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Protancyloceras (*Ammonoidea*) in the Lower Tithonian sequences of the Trento Plateau (Venetian Alps, Northern Italy)

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Abstract

In the present paper I refer to a specimen of ammonite genus *Protancyloceras* (fam. *Ancyloceratidae*) in the Southern Alps for the first time. Italian *Protancyloceras* have been mentioned, up to now, only in the Umbria-Marche Apennines (ZITTEL 1870) but the specimen were lost. The illustration of the Italian *Protancyloceras* is made together with paleoecological and paleobiogeographic considerations. A biostratigraphical study makes it possible to refer the specimen of the Southern Alps to a precise interval within lower Tithonian, lower Hybonotum Zone, i.e. the oldest record of *Protancyloceras*.

1 INTRODUCTION

Protancyloceras is an heteromorph ammonite genus (suborder *Ancyloceratina*), recorded from the Upper Jurassic (lower Tithonian) to the Berriasian (lower Cretaceous). The presence of this genus is known in a well-definited belt between Laurasia and Gondwana (Fig.1). From a morphological point of view *Protancyloceras* is coiled in a very open spiral, with ribs fine on early whorls and coarser on the later whorls.

This is the first time that a specimen of *Protancyloceras* is described in the Upper Jurassic of Southern Alps. The ammonite comes from the "Rosso Ammonitico Veronese" Formation exposed at the Roccolo section near Lavarone ("Trento Plateau", Venetian Alps, Northern Italy).

The biostratigraphical arrangement of these outcrops has recently been discussed by SARTI (1986, 1993, in prep.), CARACUEL *et al.* (1997, 1998).

Protancyloceras appeared in the Northern Carpathians with *P. guembeli* (OPPEL), in the lower Tithonian, upper part of the Hybonotum Zone (WIERZBOWSKI 1990) , that is, in distal areas of the Mediterranean Tethys. The studied ammonite of Trento Plateau has been found in the lower Hybonotum Zone, representing the oldest record of *Protancyloceras*.

2 DESCRIPTION AND BIOSTRATIGRAPHY OF THE NEW AMMONITE FROM ROSSO AMMONITICO VERONESE FORMATION

2.1. Remarks on biostratigraphy.

The Roccolo section is located in the central Trento Plateau. The Trento Plateau was a structural high (Bahamian-type carbonate) until the late Early Jurassic. Subsequent platform drowning led to sedimentary starvation and pelagic carbonate deposition (BOSELLINI & MARTINUCCI 1975, ZEMPOLICH 1993). The Rosso Ammonitico Veronese Formation marked the beginning of pelagic sedimentation on the platform and was deposited on this distal pelagic-swell system located in the northern Apulian Block. Within the epioceanic fringe, this distal pelagic-swell system was surrounded by basins extending hundreds of kilometres. The Roccolo succession studied, in the upper unit of the Rosso Ammonitico Veronese, dates from the late Kimmeridgian (Beckeri Chron) - Early Tithonian (Semiforme/Verruciferum Chron) and has a total thickness of 3 m. Based on subdivisions proposed by SARTI (1985, 1988, 1993, in prep.) and CARACUEL *et al.* (1997, 1998) the following ammonite-defined bio-chronostratigraphic units have been identified in the Roccolo section: Beckeri/Pressulum Zone in the Kimmeridgian and the Hybonotum, Albertinum

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Fig.1: Distribution of Tithonian *Protancyloceras*. Palaeogeography modified from STEVENS (1990), FOURCADE et *al.* (1991), DECOURT et *al.* (1993), OLORIZ et *al.* (1993), ENAY & CARIOU (1997). 1: Mexico. 2: Cuba. 3: Cordillera Betica. 4: Bavaria. 5: Rogoznik. 6: S.E.France. 7: Trento Plateau. 8: Umbria-Marche. 9: Crimea. 10: Turkey. 11: Iraq.

and Semiforme/Verruciferum in the lower Tithonian. Selected ammonites, among those recorded, which are significant include:

Beckeri/Pressulum Zone (from the base to 60 cm): The first record of *Hybonoticeras* defines the lower boundary *(H. pressulum* and *H. beckeri* groups), *Paralingulaticeras* and the uppermost *Sowerbyceras loryi* characterize this Zone, together with typical upper Kimmeridgian *Taramelliceras* and perisphinctids.

Hybonotum Zone (from 60 to 200 cm): *Hybonoticeras* (group of *hybonotum*) together with *Protancyloceras* sp. aff. *guembeli* studied in the present paper and gathered 25 cm over the base of the Tithonian, characterize the first tithonian layer, 50 cm thick. *Haploceras elimatum* and *H. staszycii*, *Ptychophylloceras ptychoicum*, together with lower Tithonian perisphinctid assemblages has also been recognized.

