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NOTA BREVE

West Antarctic Rift system: a possible New Zealand-Patagonia Oligocene paleobiogeographic link

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The extant marine benthic faunas in the New Zealand region and those belonging to the Magallanes and Antarctic biogeographic provinces may share a common origin dating back as far as the Early Cretaceous (Zinsmeister, 1982; Crame, 1999). These faunas have diverged ever since but the tempo and mode of this divergence remains imperfectly understood. Studies on the biogeographical affinities among the marine benthic faunas from the Southern Hemisphere point to close paleobiogeographical relationships between New Zealand, West Antarctica and southern South America after the final break-up of Gondwana (Griffin and Hünicken, 1994; Zinsmeister and Griffin, 1995; Stilwell, 2003).

The paleobiogeographical evolution of these faunas occurred in the context of the dramatic and continuous geodynamic events that led from relatively warm, ice-free "greenhouse" conditions to an "ice-house" state (Francis *et al*., 2009). Crucial oceanographic modifications took place in the Southern Hemisphere during the period between 35 and 15 Ma. These included the establishment of broad zonal belts of surface-water masses separated by oceanic fronts (Nelson and Cooke, 2001; Lagabrielle *et al*., 2009). These belts had a paramount role in the isolation and evolution of the marine faunas in the Southern Hemisphere (Arntz, 1999). However, paleontological evidence demonstrates that during this period paleobiogeographic connections between New Zealand and Patagonia were maintained, as shown by the presence of numerous common taxa. Twenty two mollusk genera appearing in South American Late Oligocene–Miocene rocks are recorded also in New Zealand, but making their first appearance there in older rocks (*Deminucula*, *Notolimopsis*, *Glycymeris* (*Glycymerula*), *Cyclochlamys*, *Gonimyrtea*, *Spissatella*, *Scalpomactra*, *Turia*, *Crosseola*, *Sigapatella*, *Trichosirius*, *Sassia zealta* group, *Ataxocerithium*, *Penion*, *Nassarius* (Hima), Xymenella, *Austromitra*, *Zeacuminia*, *Eoturris*, *Neoguraleus* (*Fusiguraleus*), *Oamaruia* (*Oamaruia*), and *Opimilda*. At the same time, 16 taxa appear in South America in rocks older than those containing these taxa in New Zealand (*Zygochlamys*, *Tiostrea*, *Aulacomya*, *Lucinoma*, *Antisolarium* (from *Valdesia*), *Xymene*, ?*Trophon*, Provocator, *Antimelatoma*, *Solemyarina*, *Anadara*, *Mytilus*, *Protothaca*, *Diloma*, *Argobuccinum*, *Fusitriton*). At the same time (Late Oligocene–Early Miocene), eight genera appear in both areas (*Neopanis*, *Austrovenus* (from *Ameghinomya*), *Cirsotrema* (large species), *Oamaruia* (*Zeadmete*), *Puyseguria*, *Cosa*, *Notolimea*, *Lamprodomina* (Beu *et al*., 1997).

Bryozoans recorded from around the Oligocene–Miocene boundary in Patagonia are typically pan-Gondwanan. However, a recent record of a species belonging to Cinctiporidae (figure 1) -a distinctive family previously regarded as a New Zealand endemic (Boardman *et al*., 1992) – within the Monte León Formation (Early Miocene) cropping out in the Puerto Deseado area (47º 32′ 52′S, 66º 30′ 57′′W), Argentina, reinforces the idea of connections between the western South Atlantic and New Zealand as late as the Early Miocene. With the exception of a doubtful occurrence in the Maastrichtian of South Africa (Boardman *et al*., 1992), cinctiporids were known only from the Late Paleocene-Early Eocene to Recent of New Zealand (Gordon and Taylor, 1999) before the surprising discovery of the Argentinean material.

