Jurassic gastropods from Sicily; new data to the classification of Ataphridae (Trochoidea)

J. Szabó, M.A. Conti & S. Monari

J. Szabó, M.A. Conti & S. Monari. Jurassic gastropods from Sicily; new data on the classification of the Ataphridae (Trochoidea). — Scripta Geol., Spec. Issue 2: 407-416, 3 figs., Leiden, December 1993.
J. Szabó, Palaeontological Department, Hungarian Natural History Museum, Múzeum krt. 14-16, Budapest pf. 330, H-1370, Hungary; M.A. Conti, S. Monari, Department of Earth Sciences, University 'La Sapienza', P.le Aldo Moro 5, I-00185 Roma, Italy.

Key words: Jurassic, Tethys, Sicily, Gastropoda, Trochoidea.
Members of Ataphridae became a progressive group in one of the two types of Tethyan faunas. Some of the new forms, which evolved from ataphrid ancestors, can be classified within the family, whilst others show a transitional morphology towards the turbinid subfamily Colloniinae. Other finds suggest a close relationship between Ataphridae and Crossostomatidae.

Contents

Introduction

Detailed palaeontological exploration of poorly known palaeobiogeographical regions frequently results in new evidence leading to modifications in the systematics of certain fossil groups. That is the case with the long known Jurassic 'Mediterranean Province' of the Tethyan Realm, which was established practically on the basis of ammonite faunal data (Neumayr, 1872). Almost each new locality contains unknown gastropod taxa and many of them cannot be accommodated within the existing systematical framework.

The Early to Middle Liassic Mediterranean gastropods are relatively well known but the Late Liassic and younger record is scarce. The pre-Toarcian faunas not only show a strong provincialism in relation to those of the shelves and epicontinental seas of stable Europe but also a palaeobiogeographical inhomogenity of the 'Mediterranean Province' (Szabó, 1980a, 1984, 1988, 1992, in press). Both main Western Tethyan Jurassic environmental complexes, the carbonate platform-reef system (Sicilian Subprovince) and its drowned parts (Alpine Subprovince), have characteristic faunas. To distinguish the two regions from a point of view of their gastropod faunal

composition, Szabó (op. cit.) proposed the above subprovincial names without an exact knowledge about the ratio of the relation between the palaeoecological and the palaeogeographical factors causing the faunal separation. Conti & Monari (1991) suggested that the palaeoenvironmental factors were more important controlling the distribution of some Alpine elements, recognised in the Liassic (Late Sinemurian-Early Pliensbachian) Ammonitico Rosso sediments in the western Pontides (Turkey) belonging to the Sakarya Continent of Sengör & Yilmaz (1981). From the Late Liassic to the latest Jurassic, gastropods are practically unknown from the living Tethyan platform reef regions but some faunas are published from the Alpine Subprovince. The important Alpine gastropod localities, scattered both geographically and stratigraphically, are closely connected to palaeoenvironments on submarine heights which must have provided biotopes. At the recently studied localities the embedding rock is usually a strongly condensed limestone (Wendt, 1968, 1971; Szabó 1979, 1980b, 1981, 1982, 1983; Conti & Fischer, 1981, 1984a, b; Conti & Monari, 1986; Conti & Szabó, 1987; Conti, 1988). A similar lithology can be inferred in many cases of the previously published occurrences (Uhlig, 1878, 1881; Meneghini, 1879; Vacek, 1886 and its revision: Conti & Szabó, 1989; de Gregorio, 1886a, b; Gioli, 1887, 1888; Fucini, 1892; Botto Micca, 1893; Parona, 1894 and its revision: Conti & Fischer, 1983; Greco, 1899). These data indicate the latest Toarcian to Early Aalenian and provide a quite detailed picture of the Bajocian gastropod faunas of the discussed palaeobiogeographical area. The gastropods of Sicily, subject of the present paper, make the picture more complete and allow to draw a new one because the extremely rich and well preserved Lower Toarcian to Lower Oxfordian material fills many gaps in the fossil record.

The authors accept Cox's (in: Knight et al., 1960) classification, including the Ataphridae in the Trochoidea, because this systematic assignment corresponds best with the available knowledge about the members of the family.