Albertinum Zone (from 200 to 250 cm): First record of *Virgatosimoceras albertinum* defines the lower boundary (and *V.rothpletzi* from the upper part) together *with Haploceras cassiferum*, "*Subplanitoides*" and related macroconchs.

Semiforme/Verruciferum Zone (from 250 to 320 cm): Abundant *Haploceras verruciferum* s.s., less common (rate 1:6) *Semiformiceras semiforme* and then *Simoceras aesinense*. Lower Tithonian perisphinctids are common.

2.2 Systematic description

Family Ancyloceratidae GILL, 1871
Genus *Protancyloceras* SPATH 1924
Protancyloceras sp. aff. *guembeli* (OPPEL, 1865)
fig. 2 a,b,c

aff. 1865 Ancyloceras Guembeli OPPEL, p.547
aff. 1870 Ancyloceras Guembeli OPPEL - ZITTEL, p.155, pi. 12 (36), fig. 1-2
aff. 1990 Protancyloceras guembeli (OPPEL) - WIERZBOWSKI, p.479, pl.1, fig.1-6

2.2.1 Material

The ammonite studied is kept in the Museum of Geology and Palaeontology, University of Bologna, collection "Trentino 3", inv. number RO-193.

2.2.2 Description

The ammonite is preserved as a fragment of the body chamber (Fig. 2). The fragment of whorl has a height of 18 - 19 mm (between two ribs) and a length of 50 mm. The whorl section is sub-rectangular and 20 - 22 mm thick. The specimen is slightly curved and probably represents the last part of the open spiral of the ammonite. The specimen belongs to a large individual which possibly may be about 15 cm in diameter.

On the whorl side there are single ribs. The ribs are thick, prorsiradiate, and terminated with ventro-lateral tubercle. The median part of the venter shows a weakening of ribbing.

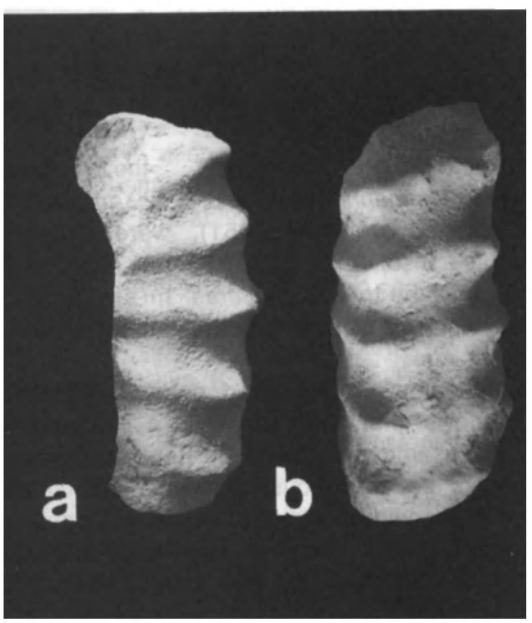

Fig.2 a-b: *Protancyloceras* aff. *guembeli* (Oppel). Lateral (a) and ventral (b) views, body chamber, lower Hybonotum Zone, Roccolo section (Lavarone, Trento Plateau, Northern Italy), inv.n. RO-193, (x 1).

2.2.3. Remarks

The specimen shares the ornamentation and the very slightly curved whorl, representing part of an open spiral, differing in the relatively larger size and in the poorly developed weakening of ventral ribbing, with *Protancyloceras guembeli* of the upper Hybonotum Zone. The middle Tithonian species *Protancyloceras kurdistanense* SPATH also seems to be similar to *P.* sp. aff. *guembeli* here discussed, but our specimen differs in subrectangular whorl section as well as in the presence of straight but not curved ribs at the venter, more distantly spaced, and in the marked ventro-lateral thickening of ribs. *P.* aff. *guembeli* described by WIERZBOWSKY (1990) in the Darwini Zone, differs in the poorly developed ventrolateral swellings of ribs, in the closer ribs as well as in a more circular whorl section.

2.2.4 Stratigraphic occurrence

The specimen comes from the lower Hybonotum Zone of Lavarone (Trento Plateau, Southern Alps, Italy). *P. guembeli* described by KUTEK & WIERZBOWSKY (1986) and WIERZBOWSKY (1990) comes from the upper Hybonotum and Darwini Zone (= Albertinum Zone) of Poland. *P.* aff. *guembeli* described by WIERZBOWSKY (1990) comes from the Darwini Zone of Poland. The species *P. kurdistanense* described by SPATH (1950) comes from the middle Tithonian of Iraq.

