Paläontologische Zeitschrift	77 (2)	353–360	Stuttgart, Oktober 2003

Taxonomic and biostratigraphic re-evaluation of *Perisphinctes internispinosus* KRANTZ, 1926 (Upper Jurassic, Ammonoidea)

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with 4 figures and 1 table

Abstract: The lectotype of *Perisphinctes internispinosus* KRANTZ, 1926, type species of *Windhauseniceras* LEANZA, 1945, from the upper Middle Tithonian of Cerro Lotena (Neuquén-Mendoza Basin, Argentina) is designated. The type series, housed in the Paläontologisches Institut der Universität Bonn, was originally illustrated by hand-drawings of two of the eleven specimens. The lectotype is illustrated by a photograph for the first time. The specimen is probably a large microconch; the most likely corresponding macroconch appears to be *H.* aff. *steinmanni* (STEUER, 1897) from Cerro Lotena. *Windhauseniceras internispinosum* is the index and guide species of the *Internispinosum* Biozone, upper Middle Tithonian, most probably *Ponti* Zone in age. The occurrence in Arroyo del Yeso (Mendoza) below a succession of *Micracanthoceras* species including *M. mirum* (LEANZA, 1945) which is very close to *M. microcanthum*, strongly supports this correlation. The species occurs throughout the Neuquén-Mendoza Basin and probably also in the Tarapacá Basin, Northern Chile.

Keywords: Ammonoidea, Himalayitidae, *Windhauseniceras*, Andes, Neuquén-Mendoza Basin, Tithonian, Upper Jurassic

Kurzfassung: Der Lectotypus von *Perisphinctes internispinosus* KRANTZ, 1926, Typusart von *Windhauseniceras* LEANZA, 1945 aus dem oberen Mittel-Tithonium von Cerro Lotena (Neuquén-Mendoza-Becken, Argentinien) wird festgelegt. Die Typus-Serie, aufbewahrt im Paläontologischen Institut der Universität Bonn, wurde ursprünglich durch Handzeichnungen von 2 der 11 Exemplare illustriert. Der Lectotypus wird erstmals im Foto dargestellt. Das Exemplar ist wahrscheinlich ein großer Microconch; der zugehörige Macroconch ist höchstwahrscheinlich *H.* aff. *steinmanni* (STEUER, 1897) aus Cerro Lotena. *Windhauseniceras internispinosum* ist Index- und Leitart der *Internispinosum*-Biozone, oberes Mittel-Tithonium, höchstwahrscheinlich *Ponti*-Zone. Das Vorkommen in Arroyo del Yeso (Mendoza) unterhalb einer Folge von *Micracanthoceras*-Arten einschließlich *M. mirum* (LEANZA, 1945), der nah verwandt mit *M. microcanthum* ist, unterstützt diese Korrelation. Die Art ist weit verbreitet im Neuquén-Mendoza-Becken und wahrscheinlich auch im Tarapacá-Becken, Nord-Chile.

Schlüsselwörter: Ammonoidea, Himalayitidae, *Windhauseniceras*, Anden, Neuquén-Mendoza Becken, Tithonium, Ober-Jura

Introduction

Perisphinctes internispinosus KRANTZ, 1926, type species of *Windhauseniceras* LEANZA, 1945, is a conspicuous himalayitid ammonite of the Andean upper Middle Tithonian, relevant in biostratigraphy and systematics. It is the index and guide species of the *Internispinosum* Biozone (WEAVER 1931; LEANZA 1980, 1981a) and appears to be a link between *Torquatisphinctes proximus* (STEUER, 1897) (Torquatisphinctinae) and early Andean himalayitids (PARENT 2001). *Perisphinctes internispinosus* was based on eleven specimens of which two were figured by hand-drawn illustrations (KRANTZ 1926: pl. 14 figs. 1–2, pl. 15 figs. 5–6; Spanish translation: KRANTZ 1928: pl. 2 figs. 3–4). These pictures, however, differ slightly from the actual specimens. The purpose of this note is to designate and illustrate photographically for the first time the lectotype of the species, and to briefly review its biostratigraphy and taxonomy in order to ensure the stabilization of interpretation of a stratigraphically important species.

