

## A LATE TRIASSIC OSTRACOD ASSEMBLAGE FROM THE QUATTERVALS NAPPE (AUSTROALPINE, NORTHERN ITALY)

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**Riassunto.** La successione norica della Falda Quattervals (Austroalpino Centrale, Italia settentrionale) registra una evoluzione stratigrafica da facies di piattaforma carbonatica di mare basso soggetta a fenomeni di dolomitizzazione precoce (Dolomia Principale-Hauptdolomit) verso facies di transizione (Formazione di Pra Grata), rappresentate da alternanze di dolomie e calcari scuri e breccie dolomitiche di pendio. La successione evolve, poi, verso facies di bacino intrapiattaforma (Calcare di Quattervals), rappresentate da calcari scuri con subordinate intercalazioni di breccie contenenti clasti con facies di piattaforma e livelli paraconglomerati.

Le facies bacinali e transizionali consistono prevalentemente di materiale risedimentato dalla piattaforma; sono, inoltre, presenti livelli di materiale detritico fine e orizzonti microbialitici.

Le facies bacinali contengono abbondante materiale bioclastico, all'interno del quale è stato possibile riconoscere un'interessante associazione ad ostracodi, costituita da numerosi individui appartenenti a poche specie, che denota condizioni ambientali poco favorevoli caratterizzate da variazioni di salinità e scarsa ossigenazione. Nonostante la intensa tettonica alpina e la diffusa ricristallizzazione, l'analisi del materiale raccolto alla base del Calcare di Quattervals, ha permesso di identificare, insieme a forme già note, le due nuove specie di ostracodi *Rhombocythere dimorphica* e *Kerocythere quattervalsi*.

**Abstract.** The up to 1200 m thick Norian succession of the Quattervals Nappe (Central Austroalpine, Italy) documents a tectonically-driven passage from intertidal facies (Dolomia Principale-Hauptdolomit), represented by early-dolomitized bedded to massive gray dolostones, to intraplatform basin sediments (Pra Grata Formation and Quattervals Limestone), consisting of resedimented dark limestones and thin bedded laminated limestones, alternating (mainly in the Pra Grata Formation) with intraformational breccias containing abundant shallow-water facies. The transitional and basinal facies contain an interesting ostracod assemblage, beside bioclastic layers containing shallow-water and upper slope skeletal grains. The ostracod fauna is rich in specimens belonging to few genera, denoting restricted environmental conditions characterized by variations of salinity and low oxygenation. Despite the intense deformation and recrystallization related to the Alpine tectonics, the paleontological analysis of the ostracod assemblage from the base of the Quattervals Limestone, allowed the identification of the two new species of ostracods *Rhombocythere dimorphica* and *Kerocythere quattervalsi* in association with other already known forms.

### Introduction and geological setting.

Despite the strong recrystallization related to the Alpine tectonics, an interesting ostracod assemblage has been found in the Norian carbonates of the Quattervals Nappe (Upper Austroalpine, Eastern Lombardy, Italy; Fig. 1).

The sedimentary succession of the Quattervals Nappe is exclusively represented by a Late Triassic (mainly Norian) up to 1200 metres thick carbonate succession (Hess, 1953; Somm, 1965; Berra, 1995) (Fig. 2). The lower formation of the Quattervals Nappe is represented by dolomitized inner carbonate platform facies referred to the Dolomia Principale-Hauptdolomit. This formation passes upwards to the Pra Grata Formation (Hess, 1953), characterised by alternations of limestones and dolostones. Upwards, it is covered by the well-bedded dark limestones of the basinal Quattervals Limestones, having at the top about 60 metres of marls (Crappa Mala Beds; Furrer, 1983). Above, a recovery of shallow-water carbonate platform is documented by the Murter Dolomite (Furrer, 1983). The top of the Norian succession is represented by subtidal facies belonging to the Murter Plattenkalk.

The stratigraphic boundary to the overlying Rhaetian Kossen Formation was documented by Somm (1965) both in the Quattervals Nappe and Terza Unit.

