GEOLOGICA CARPATHICA, 42, 1, BRATISLAVA, FEBRUARY 1991,
59–63

BRACHIOPOD FAUNAS OF THE TRIASSIC–JURASSIC BOUNDARY INTERVAL IN THE MEDITERRANEAN TETHYS

JOZEF MICHALÍK,[1] MAGDALENA IORDAN,[2] VLADAN RADULOVIĆ,[3] PLATON TCHOUMATCHENCO[4] and ATTILA VÖRÖS[5]

[1] Geological Institute, Slovak Academy of Sciences, Dúbravská c. 9, 842 26 Bratislava, C.S.F.R.
[2] Geological and Geophysical Institute, Str. Caransebeş 1/1, R-78344 Bucurest, Romania
[3] Institute of Regional Geology and Paleontology, Faculty of Mining and Geology, Kamenička Str. 6, Box 227, YU-11000 Beograd, Yugoslavia
[4] Geological Institute, Bulgarian Academy of Sciences, Acad. Bonchev Str., BG-1113 Sofia, Bulgaria
[5] Museum of Natural History, Geological and Paleontological Dept., Múzeum Körút 14–16, H-1370 Budapest, Hungary

(Received January 22, 1990; accepted in revised form September 7, 1990)

Abstract: Early Kimmerian paleogeographic revolution was followed by a very important evolutionary break in the Mesozoic brachiopod development. The authors illustrate Late Triassic retreate-, top Triassic oportunism-, Rhaetian/Hettangian crisis- and Early Jurassic re-establishment of brachiopods on the examples mostly from the Mediterranean province of the Tethys.

Key words: uppermost Triassic, lowermost Jurassic brachiopod communities, Mediterranean Tethys.

Introduction

The faunal change during the Triassic–Jurassic boundary interval represented one of the major, but very inconsistently known evolutionary changes of the Mesozoic brachiopod development. Williams (1965) noted a remarkable reduction of athyridaceans, spiriferinids and dielasmatids, accompanied by accelerated development of rhynchonellids and terebratulids, which has happened at that time.

Late Triassic was the time of a considerable regression of the shelf- and epicontinental seas, (Owen, 1983) accompanied by a dry and hot continental climate. The retreate of marine conditions and biotopes has lead to the decrease of brachiopods and to the degradation of brachiopod associations during Late Carnian and Norian (Michalík, 1987). Marine transgression at the end of Triassic has been connected with frequent oscillatory movements (Michalík, 1977; Gaździcki et al., 1979; Brandner, 1984). Renovation of scattered shallow-marine embayments enabled the origin of famous world-wide opportunistic faunas with many endemic elements (Dagys, 1974).

Oscillatory progradation of the epicontinental seas has continued during Early Jurassic (Hallam, 1975). However, the climate has changed rapidly. Fabricius et al. (1970) recorded a general decrease of the average temperatures at the beginning of Hettangian. Clastic influx in the marine sediments (Michalík, 1978, 1980) indicates raised humidity of the climate at this time.

Ager (1960, 1973) considered paleobiogeographic differentiation of the Liassic brachiopod faunas. He described an "Alpine Group" characterized by axiniform and inversiform morphologies, a "Tethyan Group", characterized by the presence of *Prionorhynchia, Cirpa, Propygope*, etc., and a "Marginal Group" with cynocephalous rhynchonellids and multiplicate zeilleriids. All these groups, specified and characterized in more details by Vörös (1977, 1982, 1984) or by Almèras and Elmi (1982), Almèras and Elmi (1985) have further diversified during Lower Jurassic. However, the very beginning stage of their diversification, their "root areas" and the migration routes of the first early Jurassic brachiopods are poorly known, as the brachiopod data coming from the Triassic–Jurassic boundary beds are scarce in the world literature.

