

The Berriasian genus *Groebericeras* in Argentina and the problem of its age

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Key words: Ammonoidea, *Groebericeras*, Berriasian, Tithonian, Argentina, Calpionellidae.

Groebericeras bifrons Leanza is described from the Chacao Formation of central Mendoza and the Lo Valdés Formation of central Chile. The species appears limited to the *Argentiniceras noduliferum* Zone, which is traditionally placed in the lower Berriasian. Spanish records of *Groebericeras* appear to be younger (Hoedemaeker, 1982), while *Groebericeras* from Iraq were placed in the late Berriasian by comparison with the Spanish records (Howarth, 1992).

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Introduction

The Neuquén Basin of west-central Argentina is widely known for its nearly continuous record of marine sediments from the Early Jurassic to the Early Cretaceous, now extending down to include Late Triassic marine rocks (Riccardi et al., 1997). The outcrops form a narrow belt along the Andes in the north, covering part of the Chilean Cordillera, and extending eastward in the south to form the Neuquén embayment.

One of the most extended marine transgressions in the basin is represented by the black shales of the Vaca Muerta Formation of Tithonian age. In the northern part of the basin that unit grades upward to the Berriasian Chachao Formation.

The fossils described in this paper belong to *Groebericeras*, an ammonite locally common in the Chachao Formation that was first described from Argentina and later recorded from Algeria (Pomel, 1889), Spain (Hoedemaeker, 1982), Iraq (Howarth, 1992), and Chile (Covacevich et al., 1994). We provide a full description and illustration of Argentine examples of this genus, including the type material; a discussion of its age; and also point out some problems of correlation with its other occurrences in the Tethys.

The study area is located in the Main Andean Cordillera of central Argentina and Chile (3400°S, 7000°W) (see Fig. 1).

Repositories — The specimens studied are deposited in the following institutions:

CPBA: Area de Paleontología, Universidad de Buenos Aires, Ciudad Universitaria, Buenos Aires, Argentina.

SEGEMAR: Servicio de Geología y Minería de Argentina, Av. Julio A. Roca 651, Buenos Aires, Argentina.

SNGM: Servicio Nacional de Geología y Minería de Chile, Av. Santa María 0104, Santiago de Chile.

Stratigraphy and age

The Mendoza Group comprises mostly marine rocks of Tithonian to Barremian age (Groeber, 1953). In the study area it is represented by the black shales and mudstones of the Vaca Muerta Formation (Tithonian), the mudstones, packstones, and wackestones of the Chachao Formation (Berriasian — early Valanginian) (Legarreta & Kozłowski, 1981), and the mudstones and wackestones of the Agrio Formation (late Valanginian - Hauterivian). Time-equivalent sequences in central Chile are known as Lo Valdés and Baños del Flaco Formations (González, 1963; Kohn, 1960). Ammonites are abundant all through the Vaca Muerta Formation and the lower part of Lo Valdés Formation, where they are associated with very few inoceramids, and more commonly with marine vertebrate remains. In the lower part of the Chachao Formation ammonites are still abundant, but a shallow-water bivalve fauna becomes dominant upwards.

A.F. Leanza (1945, p. 82) erected the genus *Groebericeras*, with a description and illustration of its type and only species *Groebericeras bifrons*, from the locality of Mallín Redondo, Sierra Azul, southward of our study area. The specimens were collected by Groeber from 'Titho-Neocomian' strata, now placed in the Chachao Formation. The species was associated with *Argentiniceras noduliferum* of Early Berriasian age.

In this work, *Groebericeras* has been collected from the basal beds of the Chachao Formation in central Mendoza, and equivalent levels of Lo Valdés Formation of central Chile (Aguirre-Urreta & Alvarez, 1997).

The best section measured by the authors in Mendoza is located in the eastern side of Arroyo Durazno, north of Laguna Diamante, near the Real de Las Coloradas (see Figs. 1, 2). The Vaca Muerta Formation is composed of an alternation of mudstones and shales that grades upwards to shales with calcareous nodules with abundant ammonites of the *Substeuerceras koeneni* Zone. Higher up, wackestone levels become more common, containing the enigmatic genus *Andiceras*, and towards the top of the section packstones are dominant, marking the lower Chachao Formation. *Groebericeras* has been found at the base of the formation.