### Stratigraphy.

In the studied area, only the lower part of the Quattervals Nappe succession is preserved, from Hauptdolomit to the upper Quattervals Limestone. The thickness of the Hauptdolomit, whose base is lacking, is about 400-500 m and it is mainly represented by irregu-

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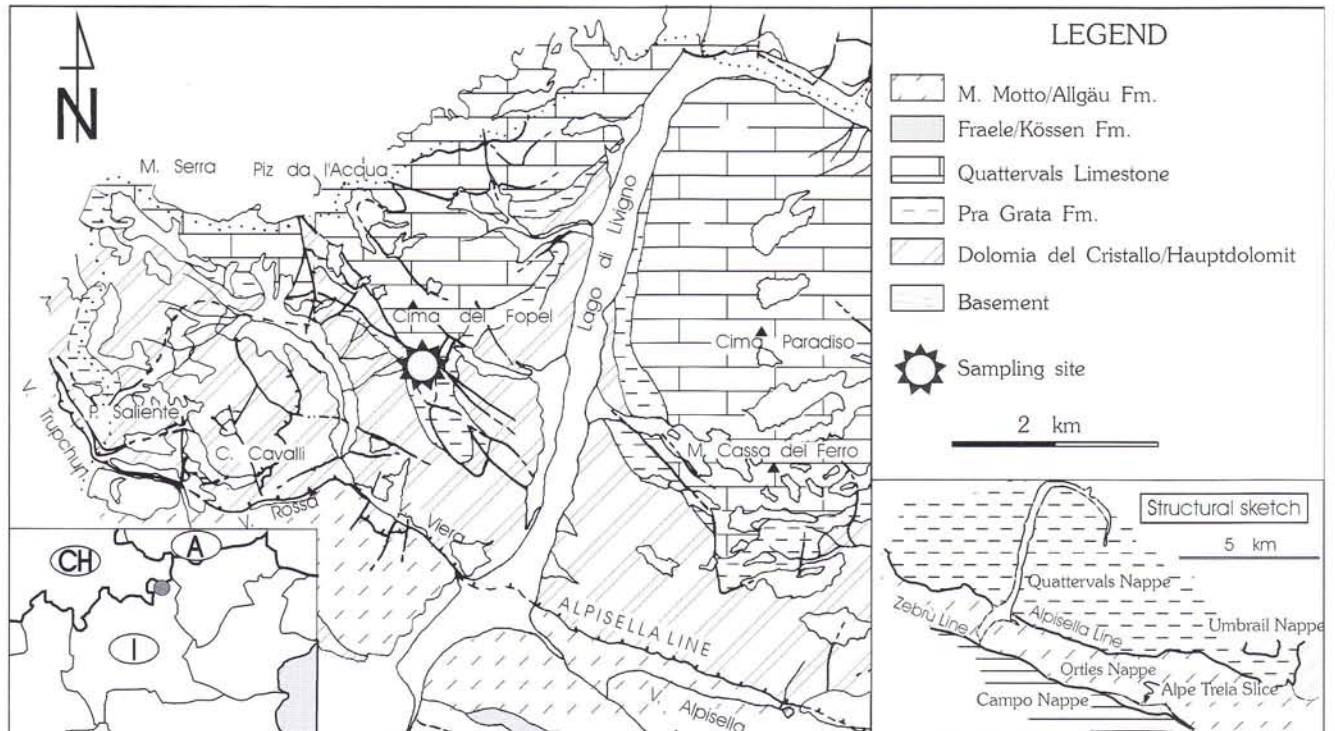


Fig. 1 - Geological map with the location of the position of the sampling site. The structural sketch refers to an area slightly larger than that of the geological map.

lar cyclic alternations of fine grained dark-grey dolostones and doloarenites, both in centimetric and plurimetric layers, with locally intraformational breccias (Somm, 1965; Berra, 1995). Doloarenites mainly consist of often normal grading intraclastic packstones, rarely bioclastic or oolitic; ripples and cross laminations, locally burrowed, are also frequent. Stromatolitic horizons (up to more than 1 m thick) are also common. Emersions are documented by mud cracks, authigenic evaporitic crystals and fenestral fabric. In the upper Hauptdolomit, the occurrence of sedimentary dykes and breccia bodies documents the beginning of the tectonically induced platform drowning leading to the development of the Quattervals Basin (Berra, 1995).

The Hauptdolomit of the Quattervals Nappe was deposited in a shallow water basin under low dysoxic conditions with local and short-term emersions. Bioclasts are represented by pelecypods and gastropods and rarely by dasycladacean algae and foraminifera.