Late Triassic brachiopod development

Late Triassic marine regression made the differences between individual paleobiogeographical provinces more expressive. The rate of endemism increased. Alpine-Carpathian region of the Tethyan Mediterranean province has been characterized by presence of *Bittnerella, Klippsteinella, Hungarispira* and other genera, while the Himomalayan province resembled more closely the "Raiblian" fauna (*Adygella, Cruratula, Sincucosta*, accompanied by *Aspidothyris, Costirhynchia, Lepismatina*, etc.). The Tethyan influence in the Eastern Asia became less impressive. On the other hand, the Boreal elements penetrated deeply into Tethyan Himomalayan province. However, the occurrence of similar forms both in Maorian (=Notal) and Boreal Realms (like *Pennospiriferina* or *Pseudolaballa*, cf. Dagys, 1974) could not be explained by a simple migration across the equator. Gradual restauration of the nearshore marine conditions at

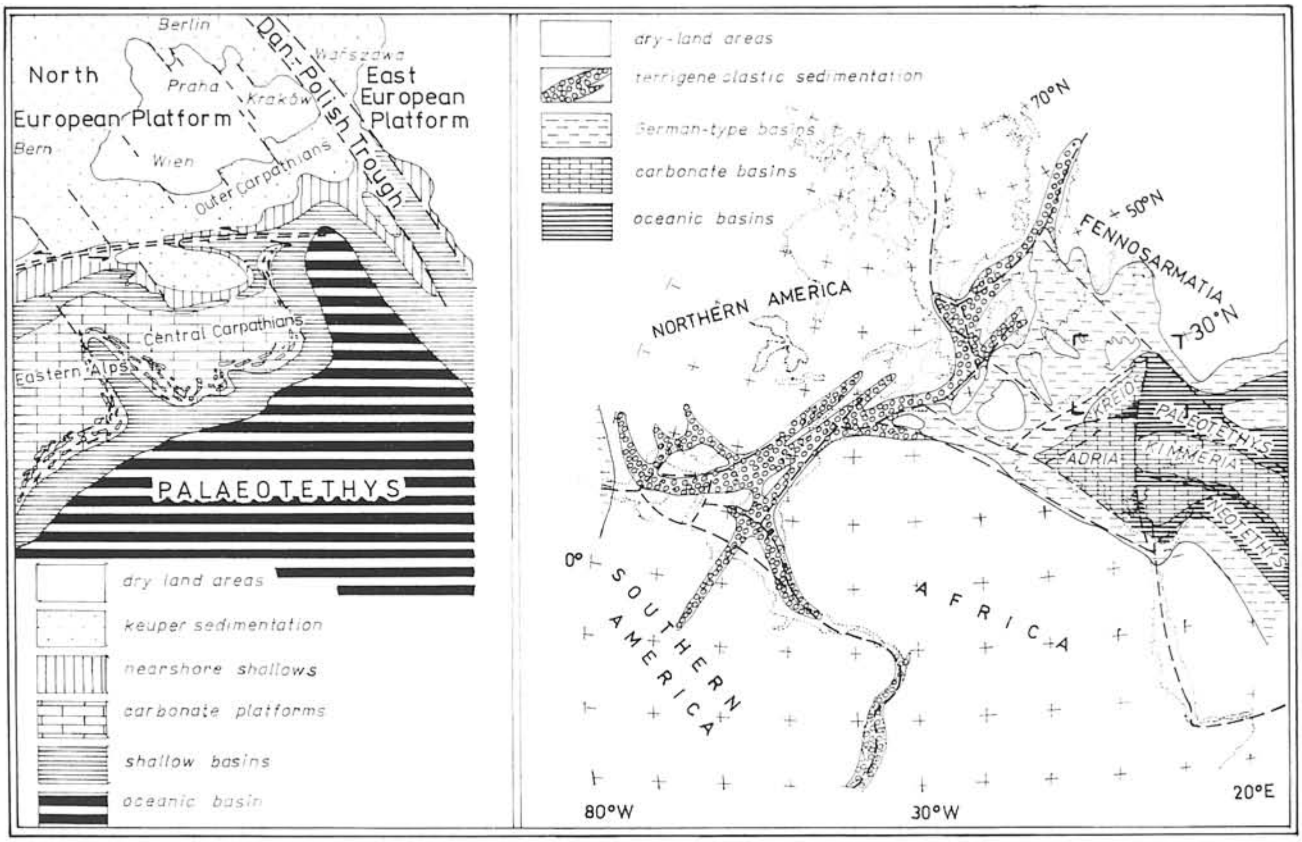

Fig. 1. Paleogeographic sketch of the Mediterranean-North Atlantic region during Late Triassic–Early Jurassic time (according to Owen, 1983; Brandner, 1984) (right) and of the West Carpathian section of the Mediterranean Tethys at the same time (left).

the end of Triassic caused a new faunal differentiation. The endemites (koninckinids, thecospirids, retziids, basiliolids, dielasmatids, wellerellids) formed locally more than 80 % of the Tethyan brachiopod populations (Michalík, 1987). The Alpine-Carpathian Subprovince contained a lot of specific forms like *Austrirhynchia*, *Bactrynium*, or *Zugmayerella*. They lived in full-marine shallow basins like those with sedimentation of Koessen Formation in Eastern Alps (Suess, 1854; Zugmayer, 1882; Bittner, 1890; Pearson, 1977), Hybe Formation in Western Carpathians (Michalík, 1975, 1976, 1977), in Soviet- and Roumanian Eastern Carpathians (Dagys and Chernov, 1974; Iordan, 1978; Bordea et al., 1978), cf. Fig. 1.

