

Discovery of Late Triassic fossils in the Chonos Metamorphic Complex, Southern Chile

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ABSTRACT

The late Triassic bivalve *Monotis (Pacimonotis) aff. subcircularis* Gabb indicative of a Norian (probably early late Norian) age has been collected from the southeastern end of Patranca Island (45°25'S-74°09'W) in the Chonos Archipelago, Southern Chile. Another fossil bivalve, *Limidae* gen. et sp. indet. has been collected from a small unnamed island (45°25'S-74°10'W) 4 km to the north, and indicates a maximum Early Carboniferous, probably Mesozoic age. The fossil bearing unit is the Potranca Formation (or Potranca Unit) which forms part of the Chonos Metamorphic Complex, interpreted as a subduction complex developed on the southwestern margin of Gondwanaland. As these rocks have been previously considered to be of Paleozoic age (Late Silurian-Early Devonian), the geologic history of this part of the continental margin must be reinterpreted. These fossils provide clear evidence that marine depositional processes persisted within the Chonos Metamorphic Complex during Late Triassic time.

Key words : Palaeontology, Fossils, Triassic, Chonos Metamorphic Complex, Chile.

RESUMEN

Hallazgo de fósiles del Triásico tardío en el Complejo Metamórfico de los Chonos, sur de Chile. Se identificó la presencia del bivalvo *Monotis (Pacimonotis) aff. subcircularis* Gabb, que indica una edad nórica (probablemente Nórico superior-temprano) en rocas provenientes del extremo suroriental de la isla Patranca (45°25'S-74°09'W) en el Archipiélago de los Chonos, Aisén. Otro bivalvo fósil, *Limidae* gen. et sp. indet. fue recolectado en una pequeña isla sin nombre perteneciente al Grupo Smith (45°25'S-74°10'W) ubicada ca. 4 km al norte de la anterior, que indica una edad máxima carbonífera inferior, probablemente mesozoica. La unidad fosilífera es la Formación Potranca (o Unidad Potranca), integrante del Complejo Metamórfico de los Chonos, que se ha interpretado como un complejo de subducción formado en el margen suroccidental del continente de Gondwana. Dado que estas rocas han sido habitualmente consideradas como paleozoicas (Silúrico superior-Devónico inferior), es necesario reinterpretar la evolución geológica de esta parte del margen continental. Estos fósiles proveen clara evidencia que los procesos de sedimentación marina persistieron en el Complejo Metamórfico de los Chonos durante el Triásico Superior.

Palabras claves : Paleontología, Fósiles, Triásico, Complejo Metamórfico de los Chonos, Chile.