Material, locality

The fissure-filling localities of Sicily (Rocca Busambra) and their significance were recognised by Wendt (1963, 1971). A preliminary list of gastropods was also given in Wendt (1971) and a detailed systematic analysis was made of the euomphalid (*Discohelix*, *Pentagonodiscus*) species (Wendt, 1968). The remaining part of the collection (approximately 1100 specimens, belonging to 220 species) was kindly put at the present authors' disposal for study.

Problems to discuss

The long (Early to Middle Jurassic) existence of circumstances causing the gastropod provinciality and the more or less isolated, usually narrow biotopes within the Alpine Subprovince led to the development of numerous new taxa. Some of them allowed or required the discussion of phylogenetic relationships and classification at different taxonomical levels. As an example, we chose the case of the Mesozoic, mainly Jurassic, family Ataphridae (Trochoidea) and related forms. This group consists of genera with perhaps the most featureless shell. The extreme forms in this rather

diverse (46 species) material and a recent trochoidean classification (Hickman & McLean, 1990) raised some important questions.

Recently a new genus, *Zircia* Szabó, 1981, and a forgotten genus, *Adeorbisina* Greco, 1899, were assigned to the Ataphridae (Szabó, 1981). The adult shell of these typically Alpine genera possesses some morphological elements which are lacking from the traditional family diagnoses (the abaxial deviation from normal coiling in *Adeorbisina*, and the subsutural keel in *Zircia*). However, the embryonal and the juvenile shell and the majority of the adult characters were considered adequate to combine them into Ataphridae. The subgenus *Cycloturbo* Conti & Fischer, 1983, having an adult morphology closer to typical ataphrids, seemed to strengthen this supposition in case of *Zircia*. At the same time, the same authors recognised a peculiar type of ornament on *Zircia* (*Zircia*) shells (fine, opisthocline lines crossing the prosocline growth lines of similar strength) which is known in some turbinid genera of the Trochoidea. Therefore the possibility of a turbinid affinity of the gastropods closely related to *Zircia* must also be taken into consideration. A number of other comparable forms in the material from Rocca Busambra enlarge the problem of delimiting Ataphridae from the Turbinidae.

Another recently erected genus, *Mariottia* Conti & Fischer, 1981, which is a close relative or a synonym of the above mentioned *Adeorbisina*, was assigned to the Crossostomatidae. The different opinions about the family accomodation of *Adeorbisina* and *Mariottia* and the excellent possibility provided by the Sicily material, motivate the present authors to elucidate the relation between the Ataphridae and the Crossostomatidae.

Hickman & McLean (1990) assigned *Crossostoma* to Liotiinae (Turbinidae) on the basis of the morphology of the near peristomial frill, which has some characters in common with another genus of the subfamily. This opinion will also be discussed from the point of view of the studied fossil material.

Ataphridae versus Crossostomatidae

The most diffused, traditional interpretations of the Ataphridae and the Crossostomatidae are best demonstrated with Cox's (in Knight et al., 1960) short diagnoses:

Family Ataphridae Cossmann, 1918 — 'Small or small-medium, turbiniform or trochiform, with flat to moderately convex, smooth whorls forming usually cyrtoconoid spire with even outline; shell wall thick; base convex, anomphalous, or possibly cryptomphalous in some forms; aperture orbicular or almost so; columellar lip concave in most forms, meeting parietal lip in uninterrupted curve; callus commonly forming tubercle on columellar lip or semicircular pad partly covering base; operculum and shell structure unknown. Trias - U. Cret.'.

The following genera were included: *Ataphrus* Gabb, 1869 (with three subgenera: *Ataphrus* s.str; *Endianaulax* Cossmann, 1902 and *Plocostylus* Gemmellaro, 1879); *Cirsostylus* Cossmann, 1918; *Trochopsidea* Wenz, 1938; *Lewisiella* Stoliczka, 1868 and ?*Paratataphrus* Dareste de la Chavan, 1954. Other genera (to be discussed here) are: *Zircia* (with the subgenera *Zircia* Szabó, 1981 and *Cycloturbo* Conti & Fischer, 1983), and *Adeorbisina* Greco, 1899.