The Chilean section was measured in the Alto Río Colina (see Fig. 1). There, the Lo Valdés Formation is characterized by a lower section of black mudstones and shales with abundant ammonite impressions. The upper part is more calcareous, and is composed of thick packstones, nodular wackestones and fetid mudstones. The measured section reaches 320 m. *Groebericeras* appears near the base of the calcareous sequence, associated with *Argentiniceras bituberculatum*.

The beds containing *Groebericeras* in Argentina have traditionally been ascribed to the early Berriasian. The Berriasian was divided in two zones: the lower one of *Argentiniceras noduliferum* and the upper one of *Spiticeras* (*Kilianiceras*) *damesi* (A.F. Leanza,

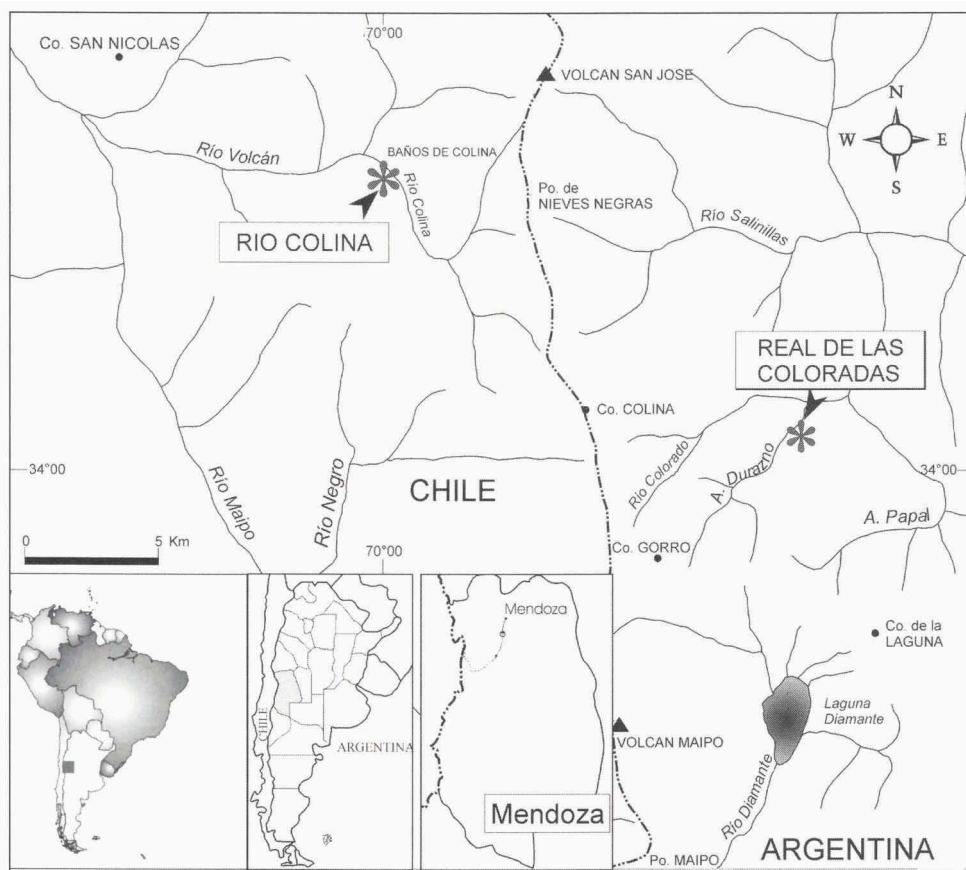


Fig. 1. Location map of the study area with fossil localities cited in the text.

1945; H. Leanza, 1981; Riccardi, 1988). In the Lo Valdés Formation, Biró-Bagóczy (1980a, b) in his study of Lo Valdés ammonites placed his Zone 5, with *Argentiniceras bituberculatum* and *Thurmannites? discoidalis*, into the early Berriasian. *A. bituberculatum* is also restricted to the *A. noduliferum* Zone in Argentina.