3 TITHONIAN PROTANCYLOCERAS ALL OVER THE WORLD

Protancyloceras is known from Italy, Poland, Germany, France, Spain, Crimea, Turkey, Tunisia, Iraq, Colombia, Mexico and Cuba. Six described Tithonian species of that genus are known.

ZITTEL (1870) recognized *Protancyloceras gracile* (OPPEL) in the Tithonian of Rave Cupa at Monte Catria (Marche Apennines, central Italy). The Italian specimen mentioned by ZITTEL (1870), probably two or three, were lost during the second war (G.SCHAIRER pers.comm. 1998).

ZITTEL (1870) also recognized *Protancyloceras guembeli* (2 specimen) and *Protancyloceras gracile* (4 specimen) in the Tithonian of Rogoznik (Carpathians, Poland). KUTEK & WIERZBOWSKY (1979, 1986) and WIERZBOWSKY (1990) deals with 40 specimen of *Protancyloceras* occurring in the lower Tithonian and lowermost middle Tithonian in the Carpathian Mts, Poland. WIERZBOWSKY (1990) recorded *Protancyloceras* sp. (9 specimen) and three successive species: *P. guembeli* (5 specimen) and aff. *guembeli* (3 specimen), *P. passendorferi* WIERZBOWSKI (15 specimen) and *P. gracile* (8 specimen) that represent a single lineage which in

late Tithonian possibly gave rise to the genus *Vinalesites* (WIERZBOWSKY, 1990). CECCA et *al.* (1994) recognized one specimen of *Protancyloceras* cfr. *gracile* in the same Carpathian locality of WIERZBOWSKI (1990) (Stankowa Skala), in the upper part of the Darwini Zone.

BARTHEL (1962) recognized one specimen of *P. gracile* and one specimen of *Protancyloceras* sp. (possible a *juvenile*) occurring in the middle Tithonian of Neuburg (Bavaria, South Germany). BARTHEL & GEYSSANT (1973) recognized faunal elements of Tethyan affinity, from the middle Tithonian of Neuburg (Bavaria, South Germany): the authors recorded two specimen of *Protancyloceras* sp. SCHWEIGERT & SCHERZINGER (1995) recognized one fragment probably of *P. guembeli* in the Hybonotum Zone (Gravesiana Subzone) of Swabia (South Germany).

RETOWSKI (1893) recognized some fragmentary specimen of *Protancyloceras gracile* in the Tithonian of Crimea.

ENAY et *al.* (1968) deals with 7 specimen of *P. catalinense* (IMLAY), 2 specimen of *P. hondense* (IMLAY) and 15 specimen of *P. gracile* occurring in the middle Tithonian (Fallauxi and Ponti Zone: ENAY 1976) of western Taurus (Anatolia, South Turkey).

SPATH (1950) deals with 4 specimen of *Protancyloceras kurdistanense* and 5 specimen of *Protancyloceras* sp. aff. *gracile* (probably two specimen are *P. hondense*, fide BARTHEL & GEYSSANT, 1973 and MYCZYNSKI, 1989) occurring in the middle Tithonian at Kurdistan, northern Iraq.

ENAY & GEYSSANT (1975) recognized *Protancyloceras* sp. (very rare fragments, acc. to the material collected by OLORIZ in the area, pers. comm. 1998) from the middle Tithonian, Darwini Zone (= Albertinum Zone) of the Betic Cordillera (Spain).

Leptoceras sp. ind., in MAZENOT (1939, pl.40, fig.3) is probably a specimen of *Protancyloceras gracile*, occurring in the middle Tithonian (or close to the lower/middle Tithonian boundary) of Saint-Concors (south-east France).

BURCKHARDT (1919-21) recognized a specimen of *Protancyloceras* sp. (sub *Crioceras* sp.ind., Pl.21, fig.3) in the upper Tithonian ("Jurassic/ Cretaceous boundary") of Sierra de Ramirez (Simon), Mexico. OLORIZ & TAVERA (1989) stated this level can be correlated with the Jacobi Zone, i.e. the first Berriasian biozone. In the same stratigraphic levels, CANTU CHAPA (1980, 1984) recognized a few other specimen of *Protancyloceras* sp. in Mexico.