Different associations, dominated by *Triadithyris*, *Neoretzia*, *Koninckina*, *Laballa*, *Aulacothyropsis*, etc. dwelled in deeper basins: Zlambach Fm. in Eastern Alps, Bleskový prameň Fm. in Western Carpathians (Siblík, 1967) or many localities in Anatolia, Crimea, Caucasus, Iran and Pamir (Dagys, 1963, 1974; Kristan-Tollmann et al., 1979). On the other hand, extensive restricted shallows rimming emerged lands and submarine elevations were inhabited by opportunistic mono-associations of *Rhaetina gregaria* (SUESS) (Bavarian Alps, Central West Carpathians, Bakony Mts. of the Transdanubian Mid-Mountains, Carnian Alps of Slovenia, or even eastern Iran, cf. Stocklin, 1972). Gradual closing of Palaeotethys interrupted the connections between the Mediterranean and the easternmore regions: the presence of *Triadispira* and *Majkopella* has characterized the Crimean-Caucasian Subprovince; *Pamirotheca* and *Pamirothyris* were typical inhabitants of the Pamir Subprovince; *Dierisma*, *Yidunella*, *Excavatorhynchia*, *Lunaria*, or *Zhidothyris* inhabited several southeastern Asian subprovinces. Southern Mediterranean assemblages contained some endemic genera (*Carapezzia*), too. The Himomalayan Province was characterized by a lack of laballids, thecospiraceans, but by the presence of *Misolia*, *Hagabirhynchia*, *Eoseptaliphoria*, *Himalairhynchia*, *Tibetothyris* and many others (Sun, 1980). Primorye and Far East have lost the connection with Tethys becoming an integrated part of the Boreal Realm with characteristic fauna (*Sakawairhynchia*, *Planirhynchia*, *Laevithyris*, *Pseudohalorella* etc., cf. Dagys et al., 1979). North American Boreal has been characterized by the presence of *Spondylospira*, *Plectoconcha*, *Lepismatina*. The associations of the Notal Realm differed sharply from the Boreal ones (*Clavigera*, *Rastelligera*). However, no detailed study of the brachiopod successions and development has been published from this area yet.