The overlying Pra Grata Formation whose thickness increases from 30 to 200 m southwards (Berra, 1995) is characterised by irregular alternations of limestones and dolostones. Their abundance varies along the succession: dolostones prevails at the base, while limestones become more important toward the top. Limestones consist of fine grained, bioclastic, commonly thin bedded calcarenites, often with millimetric marly horizons. Locally slumps are present. In the upper part, intercalations of paraconglomerate beds up to 3 metres thick often occur. The dolostones consist of generally

light-gray chaotic breccia bodies (up to 10 m thick) sometimes amalgamated, containing carbonate platform derived clasts. Centimetric to decimetric doloarenite beds are common. Alternations of dolostones and limestones are indicative of the existence of an adjacent submerging carbonate platform of Dolomia Principale-Hauptdolomit. Muds and fine calcarenites were exported by currents or storms from the surrounding carbonate platform, as documented by microfacies often rich in platform-derived shallow water allochems. Dolomitic breccias were directly derived from the dismantling of dolomitised and lithified carbonate platform facies, probably exposed along scarps (Berra, 1995). The large number of breccia bodies and the occurrence of slumps indicate that Pra Grata Formation deposition occurred on a developing slope. Both the lower and upper limits of the formation are transitional.

The Quattervals Limestone (600-650 m thick) is almost entirely represented by dark, bedded mudstones and wackestones, with marly joints and frequent intercalations of graded packstones yielding platform-derived grains (Somm, 1965; Berra, 1995). Paraconglomerate in up to 4m thick beds, and more rarely breccias, are intercalated. The upper limit with the Crappa Mala Beds (Obere Mergel; Somm, 1965) has not been observed in the studied area. The Quattervals Limestones were not deposited on perfectly flat-lying sea-bottoms: slumps, overfolds and slump scars document deposition on a low-angle slope. Microfacies analysis showed two genetically different deposits: intraclastic-bioclastic lime-

