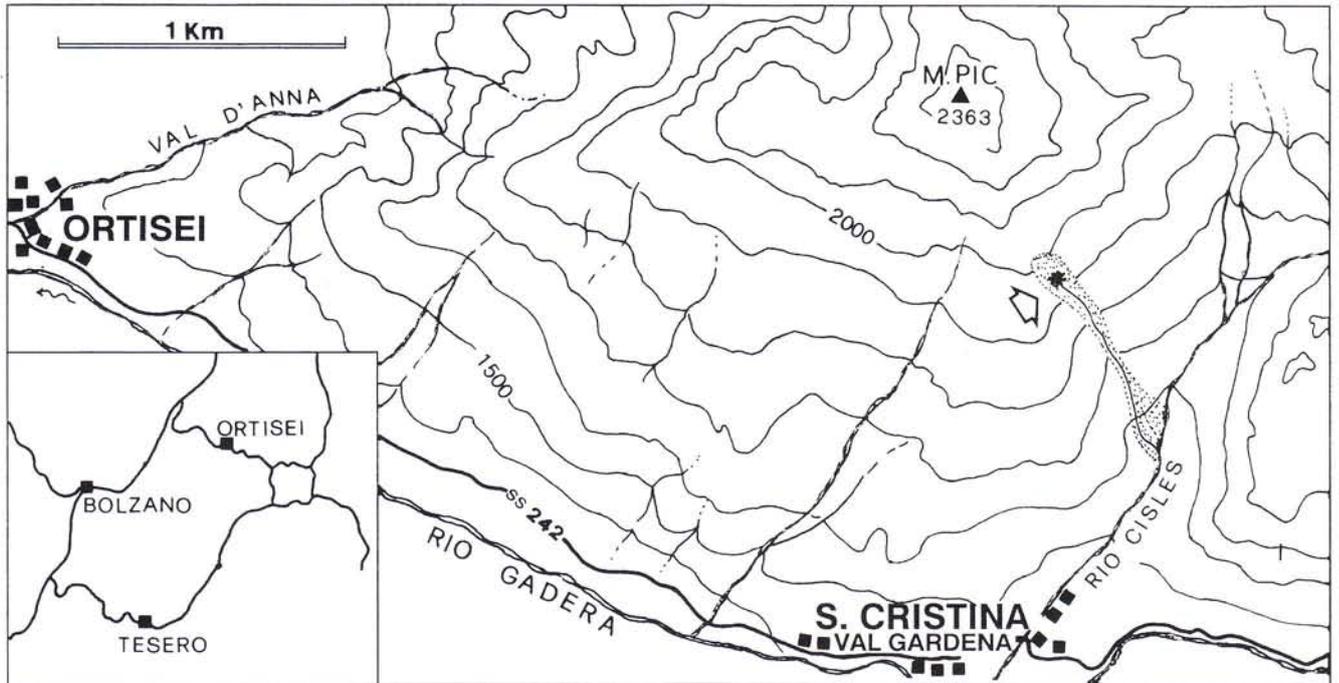
Fig. 1 - Geographical setting of the locality (asterisk) from which the ammonoid has been collected.

The ammonoid occurs in a small slab of blackish marly limestone, very rich in ostracods, belonging to the Badiota Facies (Fig. 2). This facies represents the upper part of the Bellerophon Fm. in the Valgardena area, as well as in all the western Dolomites. In his schematic description of the Pic Mt. section, Accordi (1955) described a unit (unit 6) made up of "*Calcare argilloso a ostracodi e a piccoli molluschi*" (=marly limestone with ostracods and small molluscs"), from which probably the ammonoid derives. However, Accordi (1955) did not report the thickness of this unit but only that of the whole Badiota facies, which is 35 m thick (from unit 3 to unit 7).

In the Valgardena area, recent stratigraphic data on the Bellerophon Fm. are reported from the Seceda section (Massari et al., 1994), located about 2 km NW of Pic Mt. In this section the Badiota Facies is about 35 m thick, as in the Pic section, and represents the 5th and 6th sequences of third order into which Massari et al. (1994) divided the Upper Permian of the Eastern Southern Alps.

The lower part of the 5th sequence is a transgressive segment made up of dominant subtidal fossiliferous limestones, rich in algae and forams (upper part of the Algae Assemblage of Broglio Loriga et al., 1988). The uppermost, regressive part of the sequence consists of silty dolomites and marly limestones, with a biofacies characterized by the mass occurrence of ostracods (Ostracod Assemblage of Broglio Loriga et al., 1988). The sequence ends with vuggy dolomite with root traces which suggest subaereal exposures (Massari et al., 1994). This regionally regressive event is about 10-12 m thick (Fig. 3).