Systematic Paleontology

Measurements are indicated as follows: diameter (*D*), diameter at the last adult septum (*D*ls), final adult diameter at peristome (*D*p), umbilical width (*U*), whorl width (*W*), whorl height (H_1), and whorl ventral height (H_2), all given in millimeters [mm]; counts of number of primary (*P*) and ventral (*V*) ribs per half-whorl; length of bodychamber (*LBC*) in degrees [°]. (e) = measurement estimated from reconstruction; bodychamber is abbreviated as BC and phragmocone as Ph; female (macroconch) = [M]; male (microconch) = [m]. Type specimens are housed in the Paläontologisches Institut der Universität Bonn (IPB).

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0031–0220/03/0077–0353 $ 4.00

Tab. 1. Measurements of the lectotype of *Perisphinctes internispinosus* KRANTZ, 1926. For symbols and abbreviations see Systematic Paleontology.

IPB 25a	*D*	*U*	*U/D*	*W*	*W/D*	H_1	H_1/D	W/H_1	*P*	*V*
BC	150(e)	73.0	0.49(e)	–	–	–	–	–	–	–
	116.5	52.0	0.45	38.0	0.33	38.0	0.33	1.00	26	52
Ph	87.0	38.0	0.44	27.0	0.31	26.0	0.30	1.04	20	–
	68.0	29.0	0.43	–	–	–	–	–	17	–
	35.0	–	–	–	–	–	–	–	10	–
	20.0	–	–	–	–	–	–	–	9	–
	10.0	–	–	–	–	–	–	–	8	–

Order Ammonoidea ZITTEL, 1884
Suborder Ammonitina HYATT, 1884
Superfamily Perisphinctoidea STEINMANN, 1890

Family Himalayitidae SPATH, 1925

Remarks: Inner and middle whorls of *Windhauseniceras internispinosum* (KRANTZ) are typically himalayitid, moderately wide and depressed, tuberculated with frequent furcation of ribs from lateral tubercles or spines, and occasional occurrence of looped ribs; thus the genus *Windhauseniceras* is included in this family following ARKELL (1957). LEANZA & ZEISS (1992) proposed the subfamily Windhauseniceratinae as a "parallel development to the subfamily Paraulacosphinctinae", apparently included into the family Perisphinctidae (see LEANZA & ZEISS 1992). These authors included in Windhauseniceratinae, in addition to *Windhauseniceras*, the genus *Zapalia* LEANZA & ZEISS, 1990 of which the holotype of the type species (LEANZA & ZEISS 1990: pl. 36 fig. 7) shows typical lithacoceratid features (cf. PARENT, 2003). Thus, for the time being, the subfamily is not accepted here pending results of work in progress by H.A. LEANZA and A. ZEISS on the Zapala ammonite fauna (ZEISS, pers. comm. 22/05/2002).

Genus *Windhauseniceras* LEANZA, 1945

Type species: *Perisphinctes internispinosus* KRANTZ, 1926; by OD.

Diagnosis: The diagnosis given by ARKELL (1957: *L*356) remains adequate. Inner whorls coronate, *Stephanoceras*-like, with strong, distant biplicate and triplicate ribs and row of outer lateral tubercles at points of furcation; ribbing not interrupted or tuberculate on venter, which has median flattening; on outer whorls venter becomes rounded and ribbing loses tubercles, closes up, and revers to typical *Perisphinctes* style.

Windhauseniceras internispinosum (KRANTZ, 1926)
Figs. 1–4, Tab. 1

1921 *Reineckeia* cf. *stephanoides* OPPEL sp. – STEUER: 58, pl. 14 figs. 11–12.

*1926 *Perisphinctes internispinosus* nov. sp. KRANTZ: 453, pl. 14 figs. 1–2 (lect.), pl. 15 figs. 5–6.

1928 *Perisphinctes internispinosus* nov. sp. – KRANTZ: 39, pl. 2 figs. 3 (lectotype)–4.

1931 *Perisphinctes internispinosus* KRANTZ. – WEAVER: 419, pl. 47 fig. 312.

1945 *Windhauseniceras* cf. *internispinosum* (KRANTZ). – LEANZA: 23, pl. 21 fig. 6.