IMLAY (1942) recognized 37 specimen of *Protancyloceras catalinense* and *P. hondense* occurring in the Upper Tithonian at Cuba. Seven specimen of *P. hondense* and one specimen of *P.* cf. *kurdistanense* have been reported from the upper Tithonian of Cuba by MYCZYNSKI (1977). MYCZYNSKI (1989) deals with 3 specimen of *Protancyloceras* sp. aff. *gracile* occurring in the lower Tithonian and two specimen of *Protancyloceras* sp. *A* occurring in the upper Tithonian of western Cuba and reported "abundant *Protancyloceras hondense* and *P. catalinense*" from the upper part of lower Tithonian - upper Tithonian of Western Cuba. One specimen of *P.* cf. *hondense* and one of *P.* sp. indet. has also been reported from the lower Tithonian by MYCZYNSKI (1994).

I also provide some notes about the Berriasian species: ARNOULD-SAGET (1951) and MEMMI (1967), recorded *Protancyloceras punicum* ARNOULD-SAGET in the Grandis Zone (lower Berriasian) of central Tunisia. MEMMI (1967), BUSNARDO *et al.* (1976), BURROLLET *et al.* (1983) recorded *Protancyloceras punicum, P. cristatum* ARNOULD-SAGET, *P. acutituberculatum* ARNOULD-SAGET, *P.* cfr. *gracile, P. bicostatum, P. depressum* ARNOULD-SAGET, *P.* sp. ind. in the Andrussowi Zone and Boissieri Zone of central Tunisia. MEMMI et *al.* (1989) recorded *P. eximium* ARNOULD-SAGET and *P. cristatum* in the Occitanica Zone (middle Berriasian) and *P.* aff. *punicum* in the Jacobi Zone (lower Berriasian) and in the lower Valanginian of northeast Tunisia.

ALLEMANN *et al.*(1975) recorded *Protancyloceras punicum* in the Grandis Zone (lower Berriasian) of Murcia (Spain). HOEDEMAEKER (1982) recorded *Protancyloceras* sp. in the Andrussowi and Boissieri Zones of Betic Cordillera (Spain); COMPANY & TAVERA (1984/85) *P. punicum* and *P .cristatum* in the Boissieri Zone of Cordillera Betica (Spain).

Protancyloceras jelevi mazenoti NIKOLOV (fig. in MAZENOT 1939, only tav.40, fig.1) is recorded in the Berriasian of "La Faurie", S.E. France.

One specimen of *Protancyloceras* sp. ("*Leptoceras*" sp. of HAAS, 1960, fig.4,5) comes from Colombia, South America.

WIEDMANN (1973) supposed the species *Leptoceras steinmanni* RIVERA and *L. lissoni* RIVERA of Perù, described by RIVERA (1951), were *Protancyloceras* (see also GEYER 1983). In my opinion the specimen may be true *Leptoceras*. In any case the fossil assemblage clearly indicates a Berriasian to Valanginian Age.

Summarizing, the published data on *Protancyloceras* shows that this genus is a scarce component of the ammonite fauna. In Italy, because the collection of several thousand ammonites contains only one preserved specimen, this genus appears to be extremely rare. To our knowledge the Carpathian Mts. and Cuba are the only Tithonian localities known by more than 40 specimen. Less than half the specimen have been collected in Turkey. In the others localities only a few specimen have been collected.

4 PALAEOGEOGRAPHY AND PALAEOECOLOGY

Protancyloceras is very scantily represented, especially in lower Tithonian, but is very useful for longe-range correlation. This genus appeared in the lower Tithonian, in distal areas of the Mediterranean Tethys and, among late Jurassic and early Cretaceous uncoiled ammonites, has the widest geographic distribution (Fig.1). The geographic distribution in Europe follows the Tethyan open-sea realms (i.e. Mediterranean s.s. and Sub-Mediterranean faunas: Neuburg, Southern Alps, Umbria-Marche, Carpathian mts., S.E. France, Spain).

In the lower Tithonian the genus seems to be restricted to Cuba, Carpathians, Southern Spain, Trento Plateau and Swabia. In the middle and upper Tithonian the genus rapidly expanded and the area of distribution also includes Mexico, Crimea, S.E. France, Northern Iraq, Franconia and Turkey.

The Trento Plateau in the Tithonian was deep and unsuitable to the mode of life of *Protancyloceras*. The *Proytancyloceras* have their main distribution (20% of the faunal spectra, fide CECCA 1992) and thus presumably the favoured biotope, at least in the Tithonian, on the taluses environments of the Carpathians, close to the slope of an intra-oceanic ridge (Czorsztyn ridge). It is plausible to imagine that taluses in oceanic environment were the favoured habitats: *Protancyloceras* were pelagic, uncoiled ammonites, with an up-turned aperture (WESTERMANN 1990, 1996; WIERZBOWSKI 1990; CECCA 1992); they may have been mucus-trap-feeder feeding or plankton feeding from the water column (NESIS 1986, WESTERMANN 1990) and they seems ecologically well adapted to talus environment close to the slope of intra-oceanic ridges or not very deep distal platforms (e.g. Umbria-Marche Apennines, Cuba, Carpathians) and, less frequently, probably reflecting more unstable environmental factors, continental shelf slopes (e.g. Bavaria, Saint-Concors).