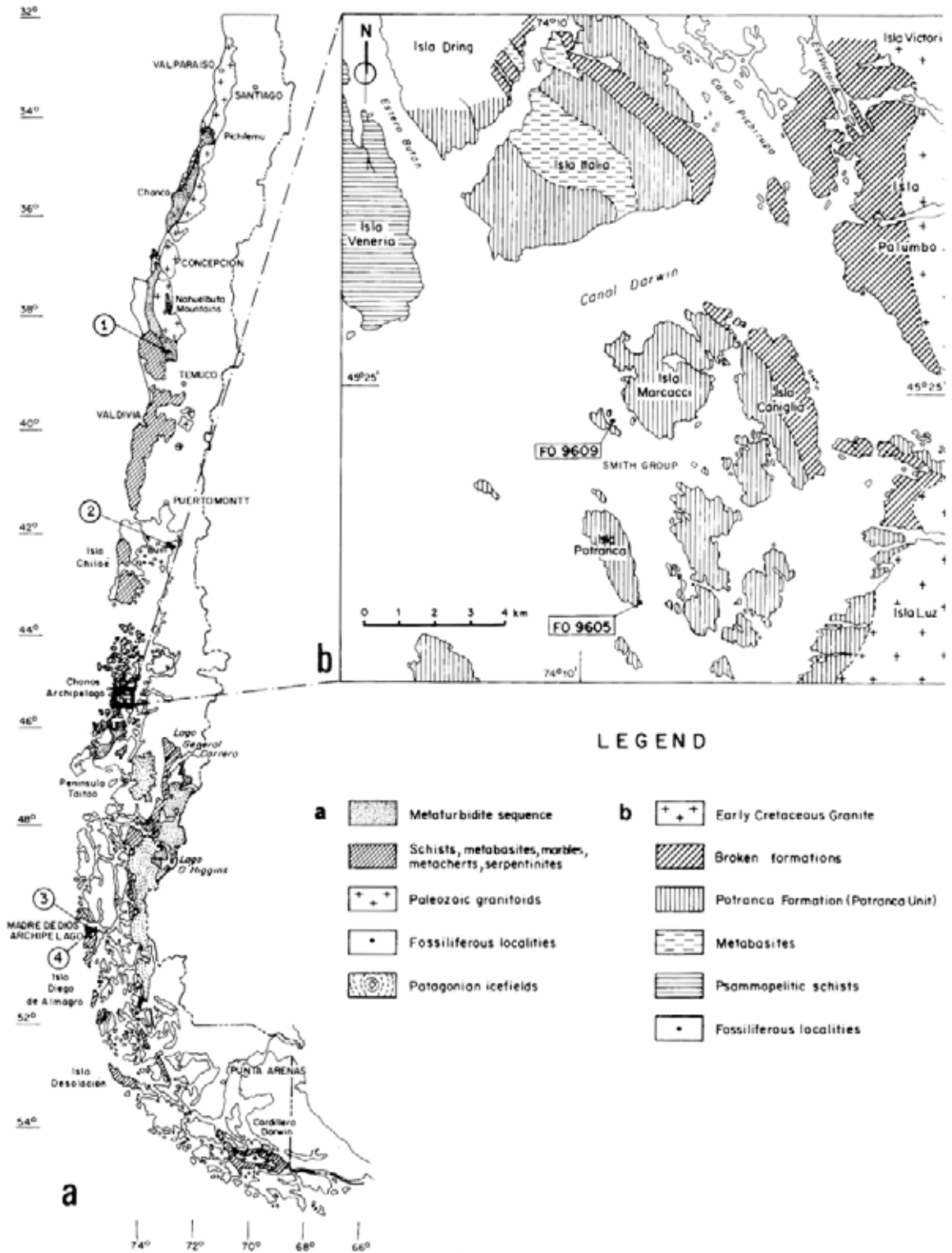


FIG. texto 1. **a**- location map of the Chonos Metamorphic Complex , in the frame of the 'basement rocks' of Southern Chile (modified from Hervé, 1988). Fossiliferous localities in this 'basement' indicated; **b**- geologic map of the Smith Group of islands within the Chonos Archipelago (modified from Hormazábal, 1991), with indication of the fossil bearing localities discussed in this paper.

INTRODUCTION

Large tracts of the Coast Ranges of Chile south of 34°S are underlain by igneous and metamorphic complexes. These rocks were represented as Precambrian in the geological map of South America (Harrington, 1962). However, radiometric dating of the complexes at different latitudes (*in* Hervé, 1988) has failed to yield ages older than Carboniferous; these ages are interpreted broadly as the age of metamorphism of the complexes.