The uppermost Bellerophon Fm., about 1.5 m thick in the Seceda section, records the transgressive event of the sixth sequence which is mainly represented by the basal Werfen Fm. (Tesero Horizon and Mazzin Member). The top of the Belle-
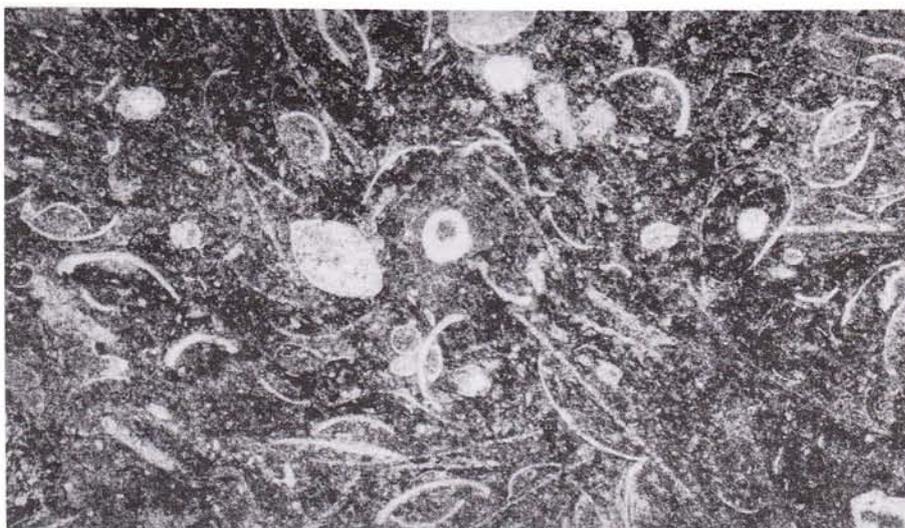
Fig. 2 - Ostracod biofacies of the matrix containing the ammonoid. Negative print from acetate peel (x 40).

tains three Dorashamian genera: *Paratirolites* Stoyanow, *Dzhulfites* Shevyrev and *Abichites* Shevyrev. The latter two genera have been considered by Teichert et al. (1973) as synonyms of *Paratirolites*. Because *Dzhulfites* is slightly older than the other two genera (*Paratirolites* and *Abichites* are associated in the *Paratirolites* beds), a comparison with the genera proposed by Shevyrev (1965) is necessary.

Dzhulfites is characterized by an ovoidal-subrectangular, slightly compressed whorl section and a ventral lobe which is simple-pronged and non-denticulated. The Dolomites specimen has a whorl section which is slightly depressed, scarcely subpentagonal, with a small denticle on the last adoral ventral lobe as occurs in *Paratirolites* and *Abichites*.
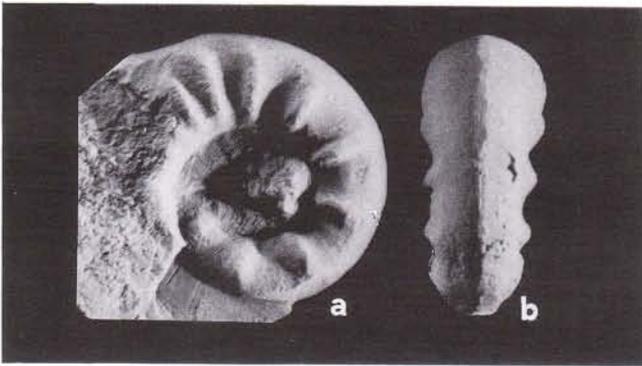
Fig. 4 - *Paratirolites* sp., lateral (a) and ventral (b) views; Jmuëia da Insom, Santa Cristina Valgardena (Bolzano), x 2.
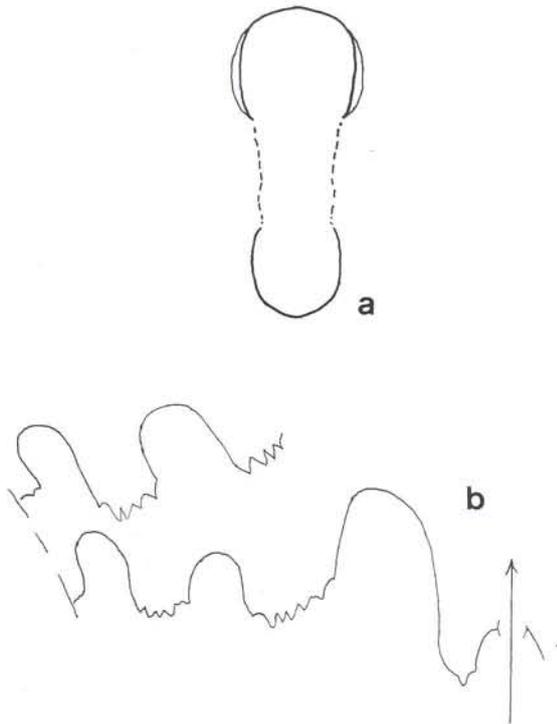
Fig. 5 - Shell section (a, x 2) and last (end of phragmocone) suture lines at a whorl height of 7.1 mm (b, x 7) of *Paratirolites* sp.; Jmuëia da Insom, Santa Cristina Valgardena (Bolzano).