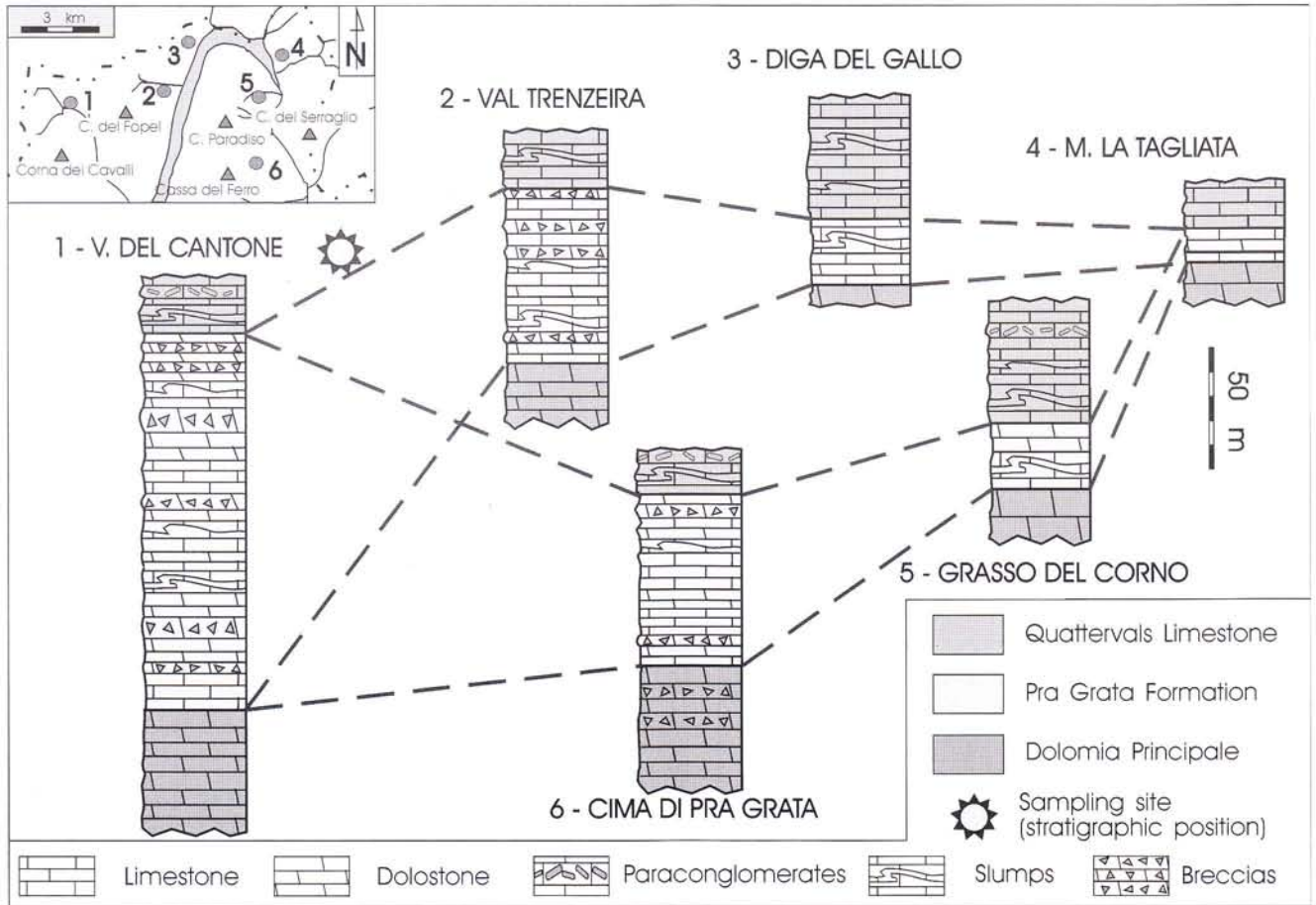


Fig. 2 - Simplified stratigraphic section of the Quattervals Nappe succession (modified after Berra, 1995). The star indicates the approximate stratigraphic position of the studied ostracod assemblage, located between section 1 and 2.

stones directly derived from sedimentation of platform material and limestones derived from decantation of fine grained material and represented by mudstones and fine-grained wackestones. Small foraminifers, sponge spicules, rare ammonoids and calcified radiolarians are present. The dark colour of the sediments and the absence of bioturbation document unfavourable conditions for the development of diversified benthic communities on the bottom of the Quattervals Basin.

The evolution of the stratigraphic succession allows reconstruction of an asymmetric intraplatform basin controlled by syndepositional extensional tectonics, with a north-south width of at least about 8 km and an east-west width of some tens of km (Berra, 1995). The sedimentary input was twofold, with breccias mainly from southern high and limestones from sweeping of the two margins. The southern margin of the basin was tectonically-controlled, whereas the northern was a flexural-type margin: the depocentre was asymmetric, and situated near the southern margin (Berra, 1995).

Facies analysis demonstrates that the Quattervals Basin was a partly isolated sea-way; water exchanges with a wider marine basin occurred only for the surface water, while the bottom conditions were dysoxic to anoxic.

**Palaeontology.**

Despite the intense and polyphasic alpine tectonics and the strong recrystallisation locally destroying the original features of the sediments, ostracods occurrence has been documented in all the three formations considered here. Ostracods are particularly abundant in the fine-grained calcareous facies of the Pra Grata Formation and Quattervals Limestone, generally associated with rare specimens of Norian-Rhaetian foraminifers referable to *Gandinella falsofriedli* (Salaj, Borza & Samuel). The present paper is focused on a rich ostracod assemblage from a calcareous outcrop stratigraphically referred to the Pra Grata Formation (coord. Gauss Boaga 1588, 510-5159, 250). The assemblage has been recorded from well-bedded black limestones consisting of recrystallised packstones-wackestones.

The ostracod-bearing facies are mainly represented by dark resedimented fine-grained calcarenites and by dark microbialites, where ostracods are trapped between the organic laminae. The sedimentological features indicate that the ostracods probably lived within the microbialitic mats, which developed in subtidal conditions on low-oxygenated bottoms.

The studied assemblages come from samples consisting of microbilaites or fine-grained limestones (packstones). Bioclasts are generally rare and the material is poorly preserved; most of the specimens are internal molds and of course the external ornamentation is often damaged or even missing. Nevertheless, this fauna is notable by the fact that the preservation in such a series is exceptional and it is the first description of ostracods in this area of this age.

This assemblage is characterised by a low number of species (5) belonging to 5 genera and the abundance of specimens belonging to one species (i.e. almost 150 specimens of *Kerocythere quattervalsi* n.sp.).