Family Crossostomatidae Cox, 1960 — 'Rotelliform or low-turbiniform, thick-shel-

led, of smooth, strongly convex whorls; aperture circular, with uninterrupted peristome and outer lip strongly thickened externally. M. Trias (Ladin.) - M. Jur. (Bajoc.)'.

Included were *Crossostoma* Morris & Lycett, 1851 and *Palaeocollonia* Kittl, 1899. Tentatively *Mariottia* Conti & Fischer, 1981 and *Planicollonia* Conti & Monari, 1986 are assigned to this family.

The shells of both families are quite simple and similar to each other, suggesting a closer relationship than that is reflected in the existing gastropod classifications. The only significant difference is the presence of a peristomial modification in the crossostomatid genera. It is a special, backward oriented frill between the suture and the periphery, just before the last peristome in the case of the type species of *Crossostoma*. Other species, bearing a simple varix at a similar position or just at the last peristome and species with trumpet-like last peristome are also included in *Crossostoma*. The latter peristome type is known in *Palaeocollonia*, which has also a moderately broad umbilicus that is the only significant difference from *Crossostoma*. Because the presence or absence of a simple umbilicus does not have a high systematical value (Conti & Szabó, 1987; Hickman & McLean, 1990), *Palaeocollonia* can be regarded as a subgenus of *Crossostoma*. The inner lip of the adult crossostomatid species is simple, usually with a thin callosity and sometimes with a weak inner thickening.

In the Sicilian material, there are some specimens that seem to confirm the assumption of a close relationship between the two families. The specimens belong to a *Crossostoma* species, having an outer varix with a shape and position similar to that of the frill on the type species (Fig. 1). Some of the available specimens died just before reaching the final growth stage, they have an *Ataphrus*-type inner lip with a low tubercle in the columellar region and a shallow excavation below it. On the completely adult specimens, these morphological elements are covered by a callus, that can hardly be distinguished from other parts of the shell. Though the final shape of the near-peristome thickening differs from that of the type species, this observation may be evaluated as an intermediate evolutionary stage between *Ataphrus* and *Crossostoma*. In this case, the correct systematic placement of Crossostomatidae should be within the Trochoidea instead of the Craspedostomatoidea, perhaps as a subfamily of the Ataphridae. Further studies are necessary to decide whether this is

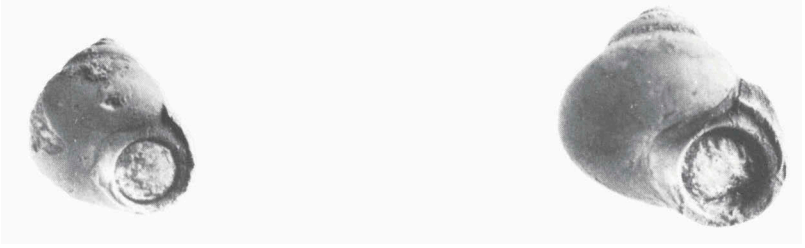

Figure 1. A not completely adult specimen (left, X 2.5) of *Crossostoma* sp. from Rocca Busambra shows inner lip characters of *Ataphrus (Ataphrus)*: a tubercle at the base of the columella and an excavation on the basal lip below the tubercle. They are covered by a callus in the final growth stage (right, X 2.8). The presence of *Ataphrus* characters in this *Crossostoma* species suggests a close phylogenetic relation of these genera and, consequently, a closer systematic place than is reflected in Knight et al. (1960).

the right classification or if we face simply a case of homoeomorphy. The different shapes of the thickening may mean that the species attributed to *Crossostoma* are a polyphyletic group.

The rich material from Sicily also helped to choose a more probable family assignment of the ambiguously evaluated *Adeorbisina-Mariottia* species group that is one of the most important Alpine palaeobiogeographical markers. These species have a characteristic morphological element that is an abaxial deviation from the normal coiling of the last whorl near the adult peristome (Fig. 2). There is another, downward (abapical) kind of deviation that frequently occurs in the species of *Crossostoma*. It is a quite common phenomenon, appearing in many families of all gastropod subclasses, in marine, limnic and terrestrial environments. The *Adeorbisina-Mariottia* deviation is clearly separable from the other type, though functionally they seem to be analogous to each other. With the downward deviation, the gastropods attain a more tangential peristome that gives higher stability for the animal on the substrate (Linsley, 1977). In life position, the well-developed abaxial deviation meant a significant leftward rearrangement of the shell and the visceral mass. Thus the centre of gravity got nearer or just above the midline of the extended foot making the balancing easier and ensuring higher stability.