Paleontological information about the age of deposition of these complexes is very scanty. Tavera (1979) described the presence of *Gordia* sp.? and *Crossopodia nahuelbutanus* at Lumaco (39°S) which he interpreted as indicating Silurian deposition. At Buill (42°S), Biese (1953) found trilobites not *in situ* mentioned as a 'Calymenidae von devonischen Habitus'. Pérez *in* Levi *et al.* (1966) and later Fortey *et al.* (1992) identified Devonian deposition, based on the presence of Calmoniidae trilobites. Tavera *in* Cecioni (1955) reported the presence of fusulinids in several localities in the islands of the Archipelago Madre de Dios (50-51°S) assigning the host limestones to the Permo-Carboniferous. Later, Douglas and Nestell (1976) described a fusulinid assemblage in the same area, indicative of Late Pennsylvanian and Early Permian age. Ling and Forsythe (1987) reported the presence of Late Carboniferous to Permian radiolaria in cherts from Madre de Dios Archipelago, and from Regalada Island (54°S). These localities are indicated in text figure 1a.

In the Chonos Archipelago, Miller and Sprechmann (1978) described what they identified as Early to Middle Devonian brachiopods (*Scaphiocoelia?* sp.; Early Devonian *Derbyina whitiorum* Clarke and *Schuchertella* sp.) from Patranca Island¹, Smith Group (text-Fig.1b). In later publications on this area by many authors, this was considered to be the age of deposition of the Chonos Metamorphic Complex, even though Fuenzalida and Spring (1979) mentioned that fossils from the same locality on

Patranca island as those of Miller and Sprechmann's (1978) had been identified by the late Professor J. Tavera as *Pseudomonotis ochotica* (Keyserling) (= *Monotis* (*Entomonotis*) *ochotica* (Keyserling)) indicating a Late Triassic age. As this publication did not give any details on the fossils studied, this information has not been fully considered by later authors working in the area.

In recent years, one of the authors (FH) has been conducting a study of the petrologic characteristics of the Chonos Metamorphic Complex, and had the occasion to collect fossils from the same localities on Patranca Island and the small unnamed island as those of Miller and Sprechmann's (1978) and Fuenzalida and Spring (1979). The collected material was first examined by one of the authors (AB), who considered that the fossils were not brachiopods, and that they are probably bivalves and younger than Devonian. He also noted that Miller and Sprechmann's (1978) identification of *Eocoelia?* of Early Silurian age, a strictly Northern Hemisphere genus (Llandovery-Early Wenlockian) together with typical Malvinokaffric Realm Early Devonian (Siegenian-Emsian) possibly later Devonian genera was extremely unlikely. As a result, the fossils were sent to Professor Zong-jie Fang who produced the results presented below. These results confirm Tavera's opinion on the geological age (*in* Fuenzalida and Spring, 1979). The authors doubt the correctness of Miller and Sprechmann's (1978) brachiopod identifications and suspect them to be the same bivalves present in the authors' collections. However, the authors are unsure of this supposition until their fossil material is restudied.

The purpose of this paper is to present the results of the paleontological study of the fossil samples collected on Patranca Island and on the unnamed island, with a discussion of the geological framework of the area and the implications of the new age determination.

GEOLOGICAL FRAMEWORK

The Potranca Formation (Miller and Sprechmann, 1978) later referred to as the Potranca Unit

(Davidson *et al.*, 1987) is part of the Chonos Metamorphic Complex. It is composed of submarine

¹ The name of this island has been misspelled as Potranca, in most previous publications. Patranca is the local name for a species of penguin which nests on the island. The authors use it in this paper with its proper spelling, Patranca, but they have maintained Potranca for the names of the geologic units as previously defined.

fan turbidites and subordinate pelagic cherts, both of which contain well preserved primary sedimentary structures. Bands of sheared sandstone, mudstone and conglomerate (broken formations) are locally developed.

The Smith Group of islands, where both fossil localities are situated, is underlain by a turbidite sequence, with coarse to fine-grained sandstone in beds from decimeter to 10 m thicknesses, commonly with rip up pelitic clasts. The interbedded pelites have well developed cleavage. Illite crystallinity studies (Hormazábal, 1991), indicate anchimetamorphic grade.

To the west, the turbidite sequence is replaced by strongly foliated and recrystallized mica schists

and greenschists. Miller (1979) suggested that the Potranca Formation unconformably overlies the schists. Davidson *et al.* (1987), contrarily, suggested that the schists are the result of progressive westward increase in strain and metamorphism of the Potranca Formation (Potranca Unit) rocks.