### Systematic Palaeontology

Subclass *Ostracoda* Latreille, 1806

Order *Podocopida* Müller, 1894

Suborder *Podocopina* Sars, 1866

Superfamily *Bairdiacea* Sars, 1888

Famille *Bairdiidae* Sars, 1888

Genus *Lobobairdia* Kollmann, 1963

Type species. *Lobobairdia salinaria* Kollmann, 1963

#### *Lobobairdia* sp. A

Pl. 1, fig. 1

**Material.** One complete carapace.

**Description.** A species of the genus *Lobobairdia* Kollmann, 1963 with the maximum height located in the first third of length. This specimen is close to *Lobobairdia* cf. *salinaria* Kollmann 1963 *sensu* Crasquin-Soleau &

Dépêche (1993) from the Middle Rhaetian of the ODP leg122-761C (NW of Australia). It could be referred to the same species, but the preservation is poor and does not allow observation of the ornamentation.

**Horizon and locality.** Hauptdolomit of the Quattervals Nappe, Eastern Lombardy, Italy; Norian.

#### Genus *Hungarella* Méhes, 1911

Type species. *Bairdia? problematica* Méhes, 1911

#### *Hungarella?* sp. A

Pl. 1, fig. 2-3

**Material.** Five complete carapaces.

**Description.** A species tentatively assigned to the genus *Hungarella* Méhes, 1911. The posterior border has a small radius of convexity and the maximum height is located in front of mid-length. The extremities are laterally compressed and the maximum width is located in the ventral part of the carapace. The exact taxonomic determination is made difficult by the bad preservation of the specimens recorded.

**Horizon and locality.** Hauptdolomit of the Quattervals Nappe, Eastern Lombardy, Italy; Norian.

Superfamily *Cytheracea* Baird, 1850

Family *Brachycytheridae* Puri, 1954

#### Genus *Rhombocythere* Anderson, 1964

Type species. *Rhombocythere wicheri* Anderson, 1964

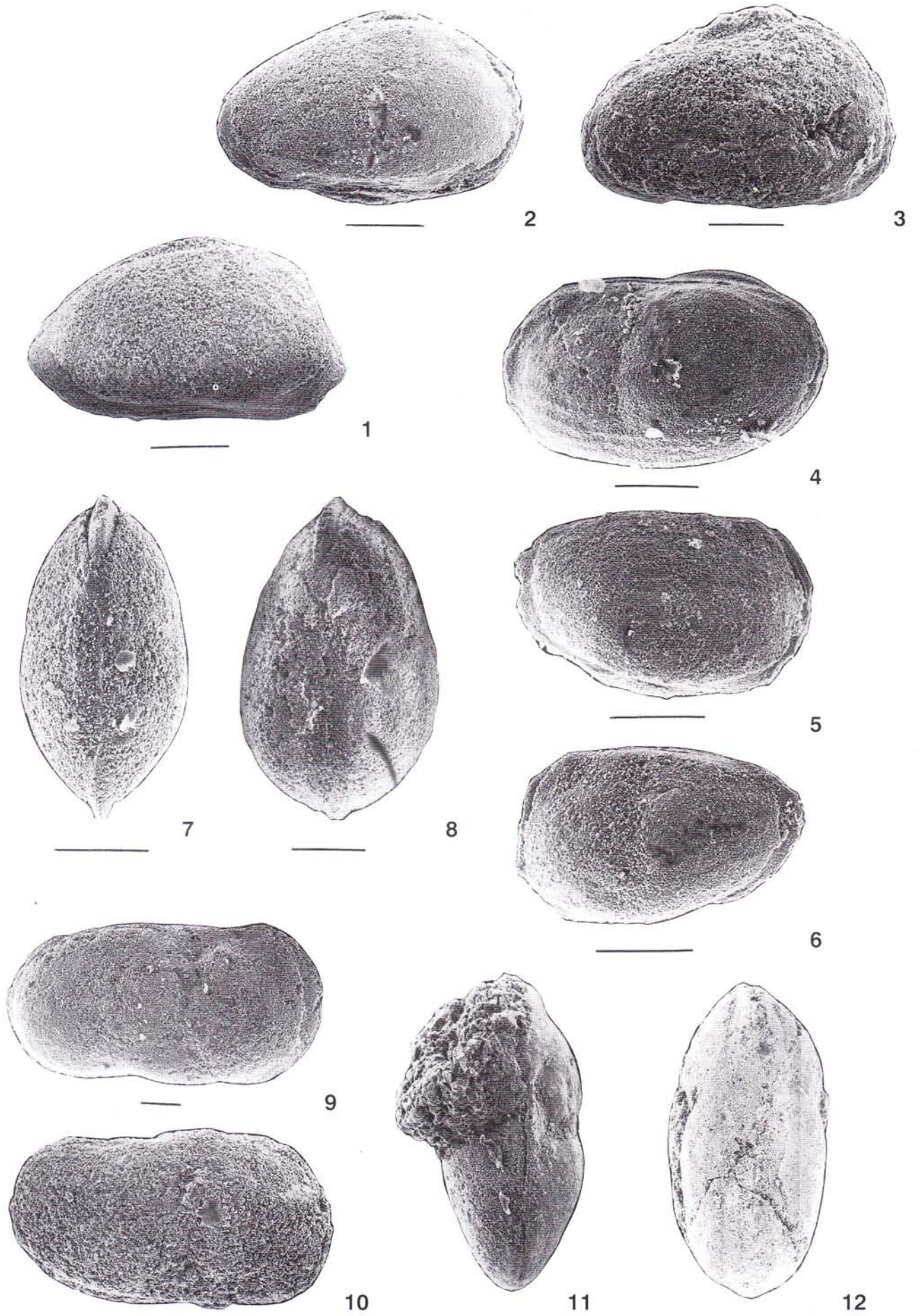
#### *Rhombocythere dimorphica* n.sp.