In the Bakony-Gerecze mountains (Hungary), that is, the very deep distal platform of the Mediterranean Tethys (GALACZ 1988; FOZY 1987, 1990; CECCA 1992), *Ancyloceratacea* are absent. Also in the Ardèche (France) *Ancyloceratacea* are absent, probably because this locality is a continental shelf slope deeper than those in Bavaria or Saint-Concors and unsuitable to the feeding behaviour and diurnal migration of ammonites like *Protancyloceras*.

BARTHEL & GEYSSANT (1973) infer these ammonites probably reached distant places well camouflaged among floating plants like today's *Sargassum*, but this hypothesis opposes the presumably deeper habitat. In the case of large and coarsely ornamented species, reaching diameters more than 15 cm, like *Protancyloceras* described in the present paper, it seems reasonable to presume a little post-mortem transportation. In *Ammonitina* (and some *Phyllo-* and *Lytoceratina*, OLORIZ *et al.* 1996) very little or no post-mortem shell drift occurred, while in many *Lytoceratina*, *Phylloceratina* and *Ancyloceratina* the data are in accordance with a comparatively more considerable post-mortem drift, probably because the sea water flooded the chambers of phragmocone very slowly (WARD 1982, WESTERMANN, 1990, CECCA *et al.* 1992. See also a historical review on this argument in OLORIZ *et al.*, 1996).

The specimen of the Trento Plateau probably arrived from another area because of the post-mortem drift, e.g. from the not far slope of the distal platform of Umbria-Marche Apennines (Italy), clearly representing a shallower environment (CECCA *et al.* 1990).

5 EVOLUTION

P. aff. *guembeli* appeared in the basal Tithonian, lower part of the Hybonotum Zone of the Trento Plateau (SARTI, present paper) i.e. in distal areas of the Mediterranean Tethys. The first record of true *P. guembeli* is identified in the northern Carpathians (WIERZBOWSKY 1990). The ancestor is unknown, CECCA (1997) suggesting that *Protancyloceras* derives from *Hybonoticeras* because of a similar ventral groove and raised, strong ribs. SCHWEIGERT & ZEISS (1998) infers the new genus *Berckemeria*, from the base of the Tithonian of Southern Germany, represents the ancestor of *Protancyloceras*. The specimen here described does not appear to have, in the preserved body chamber, a well developed ventral interruption of the ribs and a ventral groove, and is comparable in the configuration of these features with *P. kurdistanense,* indicating perhaps a phylogenetic affinity with the *P. kurdistanense* group: the "Trento Plateau" morphotype may be the ancestor linked to *P. kurdistanense*, while the "Carpathian" *P. guembeli* morphotype, with a more developed ribbing interruption at the venter, may be the ancestor of *P. hondense* ("American" branch), as suggested by THIEULOY (1966) and *P. passendorferi* ("European" branch) as established by WIERZBOWSKI (1990).

We can only suppose this phylogenetic relation; further research in the lower Tithonian of Trento Plateau and Umbria-Marche Apennines on this question is necessary. It is also highly desirable that additional material be recovered from the other above-mentioned localities so that the morphologic variation can be studied and affinities established.

6 CONCLUSIONS

Protancyloceras is a very interesting genus because of the wide geographic distribution and the consequent longe-range correlation and it is very interesting from a phylogenetic point of view because it is a new uncoiled ammonite genus appeared in the basal Tithonian once the last group of Jurassic uncoiled ammonites disappeared in the middle Callovian without descendants; *Protancyloceras* is probably the first *Ancyloceratacea*, linked to many other later uncoiled ammonites (WIEDMANN, 1973a; MATSUKAWA, 1987; KAKABADZE, 1994; CECCA, 1997).

This genus is an extremely rare but typical component of the oceanic talus associations close to the slope of intra-oceanic ridges or not very deep distal platforms. The occurrence of specimen in very distant areas is noteworthy, but the records are localized in a well-definited belt from Mexico - Cuba to Spain, Italy, Crimea, and Iraq. With the published data at our disposal there is little doubt that *Protancyloceras* origin is in an epioceanic fringe, but we do not know the first appearance point of *Protancyloceras* and the precise time of the first appearance and dispersion of the epiplancton.

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