Within the Sicily collection, an *Ataphrus* (*Ataphrus*) species occurs with a slightly

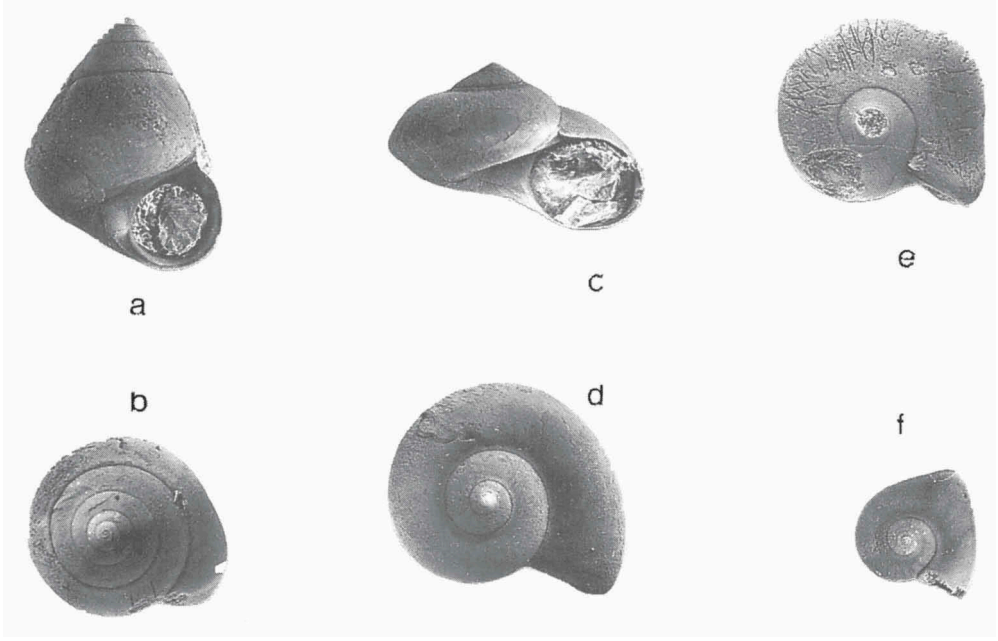

Figure 2. A weak abaxial deviation from the normal coiling near the last peristome of *Ataphrus (Ataphrus)* sp. (a-b) gives a basis to include *Adeorbisina* (c-f) in the Ataphridae. The variability of the abaxial deviation, characterising *Adeorbisina*, is demonstrated by photographs of three species (d-f). Fig. 2c is an apical view of the specimen illustrated in Fig. 2d, showing the differences in the peristome morphology of *Adeorbisina* from that of *Ataphrus*. Magnifications: a-b: X 1.9; c-d: X 1,4; e-f: X 2.1.

visible abaxial deviation (Fig. 2a-b). The inner lip tubercle and the shallow excavation below it make the generic assignment easily possible, because the peristome of the *Adeorbisina-Mariottia* species is simple, similar to that in the first (erroneous) depiction of the type species of *Ataphrus* (*A. crassus* Gabb, 1869). The appearance of the abapical deviation on the above species seems to prove the supposition that the *Adeorbisina-Mariottia* species group belongs to the Ataphridae. However, the case seems to be somewhat more complicate. One of the species has a shape resembling *Crossostoma* (*Palaeocollonia*) with a slight abaxial deviation, so the *Adeorbisina-Mariottia* species group seems to be somehow connected (homeomorphism ?) to the Crossostomatidae, too.

Ataphridae versus Turbinidae

In the collection from Sicily, there are also some additional genera besides *Zircia* that have morphological elements in common with turbinid genera (Fig. 3). One of them is *Bakonyia* Szabó, 1981, that has a shell of *Collonia*-type (low turbiniform shape, rounded peristome, rather broadly phaneromphalous base with strong periumbilical carina) and therefore the author included it in the Colloniinae (Turbinidae). This classification was strengthened by another morphological feature (an opisthocline lineation discussed above in connection with *Zircia*) that was also recently observed in a *Bakonyia* shell. However, this lineation was also discovered on some shells of a species (*Trochopsidea kondai* Szabó, 1981) that fits quite well into a traditional ataphrid genus.