Pl. 1, fig. 4-8

### PLATE 1

Scale bar is 100µm. All specimens from the sample J137, Hauptdolomit of the Quattervals Nappe, Eastern Lombardy, Italy; Norian.

- Fig. 1 - *Lobobairdia* sp. A. N° collection: P6M1413, carapace, right lateral view.  
 Figs. 2 - 3 - *Hungarella?* sp. A  
 Fig. 2 - N° collection: P6M1414, carapace, right lateral view.  
 Fig. 3 - N° collection: P6M1415, carapace, right lateral view.  
 Figs. 4-8 - *Rhombocythere dimorphica* n.sp.  
 Fig. 4 - Holotype, N° collection: P6M1416, left lateral view of a female carapace.  
 Fig. 5 - Paratype, N° collection: P6M1417, right lateral view of a male carapace.  
 Fig. 6 - N° collection: P6M1418, left lateral view of a male carapace.  
 Fig. 7 - N° collection: P6M1419, dorsal view of a male carapace.  
 Fig. 8 - N° collection: P6M1420, dorsal view of a female carapace.  
 Figs. 9-12 - *?Lutkevichinella keupera* (Will, 1969)  
 Fig. 9 - N° collection: P6M1421, carapace, right lateral view.  
 Fig. 10 - N° collection: P6M1422, carapace, right lateral view.  
 Fig. 11 - N° collection: P6M1423, carapace, dorsal view.  
 Fig. 12 - N° collection: P6M1424, carapace, ventral view.



Derivation of name. From "dimorphic" in reference to the observed sexual dimorphism.

**Holotype.** One complete female carapace figured pl. 1, fig. 4, collection number: P6M1416.

**Paratype.** One complete male carapace figured pl. 1, fig. 5, collection number: P6M1417.

**Type locality.** Eastern slope of Cima del Fopel, q. 2520 a.s.l., coord. Gauss-Boaga 1588,510-5159,250.

**Type-level.** Sample J137, lower Quaternals Formation.

**Material.** 39 complete carapaces.

**Diagnosis.** A species of the genus *Rhombocythere* Anderson, 1964 with broadly rounded posterior border, strongly compressed extremities and presenting sexual dimorphism.

**Description.** Dorsal border long and straight to gently arched. Anterior cardinal angle from 130° to 160° in female. Anterior border with large radius of convexity; maximum of convexity located a little under mid-height. Ventral border arched, ventral margin carinate. Posterior border rounded. Anterior and posterior borders strongly, laterally compressed. Maximum width located behind mid-length. Sexual dimorphism has been observed: females have the posterior part of the carapace strongly inflated and characterized by a depression in front of the brood chamber which passes the dorsal margin. Some ridges are present in the ventral part of the carapace, parallel to the ventral border.