In both measured sections, there is a continuous succession of ammonites from the late Tithonian to the Early Berriasian with no indication of any major disruption of the sequence.

Recently, H. Leanza (1996) has presented a new Andean ammonite zonation based on new findings in the Andean region and their correlation with Tethys. According to him, the zone of *Substeueroceras koeneni*, traditionally placed in the late Tithonian, embraces now the topmost part of the Tithonian, and the early and part of the mid Berriasian. The *Argentiniceras noduliferum* Zone which marked the base of the Berriasian (and that of the Cretaceous) was moved to the mid and early late Berriasian. The reasons (and validity) of these displacements are outside the scope of this paper, but we should point out that recent findings of calpionellids and microproblematics in Argentina still favour the traditional dating.

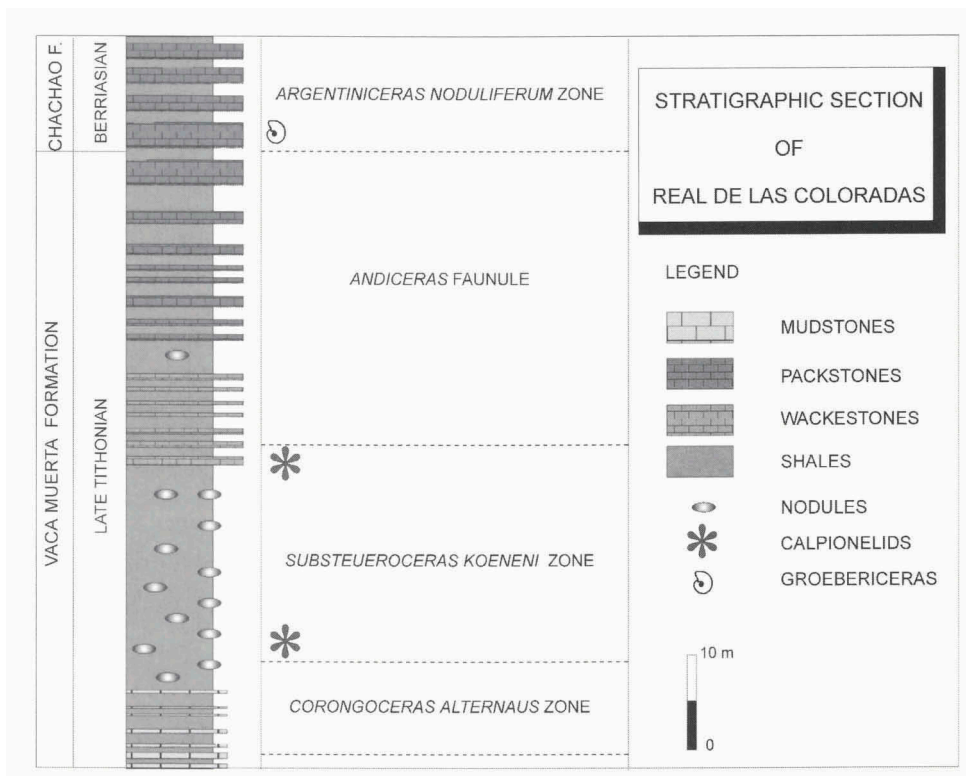


Fig. 2. Stratigraphic section of Real de Las Coloradas in Mendoza.

In our study section of Real de Las Coloradas, calpionellids and microproblematic species were recovered for the first time in Argentina, in the Vaca Muerta Formation (asterisks in Fig. 2), comprising large forms of *Calpionella alpina*, *Crassicollaria* sp., *Tintinnospella* sp., *Colomisphaera* cf. *C. carpathica* and *Didemnoidea moreti* (Fernández Carmona et al., 1996). These microfossils are associated with abundant and very well preserved ammonites of the *Substeueroceras koeneni* Zone, confirming the late Tithonian age of this ammonite assemblage zone.