The development of brachiopod communities in this time has been characterized by a sudden increase of endemism and chiefly by development of opportunistic faunas, dwelling in cracks and cavities in reef complexes, disintegrated by Early Kimmerian tectonic movements, or in shallow basins and bays with slightly distorted salinity and with pulsating bathymetrical regime.

The brachiopods of Triassic – Jurassic boundary

There is a general lack of any detailed study of brachiopod distribution and evolution across the Triassic – Jurassic boundary interval everywhere in the world. It is evident, that the brachiopods were rather rare at that time. Geyer (1889) and more recently also Pearson in its monograph on the Alpine Rhaetian brachiopods (1977) supposed that *Fissirhynchia fissicostata* and *Rhaetina gregaria* have survived until Hettangian in Hierlatz, Bergamasco, Central Apennines, Sicily and northern Africa. However, Gaetani (1970) has found the Rhaetian–Hettangian boundary interval in the Bergamasco area to be sterile. Despite of Ager's (1977) mention about the occurrences of Rhaetian–Hettangian *Rhynchonellininae* from Rif and High Atlas, Tchoumatchenco (1984) dispute any Jurassic brachiopod occurrence in northern Algeria, older than Pliensbachian.

Triassic–Jurassic boundary beds in all the known sections contain usually no brachiopod fauna (Rhaetolias–Riffkalk of Northern Alps, megalodon limestone sequences of Dachstein Lst.-type in Transdanubian Mid Mountains or in Dinarides, Kopieniec Fm. in Western Carpathians, etc.).

The oldest Lias brachiopod faunas

Paleo-Kimmerian tectonic changes have brought a new transgression on the shelves and expressive climatic change, which caused salinity distortions, clastic support, and worldwide destruction of carbonate platform system. Paleogeographic and environmental changes caused a new extinction. Brachiopods became one of seldom constituents of benthic marine communities. According to Alméras and Elmi (1985) distribution of brachiopod faunas everytimes copied zones of maximum „rain" of plankton, or downwelling currents. As the Early Jurassic plankton fertility in Tethyan basins has been rather low, true basinal brachiopod associations have arisen much later. The informations from the majority of countries are inconsistent (Michalík, 1989).

Many localities considered formerly to be Rhaetian–Hettangian ones have been proved to be much younger by modern sedimentological research (discerning of fissure fillings or olistostromal character etc.) or by elaborating of more reliable biostratigraphy.

Gaetani (1970), describing Hettangian faunal evolution of Bergamasco in Southern Alps has found the first brachiopod assemblage in his (Late Hettangian) zone 2: *Zeilleria perforata* (PIETTE), *Lobothyris ovatissimaeformis* (BOECKH), *Calcirhynchia rectemarginata* (VECCHIO) and, in the uppermost part also *Cuneirhynchia latesinuosa* (TRAUTH). Similarly, Hettangian *L. ovatissimaeformis* and *Z.* cf. *perforata* occur in Kardosrét Lst. Fm. in Bakony Mts. Poor, opportunistic brachiopod associations lived also in the West Carpathian Kopieniec Fm., in limestone formations of Outer Dinarides (Mihajlović, 1955), or Sicily.

