Brachiopod dispersal (Carboniferous): from platform to platform

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Recent articulated brachiopods are relict groups. Many genera have considerable bathymetric range such as *Platidia* occurring from 18 to 2190 m depth in the Mediterranean Sea, Atlantic and Pacific Oceans (Richardson 1997). Littoral species are rare and restricted in geographic distribution. Their specificity for specialized substrates and low dispersal capacity by the non-planktotrophic larvae brooded within mantle canals, suggest that transoceanic dispersal is impossible. Instead, paths of dispersal are along shorelines (Richardson 1997) and by oceanic currents (Zezina 2001). Palaeozoic articulated brachiopods, common on shallow shelves, probably had reproductive systems similar to recent forms (Law & Thayer 1991) and modes of dispersal similar to that of their modern counterparts.

"Platform" and "Basin" faunas are used as follows in the present paper. The "Platform" fauna is an association living on a shelf facing the open sea, in waters of sufficient oxygen and light levels. This is further subdivided into (a) a coastal and shallow shelf were brachiopods are frequently associated with corals and algae, and (b) a slope or ramp setting below wave base, with lower oxygen and light levels but still sufficient for some algae. The "Basin" fauna includes brachiopods permanently inhabiting the basin floor of increasing/variable depth in quiet, dysaerobic and muddy environments, and where the benthos is associated with pelagic and pseudo-planktonic organisms.

"Platform" Carboniferous Brachiopods

In Carboniferous reefs many brachiopods were endemic. Some non-reefal faunas, more widely distributed, exhibit interesting aspects of palaeoecology and paths of dispersal. Of the various brachiopods living on shelves during the upper Viséan – Serpukhovian, Gigantoproductids were distributed along the periphery of the "Palaeotethys" Ocean but were absent in the N. American mid-continental sea.

- *Gigantoproductus* lived unattached but stabilized by the weight of a thick-walled ventral valve on the substrate. *G. semiglobosus* (s.l.), upper Visean in age, is frequently found in muddy limestones. First described in Silesia, the species is also found in northern China, Urals, and northern England. In the French Massif Central, at the L'Ardoisière locality near Vichy (Julien 1896), related forms are present in shallow volcano-sedimentary beds. In the Los Santos de Maimona area of southwestern Spain, *G.* aff. *semiglobosus* populations colonized shallow marine clastic-detrital environments forming rigid frameworks on which *Siphonodendron* biostromes grew (Rodriguez 1996). The species occurs also in shelf olistolites of slumped Culm facies of the Rheinische Schiefergebirge (Amler 1987), and near coral-microbe patch-reefs in several localities of Montagne Noire (Aretz 2002). *Gigantoproductus crassiventer*, a species found in central England and in Nova Scotia, in conjunction with associated corals established the marine connection between central England and Eastern Canada (Von Bitter & Legrand-Blain 2006).

- *Titanaria* was stabilized by numerous fine spines. The type species, *T. costellata,* is described from terranes in the western North American Cordillera. These late Mississippian (Mamet zone 18) brachiopods are associated with colonial corals, which thrived under rough-water turbulent conditions (Dutro 1989). Later (Mamet zone 19) in the western Algerian Sahara, *T. taibinensis* followed by *T. africana* and *T. horrreitensis* migrated northwards from the Reggane to Bechar area along restricted marine basins (Legrand-Blain 1987). In this instance they are the ultimate Gigantoproductids, immediately preceding the Mid-Carboniferous global crisis. Migrating northwards, *Titanaria* gr. *africana* reached the French Pyrénées specifically the Ardengost Limestone of the Culm facies. The genus is unknown from other Palaeotethys areas, including the central and East Sahara. The question arises as to how *Titanaria* dispersed from the Pacific Ocean to the northwestern African craton during Appalachian- Mauretanian orogenesis ?

"Basin" Carboniferous Brachiopods

The mudstones deposited in anoxic basins, in which pelagic faunas are currently fossilised, represented adverse conditions for benthos settlement. In the Rheinisches Schiefergebirges "*crenistria*-beds", brachiopods are rare and small-sized in the 2-7 mm range, rarely exceeding 10 mm in length (Nicolaus 1963). Their low-diversity association consists of inarticulate Discinids and articulates such as Chonetids and smooth-shelled Spiriferids. Similar faunas were described from Viséan-Serpukhovian boundary beds in northeastern Spain

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(Martinez Chacon et al. 2003). The "Basin" brachiopods commonly retain ancestral characteristics, and at the same time, these dwarf faunas may also provide information on peculiar evolutionary processes such as paedomorphosis, Lazarus effects, and other.

Conclusion

Brachiopod global palaeobiogeography, currently studied for Permian faunas, is less known for their Carboniferous counterparts. It is hampered by differing taxonomy around the world: "the old problem of poor communication between individual research workers" (Brunton 1985). In some cases of regional palaeobiogeography, brachiopods from western Europe (especially the Culm basins) and from North Africa are useful indicators of palaeoenvironments and migration pathways.

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