Systematics

Superfamily Perisphinctaceae Steinmann, 1890

Family Olcostephanidae Haug, 1910

Subfamily Spiticeratinae Spath, 1924

Genus *Groebericeras* Leanza, 1945

Type species — *Groebericeras bifrons* Leanza, 1945, p. 82, by original designation.

Comments — *Groebericeras* is retained here as a separate genus from *Spiticeras* following Howarth (1992) and Wright et al. (1996) but with some doubts. The first author studied a larger collection of *Groebericeras* from Iraq. He pointed out that *G.*

bifrons was a junior synonym of '*Ammonites* *rocardi* Pomel, included in the same species all the records from Spain (Hoedemaeker, 1982), and described and illustrated a new species: *G. laevigatum* (Howarth, 1992, p. 630, pl. 6, figs. 5-6). He did not accept other records of *Groebericeras* (see Howarth, 1992, p. 624), a view which is followed here.

Up to the present, *Spiticeras* embraced three subgenera: *S. (Spiticeras)* s.s., *S. (Kilianiceras)* that accommodated forms with coarser ornament and longer bituberculate stage, and *S. (Negreliceras)* that comprised more compressed forms from early stages with a tendency to become smooth. *Groebericeras* was considered by Howarth (1992, p. 624) as 'essentially a smooth *Spiticeras*'.

However, our new and larger collection shows that although *Groebericeras* becomes completely smooth at large diameters, it possesses quite strong ribbing in inner and medium whorls. Also, its association with examples of *Spiticeras* that present strong tuberculation and ribbing in the inner whorls, but become completely smooth with growth (see Pl. 3, figs. 3-5) casts doubts on its segregation from *Spiticeras* and the three-fold division of this last genus.

A more detailed study of the Spiticeratinae of the Neuquén Basin will undoubtedly bring light on the systematics of the group.

Groebericeras bifrons Leanza, 1945

Pl. 1, figs. 1-9; Pl. 2, figs. 1-4; Pl. 3, figs. 1-3.

1945 *Groebericeras bifrons* — Leanza, p. 82, pl. 17, figs. 2, 5; pl. 18; pl. 19, figs. 1-2, 7.

1982 *Spiticeras (Groebericeras)* aff. *bifrons* (Leanza) — Hoedemaeker, p. 39, 41, pl. 4, fig. 3.

1994 *Groebericeras* aff. *bifrons* Leanza — Covacevich et al., fig. 2a.

Lectotype — The specimen figured by Leanza (1945, pl. 19, figs. 1-2, SEGEMAR 8067) from the Berriasian of Mallín Redondo, Sierra Azul, Mendoza, by subsequent designation of Howarth (1992, p. 628).

Material — Apart from the lectotype, 8 specimens from Mallín Redondo, Sierra Azul (SEGEMAR 8065, 7267.1-7267.6, 5865), Groeber coll., another specimen from Sierra Azul (CPBA 7609), Groeber coll., 15 specimens from Real de Las Coloradas (CPBA 18388.1-18388.15), and three specimens from Río Colina (SNGM 9301-9303).

Measurements (in mm)

| Specimen | D | Wh | Wb | U |
|----------------|-----|----------|----------|----------|
| CPBA 18388.1 | 125 | 42(0.34) | 32(0.26) | 52(0.42) |
| CPBA 18388.2 | 120 | 42(0.35) | 30(0.25) | 44(0.37) |
| CPBA 18388.3 | 100 | 37(0.37) | 29(0.29) | 32(0.32) |
| CPBA 18388.4 | 80 | 30(0.37) | 22(0.27) | 28(0.35) |
| SEGEMAR 8067 | 78 | 28(0.36) | 17(0.22) | 27(0.35) |
| SEGEMAR 7267.2 | 75 | 30(0.40) | 15(0.20) | 23(0.31) |
| CPBA 18388.5 | 73 | 26(0.36) | 20(0.27) | 27(0.37) |
| SEGEMAR 7267.1 | 70 | 28(0.40) | 15(0.21) | 20(0.29) |
| SEGEMAR 7267.3 | 68 | 27(0.40) | 16(0.23) | 20(0.29) |
| CPBA 18388.6 | 65 | 24(0.37) | 25(0.38) | 25(0.38) |
| CPBA 18388.7 | 60 | 23(0.38) | 20(0.33) | 22(0.37) |