Previously the appearances of these peculiar ornamental elements seemed to be isolated from each other. In the Sicilian material, however a number of specimens were found with transitional morphologies between the ataphrid and the Colloniinae type shells. On the basis of these specimens, a gradual change is postulated from a *Trochopsidea*-like ataphrid ancestor, having a smooth, anomphalous, turbiniform shell with circular aperture and callous inner lip, to a similarly shaped but phaneromphalous shell with a periumbilical carina, terminating in a flat, more or less triangular plane at the basal lip.

The available transitional forms permit to hypothesise more than one possible evolutionary pathway but the trend of change is as follows (Fig. 3):

1) Appearance of *Trochopsidea*(-like) species with well delimited, thick callosity, hiding a narrow umbilicus; ornament consisting of growth lines, appearance of some spiral lines and opisthocline lineation.

2) Detachment of the callous inner lip part from the parietal region; the downward shifted callus generates an angulation or a carina around a narrow umbilicus.

3) Formation of a definite and wide umbilicus, surrounded by a strong carina (*Bakonyia* stage).

The above trend can be demonstrated by the following lineage (see also Fig. 3): *Trochopsidea* s.s., *T. kondai*, *Zircia* (*Cycloturbo*), *Zircia* (*Zircia*), *Zircia* ? (unpublished, *Zircia* shape but with *Bakonyia* type umbilicus), and *Bakonyia*. However, there are also shells indicating different but sometimes parallel evolutionary lines. There are specimens with a *Zircia*-like shape with downward shifted callus, generating an angulation on the base but without umbilicus. At the same time some umbilicate forms show existence of additional colloniform species and genera, somewhat different from *Bakonyia*.