Abichites has a compressed, rectangular or subquadrate whorl section; the venter is slightly convex in the inner whorls, while it becomes flattened in the body chamber. This genus differs from *Paratirolites* by a sharp dorsal shoulder and the absence of ventral nodes on the adult whorl. Since our specimen is smaller by half with respect to the smallest specimen of *Abichites* illustrated by Shevyrev (1965), the ontogenetic changes of the whorl shape cannot be used here as an element of comparison even if the lacking of ventral nodes in *A. abichi* Shevyrev and *A. stoyanowi* (Kiparisova) (see Shevyrev, 1965, pl. 34, fig. 2-4), seems to occur already in the inner phragmocone whorls, a character in common with the Dolomites specimen. However, *Abichites* has sharp dorsal and ventral shoulders whereas they are rounded in the Dolomites ammonoid, as occurs in some *Paratirolites* species (e.g. *P. waageni*).

The Dolomites specimen has a slightly depressed whorl section and a low-arched venter with a low crest. A depressed whorl is common among *Paratirolites* species, but a ventral ridge is not present in the specimens figured by Shevyrev (1965). However, according to Tozer (1979), the lack of a ventral ridge in many Dzhulfitid species of the type area may be related to an imperfect preservation of the material, as specimens of *Paratirolites vediensis* Shevyrev from Kuh-e-Ali Bashi (Iran) have one.

Paratirolites has latero-ventral nodes; these are absent in the Dolomites specimen, in which only ribs occur. The difference could be related to the different ontogenetic stages of the confronted material illustrated by Shevyrev (1965), as these Transcaucasian specimens have sizes which are three or four times larger. However, the lectotype of *P. kittli* figured by Spath (1934, fig. 135 a, b) has ventral nodes already 19 mm in diameter. The lack of ventral nodes in the Dolomites specimen thus raises some doubts as to its attribution to the gen. *Paratirolites sensu* Shevyrev.

The specimen described here thus belongs to the fam. Dzhulfitidae but, following the Shevyrev's classification, it is impossible to determine its precise generic position as it is too small, with morphological characters in common with different genera. The lack of ventral nodes is a character of *Abichites*, while the well rounded ventral shoulder, slightly depressed whorl and low, smooth ventral crest are taxonomical features of *Paratirolites*. Since it shares more characters with *Paratirolites* than those in common with *Abichites*, the specimen resembles the former genus more than any other Late Permian ammonoid.