| | | | | |
|----------------|----|----------|----------|----------|
| SEGEMAR 8065 | 58 | 22(0.38) | 16(0.27) | 18(0.31) |
| SEGEMAR 7267.4 | 58 | 22(0.38) | 14(0.24) | 17(0.29) |
| CPBA 7609 | 57 | 21(0.37) | 16(0.28) | 20(0.35) |
| SEGEMAR 7267.5 | 55 | 21(0.38) | 14(0.25) | 17(0.32) |
| SEGEMAR 7267.6 | 53 | 18(0.34) | 15(0.28) | 13(0.24) |
| CPBA 18388.8 | 50 | 18(0.36) | 14(0.28) | 17(0.34) |
| CPBA 18388.9 | 50 | 20(0.40) | 21(0.42) | 18(0.36) |
| CPBA 18388.10 | 43 | 17(0.39) | 13(0.30) | 13(0.30) |

Description — Discoidal shell, evolute ($U/D = 0.31-0.42$), dimorphic. Large specimens may reach more than 300 mm, small ones 70-80 mm. Whorl section compressed, with flat to curved flanks, rounded venter and shallow umbilical wall. Maximum whorl breadth is in the lower third of the flanks. The inner whorls present ribs that from the umbilical seam curve forwards to meet at the venter forming a chevron. The strength of the ribbing varies in different specimens at the same diameter. There are also narrow constrictions slightly more prosocline than the ribs. None of the available specimens shows tubercles at any stage. The small adults (showing approximated suture lines) retain the ornamentation of ribs and constrictions in the body chamber. No aperture has been preserved. The large specimens become smooth even while still septate, only retaining very shallow constrictions. Suture line well indented, with broad lateral saddles and trifid lateral lobe (Fig. 4 A-B; Pl. 2, fig. 3).

Comments — Howarth (1992) considered *Groebericeras bifrons* Leanza as a junior synonym of *G. rocardi* (Pomel), a species originally described from Algeria as *Ammonites rocardi* by Pomel (1889). However, although both species present some range of variation, *G. bifrons* is more evolute, has stronger ribbing and a complete lack of tubercles, and we retain both as valid species. Also the suture line of *G. bifrons* is more incised when compared at similar whorl heights with the illustrations of Howarth (1992, figs. 6D-E).

The specimen figured from Spain as *Spiticeras* (*Groebericeras*) aff. *Sp. (G.) bifrons* by Hoedemaeker (1982, pl. 4, fig. 3) is similar to the Argentine species regarding evolution and strength of ribbing. Covacevich et al. (1994) figured a specimen that closely resembles the species as *Groebericeras* aff. *bifrons* from the Ibañez Formation in southern Chile.

Discussion

The Mesozoic sequences of the Mediterranean have been studied for more than a century, but definitions of boundaries like the Jurassic-Cretaceous boundary are still in debate (see Zakharov et al., 1996). Thus, a correlation among the Tethys and other parts of the world is difficult.

Regarding the few records of *Groebericeras* (see Fig. 4), the Algerian species (and only specimen) was placed in the Berriasian by Pomel (1889), and no more specimens have been found in the area according to Howarth (1992).

Hoedemaeker (1982) recorded *Spiticeras* (*Groebericeras*) aff. *Sp. (G.) bifrons* and *Spiticeras* (*Groebericeras*) *rocardi* from the Río Argos section in southeastern Spain. Only one specimen was illustrated, that closely resembles *G. bifrons*. The first species