**Remarks.** The new species is herein included in the genus *Rhombocythere* even though the sexual dimorphism has never been described in any species belonging to this genus. The specimens recorded in the Quaternals Limestone show a good preservation state.

**Size.** L= 0.33-0.44mm; H= 0.20-0.24mm; E= 0.17-0.29mm

**Stratigraphic and geographic distribution.** Late Triassic (Norian), Hauptdolomit of the Quaternals Nappe, Eastern Lombardy, Italy.

Family *Glorianellidae* Schneider, 1960,  
emend. Kozur, 1970

Genus *Lutkevichinella* Schneider, 1956,  
emend. Kozur, 1968

Type species. *Lutkevichinella bruttanae* Schneider, 1956

?*Lutkevichinella keupera* (Will, 1969)

Pl. 1, fig. 9-12

1969 *Limnocythere keupera* n.sp. Will, p. 56-59, pl. 1, fig. 3-4.

1970 *Albacythere* ? n.sp. - Kozur & Nicklas, p. 312, pl. 3, fig. 2.

1972 *Lutkevichinella keupera* (Will, 1969) - Urlichs, p. 679-680, pl. 3, fig. 1-5.

**Material.** Eleven carapaces.

**Remarks.** The poorly preserved specimens have been tentatively attributed to *Lutkevichinella keupera* (Will, 1969) a Norian-Rhaetian species of Germany and Denmark.

**Distribution.** Hauptdolomit of the Quaternals Nappe, Eastern Lombardy, Italy, Norian.

Family *Kerocytheridae* Kozur, 1971

Genus *Kerocythere* Kozur & Nicklas, 1970

Type species *Kerocythere raiblana* (Gümbel, 1869)

*Kerocythere quaternalsi* n.sp.

Pl. 2, fig. 1-10

**Derivation of name.** From the "Quaternals Nappe", Eastern Lombardy, Italy, locus typicus.

**Holotype.** One complete male carapace figured pl. 2, fig. 1, collection number: P6M1425.

**Paratypes.** Two complete female carapaces figured pl. 2, fig. 2, collection number: P6M1426, and pl. 2, fig. 3, collection number: P6M1427.

**Type locality.** Eastern slope of Cima del Fopel, q. 2520 a.s.l., coord. Gauss-Boaga 1588,510-5159,250.

**Type-level.** Sample J137, lower Quaternals Formation.

**Material.** 137 complete carapaces and numerous fragments.

## PLATE 2

Scale bar is 100µm. All specimens from the sample J137, Hauptdolomit of the Quaternals Nappe, Eastern Lombardy, Italy; Norian.

Figs. 1-10 - *Kerocythere quaternalsi* n.sp.

Fig. 1 - Holotype. N° collection: P6M1425, right lateral view of a male carapace.

Fig. 2 - Paratype. N° collection: P6M1426, left lateral view of a female carapace.

Fig. 3 - Paratype. N° collection: P6M1427, right lateral view of a female carapace.

Fig. 4 - N° collection: P6M1428, left lateral view of a female carapace.

Fig. 5 - N° collection: P6M1429, left lateral view of a male carapace.

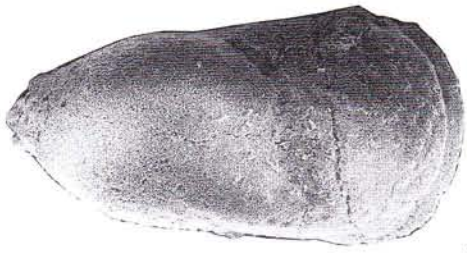
Fig. 6 - N° collection: P6M1430, left lateral view of a male carapace.

Fig. 7 - N° collection: P6M1431, left lateral view of a male carapace.

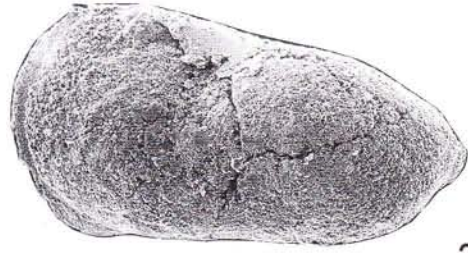
Fig. 8 - N° collection: P6M1432, dorsal view of a male carapace.

Fig. 9 - N° collection: P6M1433, ventral view of a female carapace.