A different classification of the Transcaucasian Dzhulfitidae was proposed by Teichert et al. (1973), who interpreted a large morphological variability among them regarding whorl section and ornamentation, even if they did not analyse them in detail on account of the incompleteness of the specimens. For this
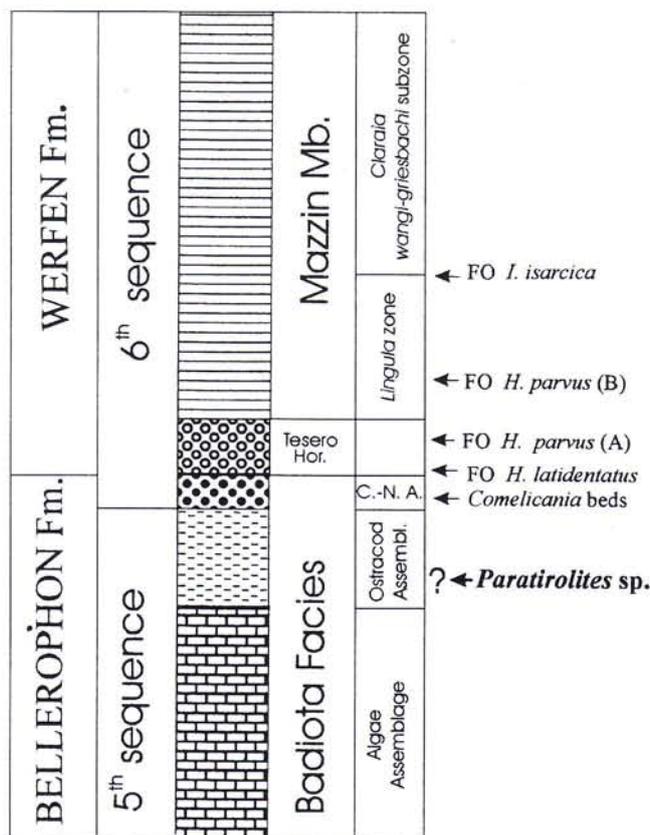
Fig. 3 - Probable stratigraphical position of *Paratirolites* sp. Litho-stratigraphical units are not to scale, as their thickness changes according to the different sections (e.g. Tesero Horizon in the Bulla and Tesero sections) from which data on conodonts are available (Wignall at al., 1996; Farabegoli & Perri, 1998). Abbreviations: C.-N. A. - *Comelicania* and *Nankinella* Assemblage. Third order sequences from Massari et al. (1994); biostratigraphic units from Broglio Loriga et al. (1988). FO *H. latidentatus* (?= *Hindeodus* n. sp. X of Orchard, 1996): at 0.3 m above the base of the Tesero Horizon (Bulla section, Farabegoli & Perri, 1998). FO *H. parvus* (A) (?= *H. latidentatus praeparvus* of Kozur, 1996, 1998): at 1.30 m above the base of Tesero Hor. (Bulla section; Farabegoli & Perri, 1998); FO *H. parvus* (B): at about 14 m above the base of Tesero Hor. (Tesero section, Wignall et al., 1996); FO *I. isarcica*: at 7 m above the FO of *H. parvus* (B) (Tesero section, Wignall et al., 1996).

rophon Fm. yields the *Comelicania* beds, which are made up of bioclastic wackestone and marls containing a well diversified assemblage with forams and algae, and brachiopods represented by *Comelicania haueri* (Stache) and *C. megalotis* (Stache) (*Comelicania* and *Nankinella* Assemblage of Broglio Loriga et al., 1988). The uppermost 10-20 cm of the Bellerophon Fm., characterized by the appearance of ooids, are made up of packstone/grainstones containing *C. merlai* Posenato, *Janiceps* spp., *Ombonia canevai* Merla and *Orthothetina ventilabrum* (Leonardi). According to Massari et al. (1994), these beds are separated from the *C. haueri* and *C. megalotis* beds by a slight erosional contact.

On the basis of the litho- and biofacies of the matrix, the ammonoid probably derives from the regressive

segment (Ostracod Assemblage) of the 5th sequence (Fig. 3). However, a lower position inside the Badiota Facies cannot be entirely excluded, as ostracod lenses occur also in the lower part of the Algae Assemblage belonging to the 4th sequence of Massari et al. (1994) (cf. Seres section, Cirilli et al., 1998, fig. 5). However, in the Pic and Seceda sections the 4th sequence is mostly represented by marl, marly dolomite and dolomite belonging to the Fiammazza Facies.

Systematic description *

Supra-generic classification according to Shevyrev, 1986

Ord. Ceratitida Hyatt, 1884
Suborder Paraceltitina Shevyrev, 1968
Superfam. *Xenodiscaceae* Frech, 1902
Fam. *Dzhulfitidae* Shevyrev, 1965
Gen. *Paratirolites* Stoyanow, 1910

Paratirolites sp.
(Fig. 4, 5)

Description. The specimen is an evolute shell of small size, incomplete, consisting of the outer whorl of phragmocone and part of the aboral dorsal region of the body chamber. It has a diameter of 19.6 mm, whorl width of 8.5 mm, whorl height of 7.2 mm and an umbilical diameter of 7.8 mm. The whorl is slightly depressed, and has flanks converging very slightly toward the dorsal shoulder; the venter is broadly arched with a hardly perceptible, smoothed crest; the ventral and dorsal shoulders are rounded. The lateral areas bear coarse ribs which, in the last half whorl of phragmocone, are distant and rectiradiate. The last two ribs, near the ventral shoulder, seem to curve forward. In the umbilical fragment of body chamber the ribs appear closer together, while they become lateral nodes in the inner umbilical whorls. The ribs are most prominent on the flanks, and they disappear towards the venter, which is smooth; ribs protude slightly on the dorsal shoulder.