The Chonos Metamorphic Complex is interpreted as a subduction complex accreted to the ancestral Pacific margin of Gondwanaland. Its metamorphism and deformation must have occurred before the intrusion of the North Patagonian Batholith, which intrudes the already deformed and metamorphosed rocks of the complex. The older ages of the North Patagonian Batholith in the Chonos Archipelago are Early Cretaceous (Pankhurst and Hervé, 1994).

SYSTEMATIC PALEONTOLOGY

Class Bivalvia Linné, 1758

Subclass Pteriomorphia Beurlen, 1944

Order Pectinoida Rafinesque, 1815

Superfamily Monotoidea Fischer, 1887

Family Monotidae Fischer, 1887

Genus *Monotis* Bronn, 1830

Subgenus *Pacimonotis* Grant-Mackie and Silbering, 1990

Type species (by original designation): *Monotis subcircularis* Gabb, 1864

Monotis (Pacimonotis) aff. subcircularis
Gabb, 1864.

Plate 1, Figs. 1, 2.

Compare: *Monotis subcircularis*, Westermann, 1962, p. 781, p. 115, Figs. 6-9; *Monotis (Entomonotis) subcircularis*, Grant-Mackie, 1978b, p. 489, Figs. 15-25, 28-43; Beltan *et al.*, 1987, p. 103, Figs. 2, 3.

Material: more than twenty fragmental specimens. Two of them are almost complete, but have been secondarily deformed.

Description: shell medium-sized, originally probably subequivalve and obliquely subcircular, posterior ear well differentiated from body of shell by auricular sulcus; slightly concave, nearly smooth; surface marked with intercalated radial plicae of three orders, similar on both valves, twenty to thirty in total, more or less wavy rather than

straight; primaries strong, narrow, high, well differentiated from interspaces, slightly weakened posterodorsally; secondaries starting from above half of shell height, significantly weaker than primaries; tertiaries very weak, appearing near ventral margin; concentric lamellae beyond recognition.

Remarks: the specimens are poorly preserved. Here, they are assigned to *Monotis (Pacimonotis)* judging from the general outline and the intercalated radial plicae, which slightly weaken posterodorsally. The visible characters of the present specimens (such as size, inflation, smooth posterior ear, and strong, narrow plicae) coincide with *M. (Pacimonotis) subcircularis* Gabb. It is reasonable to compare the present form with *M. (Pacimonotis) subcircularis* Gabb. As yet, the characters of the anterior ears and posterodorsal margins of both valves are not known. This prevents them from making a definite specific identification.

Measurements (mm)

All figures are approximate because none of the specimens is quite complete.

	L	H
Left valve (Plate 1, Fig. 1)	38	33
Right valve (Plate 1, Fig. 2)	24	17

L= length; H= height

Occurrence: Patranca Island, the Chonos Archipelago, Southern Chile; Potranca Formation of the Chonos Metamorphic Complex; Norian, Late Triassic (probably early late Norian). Field collection number F09605. Repository number SNGM 9378-9381 (Museo Geológico del Servicio Nacional de Geología y Minería, Tiltill No. 1993, Ñuñoa, Santiago, Chile).

Order Limoida Rafinesque, 1815
Superfamily Limoidea Rafinesque, 1815
Family Limidae Rafinesque, 1815

Limidae gen. et sp. indet.

Plate 1, Figs. 3-5

Material: a nearly complete, but strongly deformed right valve (length 35 mm, height 35 mm), and an incomplete right external mold.

Description: shell medium-sized, obliquely sub-ovate shell highly inflated, ophisthoclinal with anteroventral extension; hinge margin short and straight, umbo inflated, salient above hinge line, subcentral, no anterior or posterior umbonal ridge; surface covered by closely spaced radiating ribs of three orders, strong and straight, rounded, increasing by bifurcation, about 36 in number near the ventral margin, obsolete towards the anterior; no concentric ornament observed.