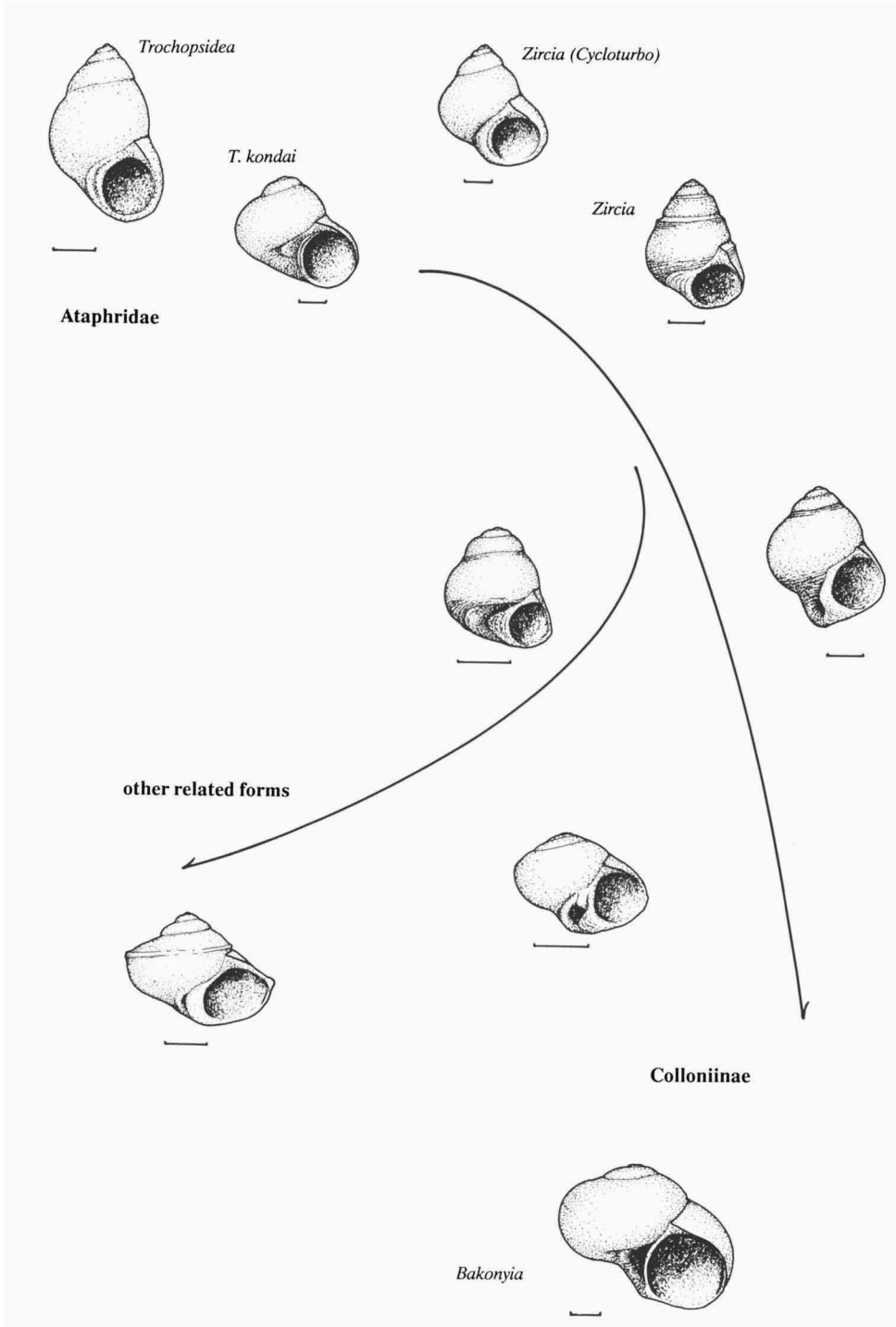

Figure 3. Morphological transition between shells of Ataphridae (Trochoidea) and Colloniinae (Turbinidae). Unnamed forms have not yet been published. Scale bars = 2 mm.

Conclusion

The high number of the recently recognised Ataphridae-related forms show that this family had a substantial share in the Alpine-type Tethyan gastropod faunas. Some of the new forms can be classified within the Ataphridae after some slight modification in the family definition (members of the diverse *Mariottia-Adeorbisina* group may require the erection of a new subfamily). The morphology of others can be evaluated as transitional toward other families. From this latter group the species with *Ataphrus*-like juvenile and *Crossostoma*-like adult peristome and the *Palaeocollonia*-like species with an abaxial deviation may be cases of homoeomorphy and both Ataphridae and Crossostomatidae can be regarded as independent families. However, a revision of the distinctive character (peristomial thickening) may bring the two families closer to each other. Both a subfamily status for the Crossostomatidae within the Ataphridae and the unification of the two families are feasible. Anyway, the authors consider a systematical placement of the Crossostomatidae within the Trochoidea most likely. The turbinid relation is quite evident but a systematical placement within the Liotiinae, as proposed by Hickman & McLean (1990), seems less likely given the lack of the strong ornament which characterises this subfamily according to Keen (in: Knight et al., 1960).

The other transitional forms discussed seem to document the derivation of a turbinid subfamily, the Colloniinae, from the Ataphridae (Fig. 3). If this conclusion is correct, many other relation and classification possibilities are to be checked or elucidated: are ataphrids the ancestors of other turbinids as well? If not, is the Turbinidae a polyphyletic family or are ataphrids actually also members of the Turbinidae? The answers to these questions need further studies on pre-Jurassic faunas also. On the basis of the Jurassic faunas, the Ataphridae is a quite well-defined family, disregarding the delimitation problems discussed above. However, if a set of morphological features are chosen in the case of the transitional forms toward the Colloniinae, the most important separation problem could be solved. One possibility is to regard those genera as members of the Colloniinae which possess two joint characters, a phaneromphalous base with periumbilical cord or carina.

Because a significant part of the available material originated from condensed beds, the precise stratigraphical dating has not yet been completed; therefore many details may have to be modified later. That is the main reason why most of the conclusions are uncertain. In spite of this, the authors intended to demonstrate the significance of Wendt's collection from Sicily with this preliminary account and to call attention to the importance of the systematical information, hidden in less explored regions.

Acknowledgements

M.A. Conti's participation in the preparation of this paper was granted by the MURST (60%).

References

Botto Micca, L., 1893. Fossili degli 'Strati a *Lioceras opalinum* Rein. e *Ludwigia murchisonae* Sow.' della

Croce di Valpore. — Boll. Soc. Geol. Ital., 12: 143-194.