1959 *Windhauseniceras internispinosum* (KRANTZ). – CORVALÁN: 16, pl. 4 figs. 16–17.

1980 *Windhauseniceras internispinosum* (KRANTZ). – LEANZA: 43, pl. 8 fig. 4, pl. 9 fig. 1.

?1980 *Hemispiticeras* aff. *steinmanni* (STEUER). – LEANZA: 43, pl. 9 fig. 2.

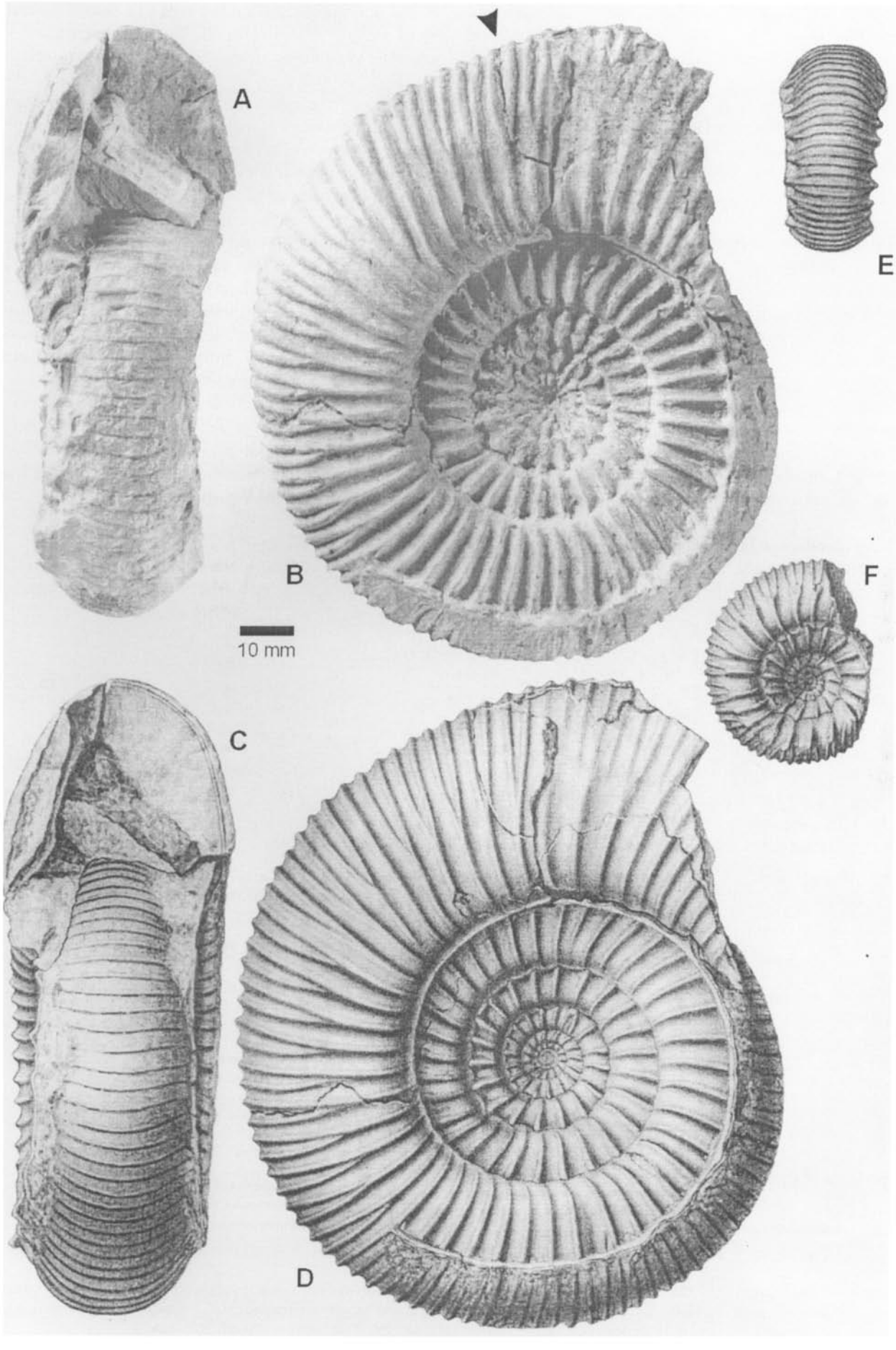
1981b *Windhauseniceras internispinosum* (KRANTZ). – LEANZA: pl. 2 figs. 7–8.