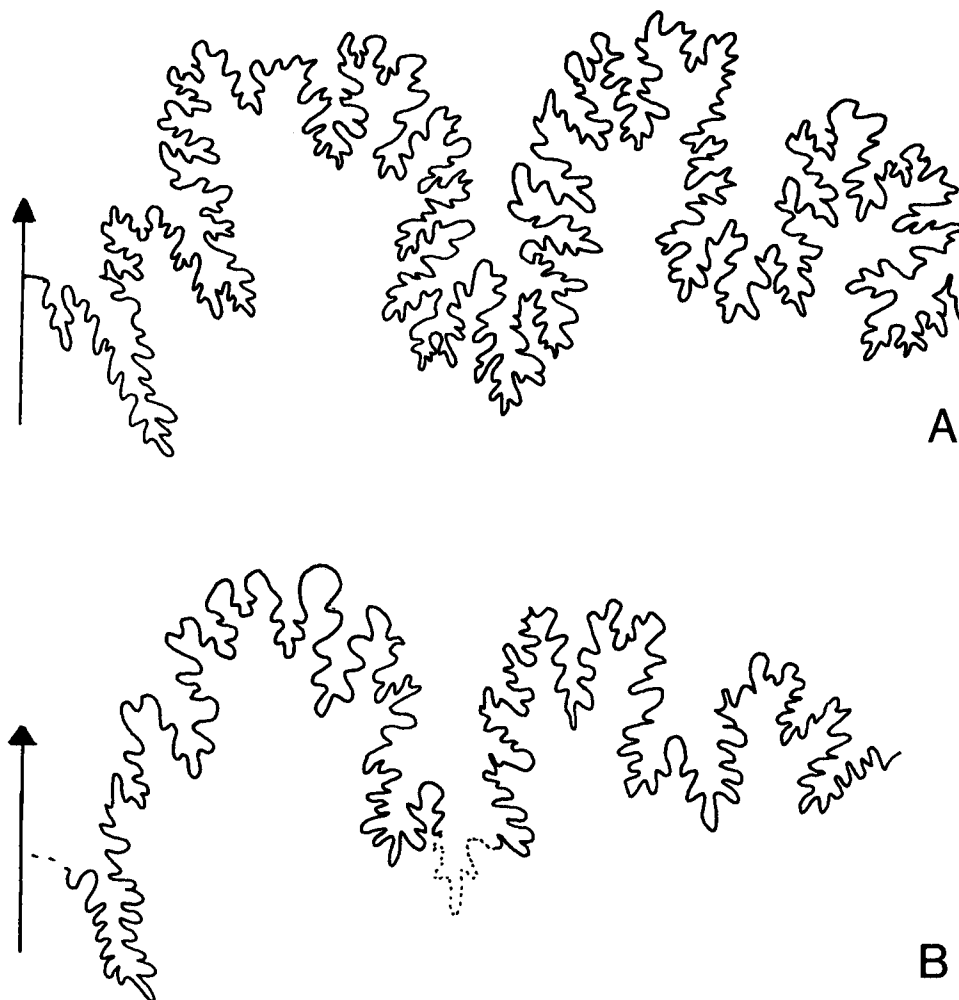


Fig. 3. Suture lines of *Groebericeras bifrons* Leanza, 1945; A: specimen SEGEMAR 5865 at Wh = 60 mm, 2; B: specimen CPBA 18388.4 at Wh = 25 mm, 5.

ranges from the *Berriasella* (*Berriasella*) *picteti* Subzone of the *Subthurmania* (*S.*) *rarefurcata* Zone to the base of the *Tirnovella alpilliensis* Zone (late Berriasian to early Valanginian sensu Hoedemaeker (1982)) while the second is restricted to the *Berriasella* (*Malbosiceras*) *paramimouna* Subzone of the *S.* (*S.*) *rarefurcata* Zone (late Berriasian).

In the two Iraqi sections studied by Howarth (1992), there are no ammonites in the lower Berriasian, and therefore the age of *Groebericeras* there has been tied with the Spanish records of the genus. Both species were placed in the *Fauriella boissieri* Zone of the late Berriasian (Howarth, 1992, fig. 2). So, it may well be that *Groebericeras* has a longer history in the early Berriasian of Tethys, but it was not preserved due to the lack of adequate facies.