Conti, M.A., 1988. Some Middle Jurassic gastropods from Veneto area (Northern Italy). — Mem. Soc. Geol., 40: 185-193.

Conti, M.A., & J.C. Fischer, 1981. Preliminary notes on the Aalenian gasteropods of Case Canepine (Umbria, Italy). In: A. Farinacci & S. Elmi (eds). Proceedings 'Rosso Ammonitico Symposium', Roma 16-21 June 1980: 137-145.

Conti, M.A., & J.C. Fischer, 1983. Revisione della fauna mesogiurassica di Acque Fredde (Lago di Garda) descritta da Parona, 1894. — Boll. Mus. Civ. St. Nat. Verona, 9 (1982): 489-522.

Conti, M.A., & J.C. Fischer, 1984a. La faune à gastropodes du Jurassiques moyen de Case Canepine (Umbria, Italie). Sistématique, paléobiogéographie, paléoécologie. — Geol. Romana, 21 (1982): 125-183.

Conti, M.A., & J.C. Fischer, 1984b. Gasteropodi Bajociani: ecologia e paleobiogeografia. — Geol. Romana, 21 (1982): 879-884.

Conti, M.A., & S. Monari, 1986. A Middle Jurassic bivalve and gastropod fauna from Umbria (Central Italy). — Geol. Romana, 23 (1984) 175-209.

Conti, M.A., & S. Monari, 1991. Bivalve and gastropod fauna from the Liassic Ammonitico Rosso facies in the Bilecik Area (Western Pontides, Turkey). — Geol. Romana, 27: 245-301.

Conti, M.A., & J. Szabó, 1987. Comparison of Bajocian gastropod faunas from the Bakony Mts. (Hungary) and Umbria (Italy). — Ann. hist.-nat. Mus. natn. hung., 79: 43-59.

Conti, M.A., & J. Szabó, 1989. A revision of the Jurassic gastropod fauna from Cape San Vigilio (S-Alps, Italy), published by M. Vacek (1886). — Frag. Min. Palaeont., 14: 29-40.

Fucini, A., 1892. Nuovi fossili della Oolite inferiore del Capo San Vigilio sul Lago di Garda. — Boll. Soc. Malac. Ital., 18: 118-138.

Gioli, G., 1887. Fossili della Oolite di San Vigilio. — Atti Soc. Tosc. Sc. Nat., Proc. Verb. 1887: 195-196.

Gioli, G., 1888. Fossili dell'Oolite Inferiore di San Vigilio e di Monte Grappa. — Atti Soc. Tosc. Sc. Nat., Mem., 10: 3-18.

Greco, B., 1899. Fauna della zona a Lioceras opalinum Rein. sp. di Rossano in Calabria. — Paleontogr. Ital., 4 (1898): 93-139.

Gregorio, A. de, 1886a. Monographie des fossiles de Valpore (Mont Grappa) du sous-horizon Grappin De Gregorio. — Ann. Geol. Paleont., 2: 1-20.

Gregorio, A. de, 1886b. Monographie des fossiles de Ghelpa du sous-horizon Ghelpin De Gregorio. — Ann. Geol. Paleont., 2: 1-28.

Hickman, C., & J.H. McLean, 1990. Systematic revision and suprageneric classification of trochacean gastropods. — Nat. Hist. Mus. Los Angeles County, Sc. Ser., 35: 1-169.

Knight, J.B., L.R. Cox., A. Myra Keen, A.G. Smith, R.L. Batten, E.L. Yochelson, N.H. Ludbrook, R. Robertson, C.M. Yonge & R.C. Moore, 1960. Treatise on invertebrate paleontology, 1. Mollusca, 1. — Geol. Soc. Am. & Univ. Kansas, Boulder, Col.: i-xvii, 1-315.

Linsley, R.M., 1977. Some 'laws' of gastropod shell form. — Paleobiology, 3: 196-206.

Meneghini, G., 1879. Fossili oolitici di San Vigilio. — Atti Soc. Tosc. Sc. Nat., Proc. Verb. 1879: 70-71.

Neumayr, M., 1872. Ueber Jura-Provinzen. — Verhandl. k. k. Geol. Reichanst., 3: 54-57.