Extensive Tethyan shelves have been affected by Paleo-Kimmerian emersion and by Early Jurassic transgression. Several zonally arranged environments of Bulgarian Stara Planina Mts. (mostly with terrigeneous influx) were colonized by brachiopods at the end of Hettangian. Sinemurian assemblages consisting of *Spiriferina walcotti* (SOW.), *S. tumida* (BUCH), *Gibbirhynchia* sp., *Quadratirhynchia* sp., *Tetrarhynchia dunrobinensis* (ROLL.), *Lobothyris grestenensis* (RADOV.), *L. punctata* (SOW.), *L. subovoides* (MUENST.) and *Zeilleria quiaoisensis* (CHOFF.) have been strongly directed environmentally (Tchoumatchenco, 1972, 1976). The oldest Jurassic fauna of Turkey has been described by Vádász (1913) and Ager (1959). It contains *Cirpa kiragliae* AGER, *Piarorhynchia deffneri* (OPPEL), *Linguithyris aspasia* (MENEGH.) and other Late Sinemurian forms. Sinemurian and Pliensbachian Hierlatz Limestone facies rich in brachiopods has sedimented in Estern Alps, Western Carpathians (Siblík, 1964), in Eastern Carpathians (Raileanu and Iordan, 1964), or in Transdanubian Central Range (Vörös, 1986). They have been dominated by *Lobothyris*, *Tetrarhynchia* and *Spiriferina*. Fine clastics of Yugoslavian part of Stara Planina Mts. contain a rich Lower Pliensbachian brachiopod fauna described by Sučić and Protić (1969, 1971, 1985). Outer Dinaride localities also contain some Pliensbachian rhynchonellids and spiriferinids (Čirić, 1949). The oldest Jurassic brachiopod associations of northern Algeria consist of Pliensbachian species *Zeilleria cornuta* (SOW.), *Rhynchonelloidea* cf. *delmensis* (HAAS), *Gibbirhynchia orsini* (GEMM.), *Tauromenia polymorpha* (SEQ.), *Lobothyris subpunctata* (DAV.), *Zeilleria* cf. *identata* (SOW.) and "*Rhynchonella*" cf. *linki* CHOFF. (Tchoumatchenco, 1984). In the Near East, lower part of carbonatic Sargelu Fm. (Iraq) contains some rhynchonellids: "*Rhynchonella*" curviceps Dal Piaz, *Tetrarhynchia* cf. *rosenbuschi* HAAS and PETRI, "*Rhynchonella*" *de lottoi* DAL PIAZ (Dunnington, Wetzel and Norton 1972).

Ager (in Hallam, 1973) supposed the main stock of the Boreal Tetrarhynchiida to be derived from North-Pacific (Japanese) forms, which have migrated during Early Jurassic through north-eastern Siberia to British Columbia, Canada and Europe. However, the evidence is rather poor. Continuous Triassic–Jurassic sections are scarce and, moreover, mostly sterile in brachiopods. In Canada, for instance, the oldest common Jurassic brachiopod fauna is Sinemurian in age (Ager and Westermann, 1963).

In the Western Argentina, Liassic carbonate sandstones overlying a Permo–Triassic volcanogene complex, are very rich in Pliensbachian brachiopods. Some of them: *Spiriferina hartmanni* (ZIETEN), *S. tumida* (BUCH), *S. walcotti* (SOW.), *Homoeorhyncia cynocephala* (RICHARD) indicate slight Tethyan affinity (Volkheimer et al., 1978; Manceñido, 1981). It is noteworthy, that this association contains the first Jurassic biplicate terebratulid *Peristerothyris columbiniformis* MANCEÑIDO.

Brachiopod faunal diversity both in the Boreal and Tethyan Realms raised until Pliensbachian. Faunal exchange during Pliensbachian and Domerian caused faunal homogenization and successive decrease of brachiopod diversity (Vörös et al., 1988).

Summary

1. Late Triassic development of brachiopods has been affected by a world-wide emersion, regression of epicontinental seas and by a reduction of life habitats. Rhaetian brachiopod associations have been characterized by strong opportunism and by rapid migration. As usually, no phyletic relations could be found in fossil record of their history of multiply colonizations and retreats.

2. The environmental conditions at the Rhaetian–Hettangian boundary time were unfavourable for brachiopod development. Deterioration of the climate, support of terrigene clastics along with fresh-water supply and salinity oscillations in shallow seas have caused the absence of brachiopods in the majority of sections. The most complete records of brachiopod evolutionary successions could be probably expected in Southern Mediterranean Subprovince (in Adriatic Block, cf. Fig. 2).