1990 *Windhauseniceras* cf. *internispinosum* (KRANTZ). – AGUIRRE-URRETA & CHARRIER: 265, pl. 1 fig. 9.

Lectotype: The specimen figured by KRANTZ (1926: pl. 14 figs. 1–2, 1928: pl. 2 fig. 3) from the Middle Tithonian (*Internispinosum* Biozone) of Cerro Lotena (Fig. 3), Vaca Muerta Fm. is designated here. The specimen (IPB 25a) is herein refigured with a photograph in Figs. 1A–B, and the original figure for comparison in Figs. 1C–D. The original type-series included eleven specimens (KRANTZ 1928: 39) from the type locality; one of these syntypes (IPB 25b, Fig. 1E–F), consisting of a phragmocone, was figured by KRANTZ (1928: pl. 2 fig. 4), and refigured by ARKELL (1957: figs. 468–7a–c) but with erroneous indication of scale.

Description of the lectotype: Maximum preserved *D* = 116.5 mm; septate up to about the last third of the last preserved whorl (cf. KRANTZ 1928: 39). Remains of the

Fig. 1. *Perisphinctes internispinosus* KRANTZ, 1926. – **A–D**: Lectotype (IPB 25a), natural size. **A–B**. Apertural and lateral views. **C–D**. Apertural and lateral views of the original figure, reproduced from KRANTZ (1928: pl. 2 figs. 3b and 3a respectively). – **E–F**: Natural size ventral and lateral views of a syntype (IPB25b), original figure reproduced from KRANTZ (1928: pl. 2 figs. 4b and 4a respectively). – Both specimens are housed at the Paläontologisches Institut der Universität Bonn. Photograph courtesy of M. Sander. Arrow indicates the probable beginning of the bodychamber.


A
B
E
F
10 mm
C
D

missing whorl portion of bodychamber, at least a half whorl (estimated *D*p = 145–150 mm), show moderate uncoiling indicating the individual as adult. Inner whorls (*D* <35 mm) coronate, very evolute, whorl section is wider than high; strong, radial primary ribs trifurcate on the ventro-lateral shoulder from a stout mammiform tubercle, probably the base of a spine; a single pair of primaries is looped. In middle whorls (about 35< *D* <70 mm) the aspect remains coronate and evolute with oval-depressed whorl section; the primary ribs are slightly prorsiradiate, bifurcating on the ventro-lateral shoulder after a lamelliform, somewhat radially elongated tubercle. A constriction is visible at about *D* = 45 mm. The last preserved whorl is evolute with an oval-compressed whorl section. The ribs arise on the umbilical wall, cross the flanks almost rectiradially and bifurcate on the upper half; secondary ribs remain strong and cross the venter unchanged. At about *D* = 100 mm a pair of primaries join at the umbilical shoulder and are followed by a straight, undivided primary that crosses the venter normally. *LBC* is at least 240°, position of the last septum is not clearly discernible.

Intraspecific variation: The biometric position of the lectotype within the known material of the species is shown in Fig. 2, including a probable macroconch, *Hemispiticeras* aff. *steinmanni* (STEUER, 1897) figured by LEANZA (1980: pl. 9 fig. 2). The most important ontogenetic changes of morphology and sculpture seen in the lectotype and syntypes occur at about the same diameters in all the specimens studied. The individual variation of the species is mainly expressed in the relative height of the whorl section and in the umbilical width that is almost constant throughout the individual ontogeny (Fig. 2B). Sexual dimorphism cannot be established with certainty from published material. The two specimens figured by LEANZA (1980: pl. 9 figs. 1–2) resemble a dimorphic pair. The smaller one with a modified peristome, suggesting a lappet (which is not preserved), compares very closely with the inner whorls of the largest one (*H.* aff. *steinmanni*) which could be the variocostate macroconch. Adult differentiation between them (Figs. 2A–C) is in the form seen in many perisphinctids: both dimorphs moderately uncoiled at maturity, showing different patterns of primary ribbing, diverging early in the ontogeny at about *D* = 40 mm and whorl section from about *D* = 80–90 mm. The densely ribbed last whorl preserved in the lectotype suggests it could be a large microconch.