Parona, C.F., 1894. La fauna fossile (Calloviana) di Acque Fredde sulla sponda veronese del Lago di Garda. — Mem. R. Acc. Lincei, 4, 7: 364-396.

Sengör, A.M.C., & Y. Yilmaz, 1981. Tethyan evolution of Turkey: a plate tectonic approach. — Tectonophysics, 75: 181-241.

Szabó, J., 1979. Lower and Middle Jurassic gastropods from the Bakony Mountains (Hungary), 1. Euomphalidae (Archaeogastropoda). — Ann. hist.-nat. Mus. natn. hung., 71: 15-31.

Szabó, J., 1980a. Liassic and Dogger gastropod zoogeography in the western part of the Tethys. —

Földt. Közl., 110: 382-394 (in Hungarian, with English abstr.).

Szabó, J., 1980b. Lower and Middle Jurassic gastropods from the Bakony Mountains (Hungary), 2. Pleurotomariacea and Fissurellacea (Archaeogastropoda). — Ann. hist.-nat. Mus. natn. hung., 72: 49-71.

Szabó, J., 1981. Lower and Middle Jurassic gastropods from the Bakony Mountains (Hungary), 3. Patellacea and Trochacea (Archaeogastropoda). — Ann. hist.-nat. Mus. natn. hung., 73: 55-67.

Szabó, J., 1982. Lower and Middle Jurassic gastropods from the Bakony Mountains (Hungary), 4. Neritacea, Craspedostomatacea, Amberleyacea (Archaeogastropoda). — Ann. hist.-nat. Mus. natn. hung., 74: 17-33.

Szabó, J., 1983. Lower and Middle Jurassic Gastropods from the Bakony Mountains (Hungary), 5. Supplement to Archaeogastropoda; Caenogastropoda. — Ann. hist.-nat. Mus. natn. hung., 75: 27-46.

Szabó, J., 1984. Stratigraphical studies on Lower and Middle Jurassic gastropods from the Bakony Mountains, Hungary. In: O. Michelson & A. Zeiss (eds). International Symposium on Jurassic Stratigraphy, Erlangen, September 1-8, 1984. — Geol. Surv. Denm., Copenhagen: 848-862.

Szabó, J., 1988. Pliensbachian and Bajocian Gastropods. In: M. Rakus, J. Dercourt & A.E.M. Nairn (eds.). Evolution of the northern margin of Tethys: the results of IGCP Project 198. — Mém. Soc. Géol. Fr., N.S., 154, 3: 25-33.

Szabó, J., 1992. Phylogeny of gastropods in the Jurassic Tethys. In: C. Meier-Brook (ed.). Proceedings of the X International Malacological Congress, Tübingen 1989. — Unitas Malacol., Tübingen: 511-514.

Szabó, J., in press. Tethyan Jurassic gastropod provinciality and some paleogeographical implications. 3rd Intern. Congr. Jurassic Stratigraphy. — Géobios, Spec. Vol.

Uhlig, V., 1878. Beiträge zur Kentniss der Juraformation in der Karpatischen Klippen. — Jahrb. k.k. Geol. Reichsanst, 28: 641-658.

Uhlig, V., 1881. Ueber die Fauna des rothen Kellowaykalkes des penninischen Klippe Babierzówka bei Neumarkt in West-Galizien. — Jahrb. k.k. Geol. Reichsanst., 31: 381-422.

Vacek, M., 1886. Über die Fauna der Oolithe von Cap S. Vigilio. — Abhandl. k.k. Geol. Reichsanst., 12: 57-212.

Wendt, J., 1963. Stratigraphisch-paläontologische Untersuchungen im Dogger Westsiziliens. — Boll. Soc. Paleont. Ital., 2, 1: 57-145.

Wendt, J., 1968. *Discohelix* (Archaeogastropoda, Euomphalacea) as an index fossil in the Tethyan Jurassic. — Palaeontology, 11: 554-575.

Wendt, J., 1971. Genese und Fauna submariner sedimentärer Spaltenfüllungen im Mediterranen Jura. — Palaeontographica, A, 136: 121-192.

Manuscript received 3 September 1992, revised version accepted 23 April 1993