Despite the enormous distance separating New Zealand and South America during the Oligocene (15,000 km eastward from South America to New Zealand and 9,000 km from New Zealand to South America), these affinities among benthic faunas with mainly short-lived larvae have been attributed by Beu *et al*. (1997) largely to the action of the

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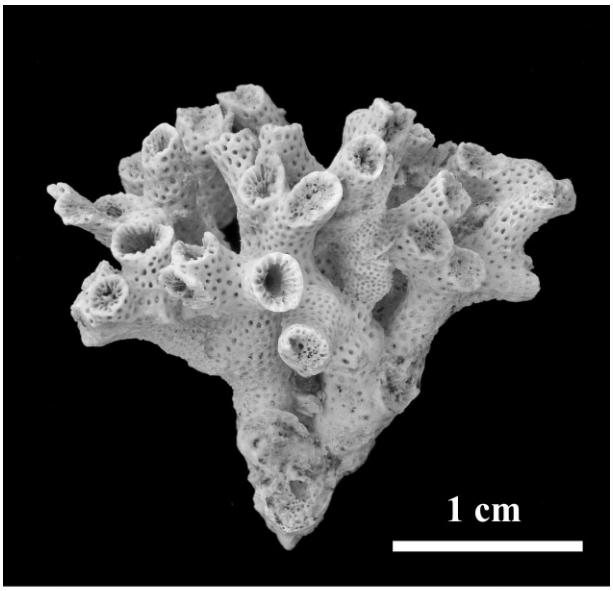

Figure 1. Specimen GHUNLPam 28.000 from Puerto Deseado area (Argentina) belonging to the cyclostome bryozoan family Cinctiporidae hitherto considered to be endemic to New Zealand. The specimen is housed in the Departamento de Ciencias Naturales of the Universidad Nacional de La Pampa / *especímen GHUNLPam 28.000 del área de Puerto Deseado (Argentina) perteneciente a un briozoo ciclostomado de la familia Cinctiporidae hasta ahora considerada endémica de Nueva Zelanda. El ejemplar se encuentra depositado en la colección del Departamento de Ciencias Naturales de la Universidad Nacional de La Pampa.*

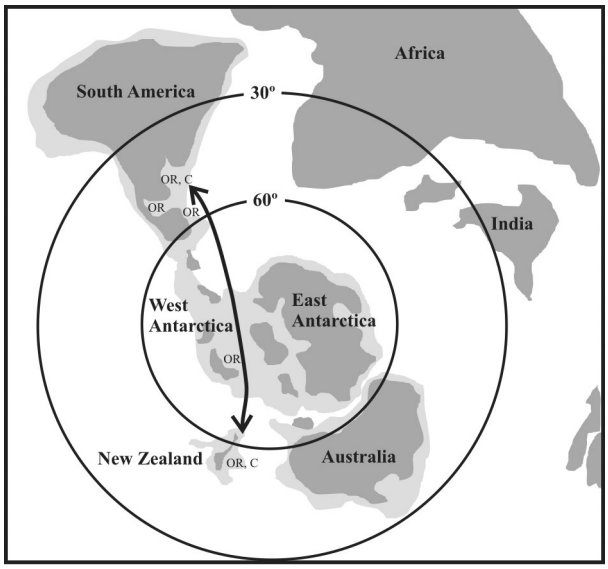

Figure 2. Schematic paleogeographic map showing the suggested marine connections during the Oligocene. **OR =** oyster reefs, **C =** Cinctiporidae. Base map modified from Nelson y Cooke (2001), Ghidella et al. (2002) y Ghiglione *et al*. (2008) / *mapa paleogeográfico esquemático mostrando las conexiones marinas sugeridas para el Oligoceno.* ***OR*** *= arrecifes ostreros,* ***C*** *= Cinctiporidae. Mapa base modificado de Nelson y Cooke (2001), Ghidella* et al. *(2002) y Ghiglione et al. (2008).*

Antarctic Circumpolar Current, established as a consequence of the opening of Drake Passage. However, if this were true it would be difficult to explain the low dispersion rate after the Early Miocene.

Here we postulate that the paleobiogeographic connection may have been along the West Antarctic Rift system. This system underwent an episode of significant extension during the Eocene-Oligocene (Cande *et al*., 2000), especially evident from seismic imaging in the McMurdo Sound (Fielding *et al*., 2008), and at the same time the full opening (c. 31 Ma) of the Tasmanian gateway possibly elicited the onset of a proto-circum-Antarctic flow of cold waters, perhaps through a West Antarctic seaway connecting the southern Pacific and Atlantic Oceans (figure 2), a scenario advocated by Nelson and Cooke (2001). While conclusive support for this hypothesis is presently limited, information assembled during the last decade after research in McMurdo Sound (Western Antarctica) is very enlightening. Boreholes CRP-2/2a and CRP-3 of the Cape Roberts Project cored approximately 1,300 m of Oligocene sediments in the Victoria Land Basin of the Ross Sea (CRST, 1999a, 1999b, 2000a, 2000b), yielding mollusks (Taviani and Beu, 2001), corals (Stolarski and Taviani, 2001), and ostracods (Dingle and Majoran, 2001) that show affinities with New Zealand and Patagonian taxa alike. Erratic boulders with giant oysters found in McMurdo Sound (albeit with no precise dating) strongly suggest the existence of great oyster reefs along the Antarctic shelf (Stilwell, 2000) similar to those described from Late Oligocene–Early Miocene successions in Patagonia (Parras and Casadío, 2005, 2006) and New Zealand (Nelson *et al*., 1983). These oysters built framework reefs in shallow-shelf environments, forming large biogenic concentrations exposed at many localities in Patagonia and New Zealand (figure 3).