Biostratigraphy: The species is known from relatively few records but covering the whole of the Neuquén-

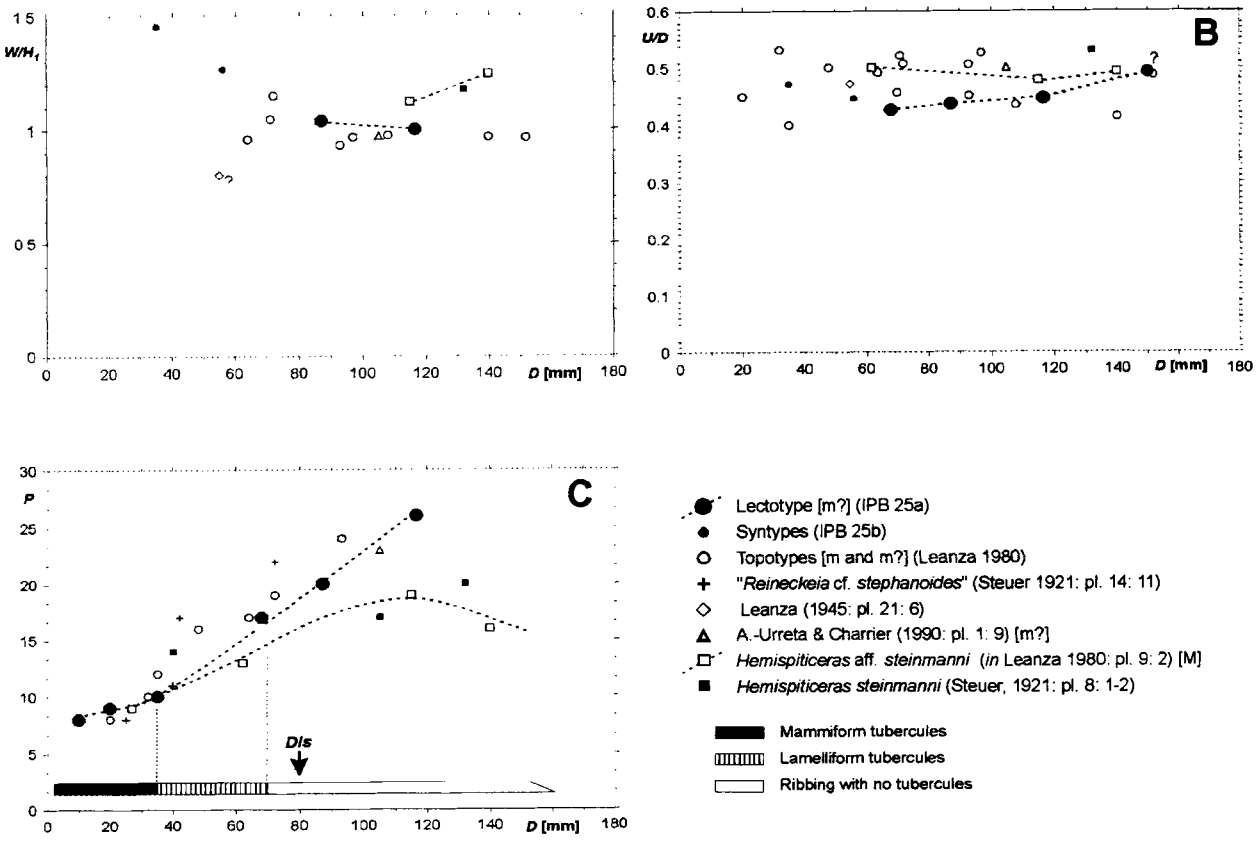


Fig. 2. *Windhauseniceras internispinosum* (KRANTZ, 1926). Ontogeny and individual variation based on types and other figured specimens. – **A**: Whorl section ($W/H_1 - D$). – **B**: Coiling ($U/D - D$). – **C**: Patterns of primary ribbing ($P - D$) and tubercles. – Ontogenetic trajectories (dotted lines) traced for the lectotype and its probable macroconch *H.* aff. *steinmanni* (see references).