The unique previous record of *Groebericeras* in Chile has been used by Covacevich

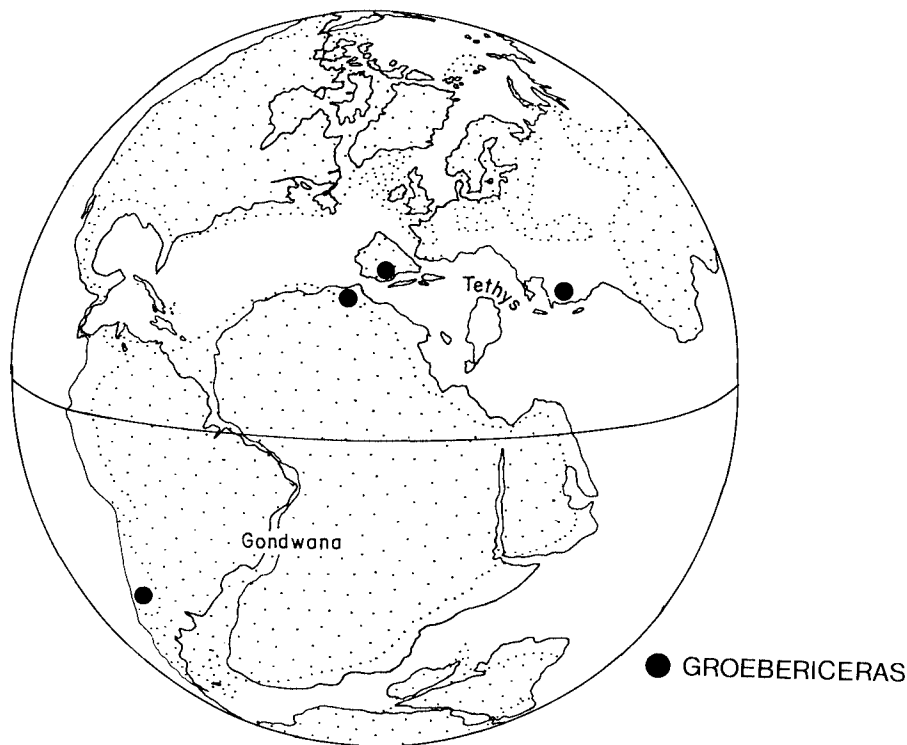


Fig. 4. Palaeogeographic reconstruction during Berriasian times with records of *Groebericeras*.

et al. (1994) to date the marine intercalations in the mostly volcanic Ibañez Formation.

With reference to the Argentine faunas, they were always referred to the *Argentiniceras noduliferum* Zone of the early Berriasian, and there is not a single record of its presence in the late Berriasian *Spiticeras damesi* Zone. Thus, it is feasible that *Groebericeras* is really present in lower Berriasian beds of Argentina and Chile, although the placement of the Jurassic-Cretaceous boundary in these Andean sequences needs more detailed studies, as well as the age of the *Andiceras* faunule.

Acknowledgements

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Plate 1

Figs. 1-9. *Groebericeras bifrons* Leanza, 1945

1-2: Ventral and lateral views of specimen SEGEMAR 8067 from Mallín Redondo (lectotype); 3-5: apertural, ventral and lateral views of specimen CPBA 7609 from Sierra Azul; 6-7: lateral and apertural views of specimen SEGEMAR 8065 from Mallín Redondo; 8: lateral view of specimen SNGM 9301 from Río Colina; 9: lateral view of specimen CPBA 18388.4 from Real de Las Coloradas. All specimens coated with ammonium chloride; all figures natural size.