3. Early Jurassic transgression has been followed by rapid colonization of shelves and epicontinental seas by brachiopod faunas, and by accelerated evolution of rhynchonellids and

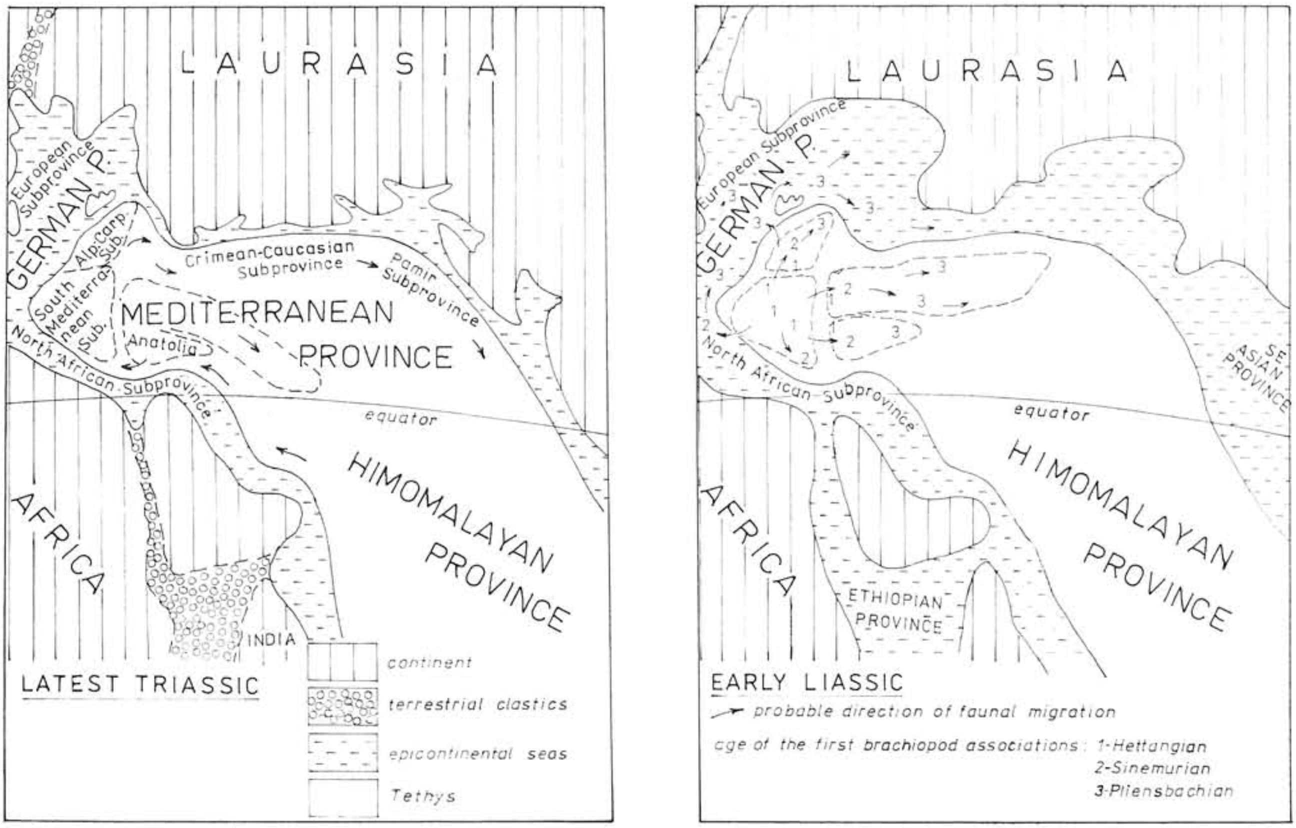

Fig. 2. A scheme of paleobiogeographic division of the Tethyan brachiopod faunas during the latest Triassic and earliest Jurassic with probable directions of their migration.

terebratulids. However, the Triassic ancestors of many Early Jurassic groups, as well as their relations and evolutionary history remain poorly known, yet.

Translated by K. Janáková

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