Mendoza Basin (Fig. 3), from south to north: Aguada del Overo (LEANZA 1993), Cerro Lotena (the type locality; KRANTZ 1928; WEAVER 1931; SUERO 1951; LEANZA 1980), Los Catutos (LEANZA & ZEISS 1990, 1992), Puerta Curacó and Sierra de Reyes (LEANZA & HUGO 1977), Arroyo del Yeso (LEANZA 1945), Arroyo La Manga (STEUER 1897, Spanish translation 1921), Arroyo Las Yeseras (VOLKHEIMER 1978), Río Leñas (CORVALÁN 1959), and Paso Los Bayos (AGUIRRE-URRETA & CHARRIER 1990). The northernmost occurrence recorded for the species is at Quebrada Asientos (26°–27°S, 69°–70°W), Atacama, Chile (PÉREZ in GARCÍA 1967). The specimen from Boyacá (Colombia) figured by BURGL (1960: pl. 1 fig. 5) resembles the typical material, but it is a fragment of uncertain stratigraphic position.

The original specimens were collected from an uncertain stratigraphic level within the *Internispinosum* Biozone of Cerro Lotena (Fig. 4). KRANTZ (1928: 46) indicated that they came from "upper Tithonian beds", together with *Aspidoceras haupti* KRANTZ, *A. euomphalum* STEUER, *Corongoceras lotenoense* Spath, *W. internispinosum* (KRANTZ), and "*Aulacosphinctes colubrinus* REIN.". Except for the latter, these ammonites are commonly attributed to the *Internispinosum* Biozone (LEANZA 1980). "*A. colubrinus* REIN.", recorded by SUERO (1951: 21) but unfigured although from comparable stratigraphic levels, could probably represent some late *Torquatisphinctes proximus* (STEUER) or a derived Torquatisphinctinae such as *Katroliceras araucanense* (LEANZA, 1980) or *Catutosphinctes* cf. *rafaeli* LEANZA & ZEISS, 1992 [= *Aulacosphinctoides* aff. *hundesianus* (UHLIG) in LEANZA 1980: pl. 5 fig. 1]. Specimens from the type section which are closely comparable with the lectotype were described by LEANZA (1980: pl. 8 fig. 4, pl. 9 fig. 1). They were collected from beds of the *Internispinosum* Biozone (Fig. 4) which locally includes about 22 m (between the first and last occurrence of the index species) of an alternation of limestone banks with ammonites and with intercalated marls and shales (LEANZA 1980). The ammonite fauna of the lower half of this sequence (Fig. 4) is the same as