Remarks: the present form looks somewhat similar to *Monotis*, especially to *M. (Maorimonotis) routhieri* avias (Grant-Mackie, 1978a, Figs. 8, 9; 1978b, Figs.

3-13), but without the juvenile growth-pause. The available material is too poorly preserved to indicate affinity. For the moment, it is tentatively placed in the family Limidae because of its strong anteroventral extension with rather short hinge margin, subcentral umbo and bifurcated radials. The family Limidae makes its appearance in the Early Carboniferous and persists to the present. Therefore, this rules out the possibility of the Potranca Formation being pre-Carboniferous in age on the unnamed island, Smith Group, the Chonos Archipelago.

Occurrence: unnamed island belonging to the Smith Group, the Chonos Archipelago, Southern Chile; Potranca Formation of the Chonos Metamorphic Complex; Triassic?. Field collection number F09609. Repository number SNGM 9382-9383 (Museo Geológico del Servicio Nacional de Geología y Minería, Tiltill No. 1993, Ñuñoa, Santiago, Chile).

DISCUSSION

The Late Triassic age obtained for the deposition of the Potranca Formation (Potranca Unit) of the Chonos Metamorphic Complex, invalidates, at least, the time frame in which the evolution of this segment of the ancestral Pacific Gondwanaland margin has been discussed (*e.g.*, Miller, 1979; Forsythe, 1982; Davidson *et al.*, 1987); these authors assumed that the depositional age of the complex was Devonian. The apparently continuous accretionary complex which extends south of 34°S along the Chilean Coast Ranges, must be now considered as a

diachronous assemblage, with Early Devonian (Buill, trilobites) to Late Triassic components. The subduction related metamorphism of the Chonos Archipelago, if the interpretation of Davidson *et al.* (1987) was correct, must have taken place in the Early Mesozoic and not in the Late Paleozoic. This may explain the lack of a voluminous Late Paleozoic batholith in the Aisén Region, as is the case between 34 and 40°S (FIG. texto 1), where the age of subduction related metamorphism seems to be firmly established as a Paleozoic event. This raises

a problem: to identify, if present, a magmatic arc related to the Late Triassic-Jurassic? subduction. A major candidate is the Central Patagonian Batholith

described in Argentina by Rapela *et al.* (1991) which has provided Late Triassic to Middle Jurassic ages.

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Patagonia crews expertly conducted the field parties to this remote area in several occasions, until the new fossils were found in 1995 and 1996. Fang's work on fossil bivalves is supported financially by National Science Foundation of China (Grant No. 49672147). The authors wish to thank Drs. S. Damborenea (Museo de Ciencias Naturales de la Plata), G.E.G. Westermann (McMaster University), H. Campbell (Institute of Geological and Nuclear Sciences Ltd.), J.A. Grant-Mackie (University of Auckland) and H. Miller (Universität München) for their helpful comments and suggestions.

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PLATE 1

Figures *Monotis (Pacimonotis) aff. subcircularis* Gabb, 1864
p. 168

1. Left valve, x 2, SNGM 9379;
2. Right valve, juvenile, x 3, SNGM 9378. Both from the Potranca Formation of the Chonos Metamorphic Complex, Norian, Upper Triassic (probably early late Norian); Patranca Island, Southern Chile. Field collection number FO9605.

Figures *Limidae gen. et sp. indet.* A strongly deformed right valve.
p. 169

3. Anterodorsal view;
4. Posteroventral view;
5. Lateral view. All x 2, SNGM 9383; from the Potranca Formation of the Chonos Metamorphic Complex, ?Triassic; an unnamed island belonging to the Smith Group of the Chonos Archipelago, Southern Chile, Field collection number FO9609.

PLATE 1