In conclusion, there is an accumulating body of tectonic, sedimentary and paleontological information that the West Antarctic Rift system could have afforded a principal paleobiogeographic seaway linkage between New Zealand and Patagonia in the Oligocene.

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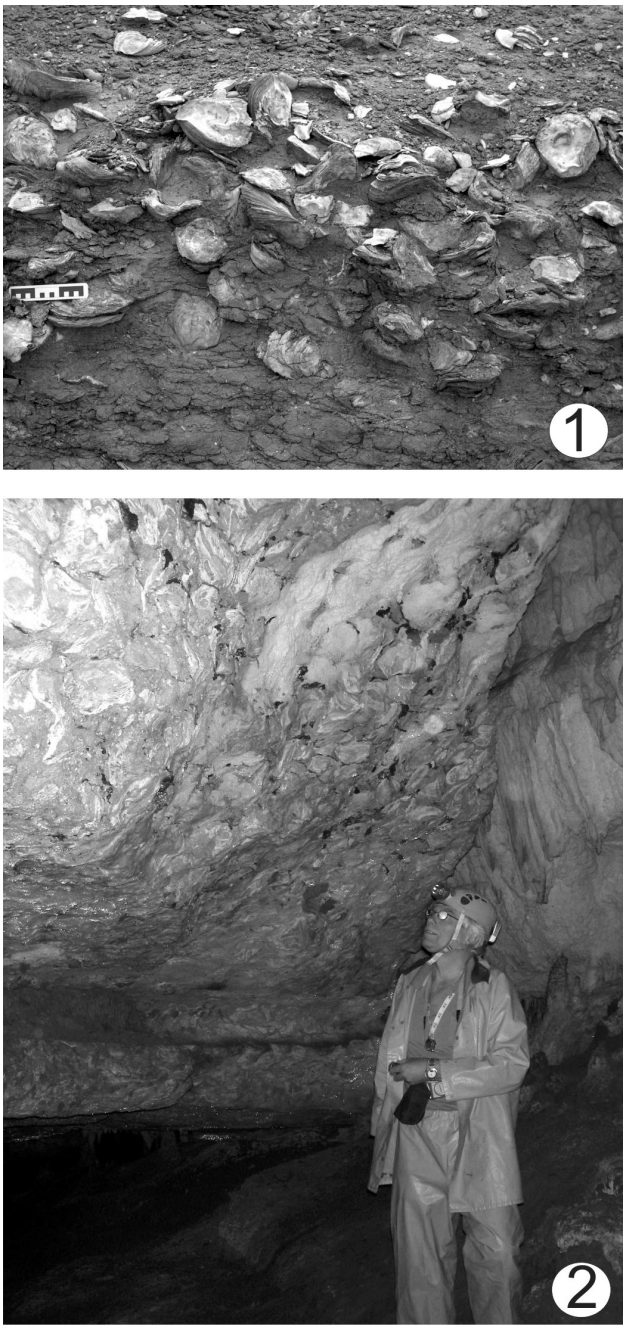

Figure 3. Oyster reefs. **1,** oyster reef in the Late Oligocene-Early Miocene Centinela Formation, La Siberia, Santa Cruz, Argentina; **2,** Oyster reef in the Late Oligocene-Early Miocene Te Kuiti Group, Piripiri Cave, Waitomo, New Zealand / *arrecifes ostreros.* ***1,*** *arrecife ostrero en la Formación Centinela (Oligoceno Tardío-Mioceno Temprano), La Siberia, Santa Cruz, Argentina;* **2,** *Arrecife ostrero en el Grupo Te Kuiti (Oligoceno Tardío-Mioceno Temprano), Cueva Piripiri, Waitomo, Nueva Zelanda.*

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