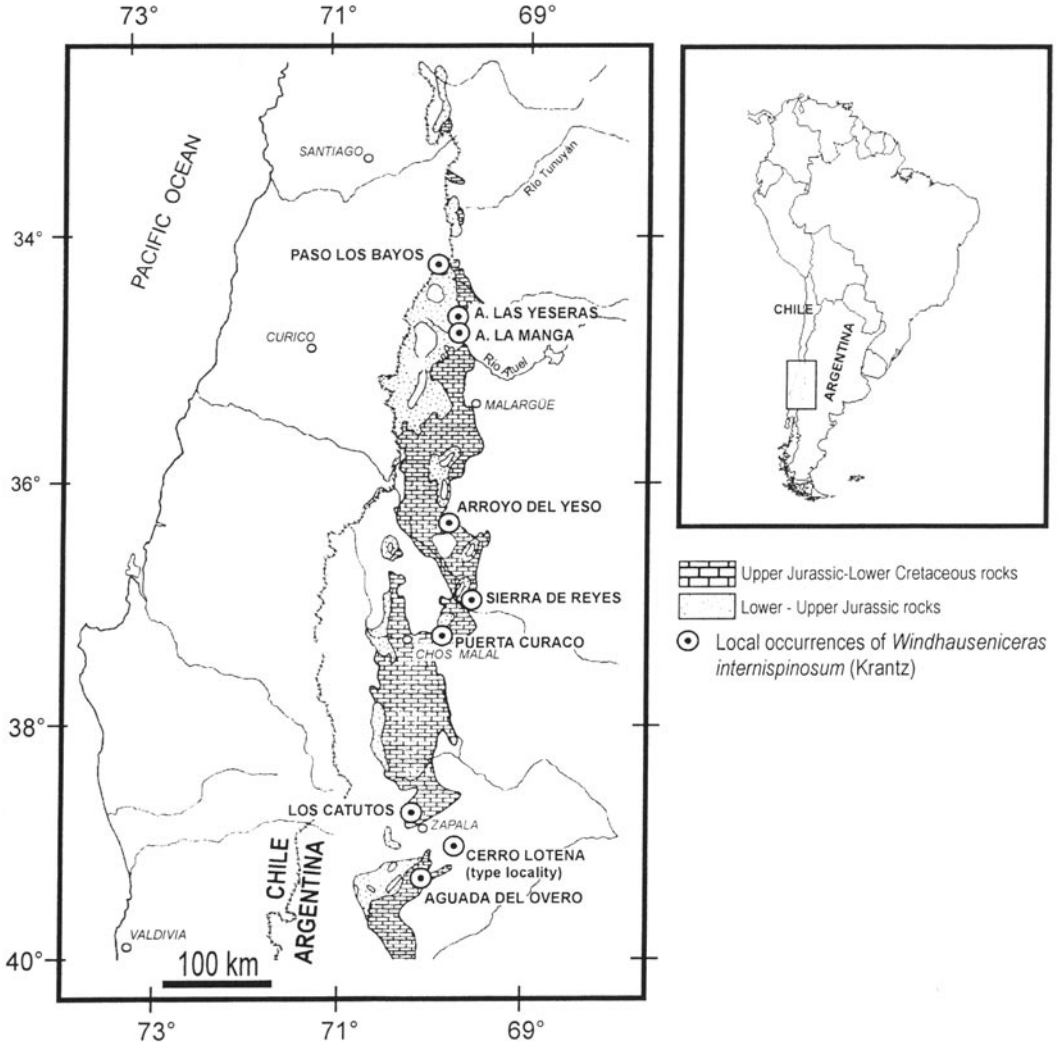


Fig. 3. Reference map of the Neuquén-Mendoza Basin indicating Jurassic outcrops (after YRIGOYEN 1979, modified) and localities yielding *Windhauseniceras internispinosum* (KRANTZ).

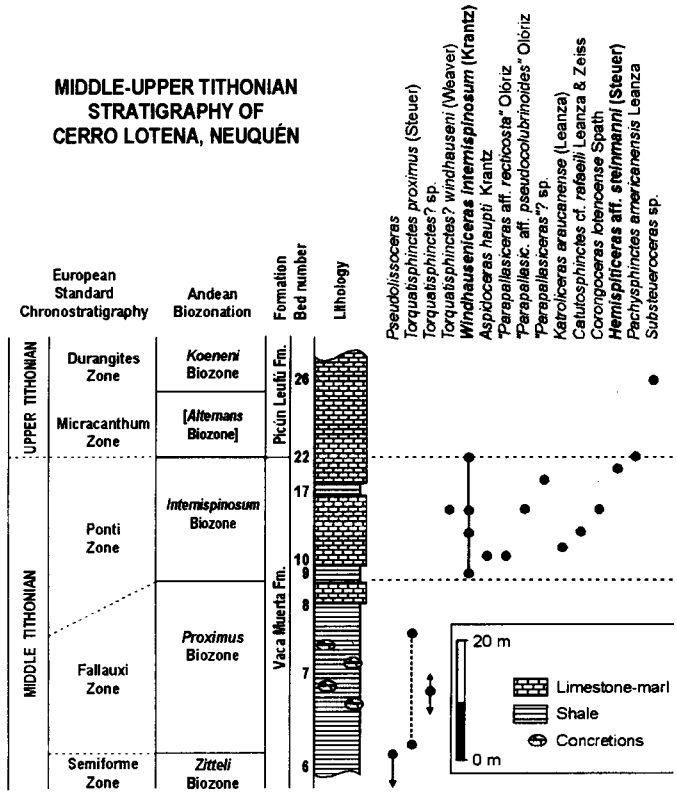


Fig. 4. Cerro Lotena partial log-section and ammonite fauna. Lithology, bed number, lithostratigraphy and distribution of ammonite occurrences after LEANZA (1980). Ammonite taxonomy after PARENT (2001 and 2003) and text. Biostratigraphy and time-correlation based on LEANZA (1981a), PARENT (2001) and discussion in text. The most probable occurrence of the lectotype of *W. internispinosum* is in the lower half of the *Internispinosum* Biozone.