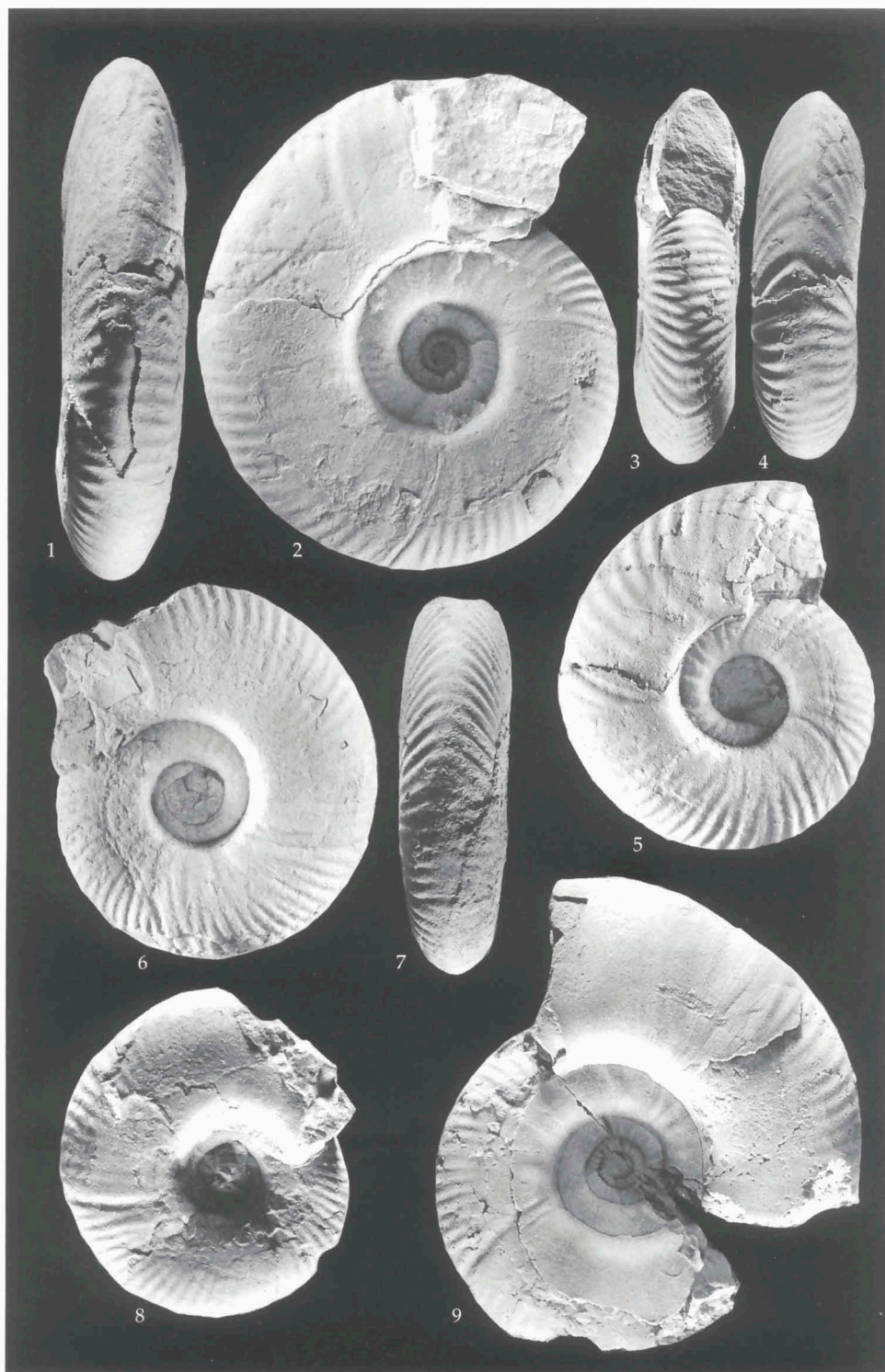


Plate 2

Figs. 1-4. *Groebericeras bifrons* Leanza, 1945

1-2: Apertural and lateral views of specimen CPBA 18388.5; 3-4: lateral views of specimens 18388.11 and 18388.2; all from Real de Las Coloradas; all specimens coated with ammonium chloride and at natural size.



Plate 3

Figs. 1-3. *Groebericeras bifrons* Leanza, 1945

1-2: Lateral and apertural views of specimen CPBA 18388.12; 3: lateral view of specimen 18388.8; all from Real de Las Coloradas; all specimens coated with ammonium chloride and at natural size.

Figs. 4-6. *Spiticeras* (*Spiticeras*?) sp.

4-5: Apertural and lateral views of specimen CPBA 18389; 6: lateral view of specimen CPBA 18390; all from Real de Las Coloradas; all specimens coated with ammonium chloride and at natural size.