Suture is ceratitic with two denticulated lateral lobes; the auxiliary lobe on umbilical seam and ventral lobe are slightly denticulated. The lateral saddle is lower than ventral and auxiliary saddles; the ventral (largest) and auxiliary saddles are asymmetrical; the latter projecting slightly toward the umbilical seam (Fig. 5b).

Comparison. The classification in the Fam. Dzhulfitidae is mainly based on the suture which has a low lateral, depressed saddle, separated from adjacent ventral and auxiliary saddles by two denticulated lobes. According to Shevyrev (1965; 1986), this family con-

reason, as already quoted, these authors considered *Abichites* synonymous of *Paratirolites*, down-grading Shevyrev's genera to a specific level. Since we have only one, very small and incomplete specimen, making it difficult to use Shevyrev's classification, we prefer to adopt that of Teichert et al. (1973), according to whom the Dolomites specimen belongs to the gen. *Paratirolites*.

As concerns the determination at specific level, some small-sized specimens of *P. kittli* figured by Teichert et al. (1973, pl. 6, fig. 7, 10, 11) have a sculpture and a venter morphology very close to ours. They have ribs without ventral nodes and a venter decidedly arched, at a shell diameter of about 45 mm. However, these specimens are about twice our own in size, and have a slightly compressed whorl (figs. 10, 11): such differences do not allow us a specific determination of our ammonoid. Therefore, adopting the classification of Teichert et al. (1973), the specimen is here determined as *Paratirolites* sp.

Age. The finding of *Paratirolites* sensu Teichert et al. (1973) in the upper Bellerophon Fm. permits us to recognize here the upper Dorashamian *Paratirolites* Zone: the last ammonoid zone of the Dorashamian, according to the original definition of this stage (Rostovtsev & Azaryan, 1971; 1973). The same correlation can also be proposed following Shevyrev's classification (*Paratirolites ? sp.*), since the Dolomites specimen has characters in common with *Paratirolites* and *Abichites*, which, in Transcaucasia, are associated in the *Paratirolites* beds; besides, it is different from *Dzhulfites*, a marker of an older Dorashamian biozone placed between *Iranites* and *Shevyrevites* zones.

However, in Transcaucasia, a younger Permian ammonoid zone has since been recognized: this is the *Pleuronodoceras occidentale* Zone, which occurs above the *Paratirolites* Zone (Akhura Suite) in a unit made up of red clays and marls, belonging to the base of the Karabagljar Suite (Zakharov, 1988). The *P. occidentale* Zone

is correlated to the upper Changxingian of South China (e.g. Yang & Li, 1992), while the Dorashamian, from *Phisonites* to *Paratirolites* Zones, is considered equivalent to the lower Changxingian (Kozur, 1989; Yin & Tong, 1998). An alternative opinion is expressed by Sweet et al. (1992) and Tozer (1979), who correlate the upper Changxingian with the Dorashamian. According to Tozer (1979) the occurrence of *Paratirolites* in the lower Changxingian of China is questionable, and *Pleuronodoceras* and *Pseudotirolites*, markers of the upper Changxingian, are associated with *Paratirolites* in the Ali Bashi Formation of Transcaucasia.

Comelicania and *Janiceps* beds of the uppermost Bellerophon Fm. are thus younger than the *Phisonites-"Comelicania"* beds of the basal Dorashamian or lower Changxingian to which they have so far been correlated (e.g. Yin & Tong, 1998). Unfortunately, no zonal marker has been found among conodonts in the uppermost Bellerophon Fm., making it impossible to define the age of this segment with precision. Conodont zonal markers such as *Hindeodus latidentatus* and *H. parvus*, the latter of which has been proposed (Yin, 1993) as the marker of the base of Triassic, only appear in the lower Werfen Fm. (Tesero Horizon and Mazzin Member), but taxonomical problems on the classification of these species impede us from objectively determining the position of the P/Tr boundary (for the taxonomical problems and chronostratigraphical significance of these conodonts see Schönlaub, 1991; Kozur, 1996; 1998; Orchard, 1996; Orchard & Krystyn, 1998; Wignall et al., 1996; Farabegoli & Perri, 1998, etc.).

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