that described by KRANTZ (1928), but the type horizon of *W. internispinosum* remains to be established by new bed-by-bed sampling.

The *Internispinosum* Biozone has been correlated with the upper Middle Tithonian by ARKELL (1956). LEANZA (1980) correlated this biozone with the *Ponti* (= *Burckhardticeras*) Zone of the Standard Scale for the European Submediterranean Province, based on the faunal resemblance of the Andean ammonites with those of Southern Spain as described by OLÓRIZ (1978). Later studies (OLÓRIZ & TAVERA 1989; PARENT & CAPELLO 1999; PARENT 2001) have mainly confirmed the late Middle Tithonian age, although there could be extensions into the early Late Tithonian, depending on the scope of the biozone and the local ranges of the guide species. Moreover, some authors (ZEISS 1983: tab. 1; JELETZKY 1984: fig. 5) have suggested correlation with the lower part of the *Microcanthum* Zone, the *Simplisphinctes* Subzone. In Arroyo del Yeso (Fig. 3), *W. internispinosum* (in LEANZA 1945: pl. 21 fig. 6) occurs clearly below a succession of species of *Micracanthoceras*, with *M. mirum* (LEANZA) at the base. *M. mirum* is a form very close to *M. micracanthum* (OPPEL) by which time correlation of at least some part of the *Internispinosum* Biozone with the *Ponti* Zone is strongly supported (Fig. 4). The above cited records of *W. internispinosum* from Cerro Lotena, Puerta Curaco, Sierra de Reyes and Río Leñas come from below *Substeueroceras koeneni* (STEUER) and *S. permulticostatum* (STEUER), and in some cases *Corongoceras alternans* (GERTH) and *Paraulacosphinctes striolatus* (STEUER) intercalate. This is in accord with the assumed correlation with Arroyo del Yeso, where the cited *Micracanthoceras* fauna described by LEANZA (1945) is overlain by *P. striolatus* upwards followed by *S. koeneni* and *Parodontoceras calistoides* (BEHRENDSEN, 1891).

Concluding remarks

The lectotype of *W. internispinosum* (KRANTZ) is an adult specimen, probably a microconch, with almost all of the bodychamber missing. The lectotype comes from an unknown horizon within the upper Middle Tithonian of Cerro Lotena, Neuquén, most probably from the lower half of the biozone at this locality. The species has a stratigraphic range confined to the *Internispinosum* Biozone, most probably *Ponti* (= *Burckhardticeras*) Zone in age, in the Neuquén-Mendoza Basin. Occurrences in northern South America are not well documented. *W. internispinosum* appears to be the earliest Andean himalayitid and evolved from *Torquatisphinctes proximus*, via *Torquatisphinctes*? *windhauseni* (WEAVER, 1931 in LEANZA 1980: pl. 8 fig. 2) or allied forms (see PARENT 2001).

Acknowledgements

J.C.W. COPE (Cardiff) has kindly enhanced the language style of the manuscript. F. OLÓRIZ (Granada) and P. RAWSON (London) have given advice on the first draft; G. SCHWEIGERT

(Stuttgart), R. ENAY (Lyon) and K.N. PAGE (Devon) made valuable reviews; S. COCCA and A. CARLINI (Zapala) have provided valuable information; M. SANDER (Bonn) has kindly provided the photographs; N. FULLBROOK (Bonn) has given valuable information on specimens; N.D.L. CLARK (Glasgow) and J. HAGGART (Vancouver) have kindly provided important bibliography.

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Eingang des Manuskriptes am 18. Juli 2002;
Annahme durch die Schriftleitung am 31. März 2003.