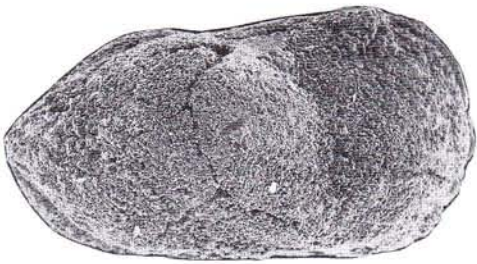
Fig. 10 - N° collection: P6M1434, dorsal view of a female carapace.



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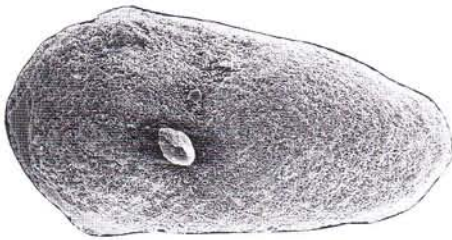
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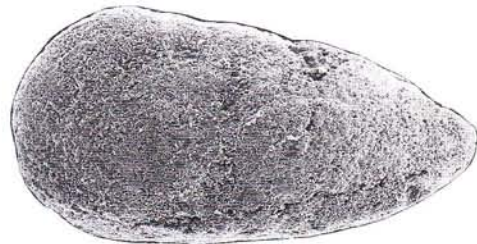
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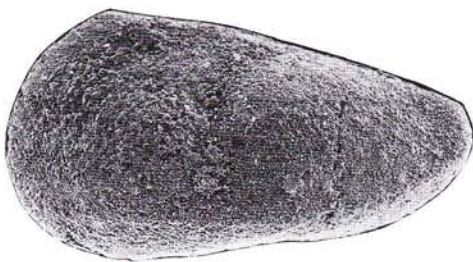
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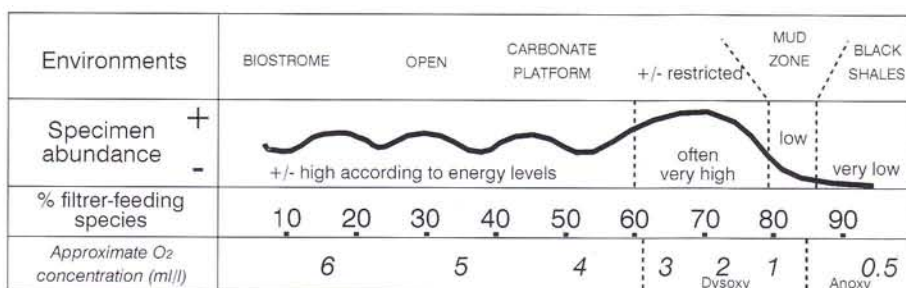


Fig. 3 - Filter-feeder species rate (benthic ostracods) and estimated oxygen concentration (from Lethiers & Whatley, 1995).

**Diagnosis.** A species of the genus *Kerocythere* Kozur & Nicklas, 1970 without ridges, with large anterior border and the ventral part of the carapace flat.

**Description.** Dorsal margin long and straight; posterior border with a small radius of convexity; ventral margin straight and long, anterior margin with a large radius of convexity; maximum height located at anterior cardinal angle; anterior and posterior parts of the carapace are laterally compressed; left valve overlaps right valve on all the free margins with a maximum at anterior and postero-ventral borders; caudal process present (rarely well preserved); presence of ocular tubercle located near anterior cardinal angle or a little bit behind; carapace is flat in the ventral part; a sulcus is located in front of mid-length and in the upper half of height; dorsal view biconvex with the sulcus well developed; surface granulo-reticulate only probably in the anterior part of the carapace; hinge line straight.

Sexual dimorphism well expressed:

female (heteromorph): the carapace is strongly inflated in the posterior half; the sulcus is deeper; the brood chamber goes over the dorsal margin in the posterior part of the carapace.

male and juveniles (tecomorphs): sulcus tenuous; postero-ventral part slightly compressed laterally.

**Remarks.** *Kerocythere quattervalsi* n.sp., is very close to the specimen figured by Kozur & Nicklas, (1970; pl. II, fig. 4) as *Kerocythere* n.sp., from the Plattenkalk-Niveau, Hauptdolomit, Austria. It seems that in this species, ridges are present on ventral and dorsal borders and the hinge line is not straight.

**Size.** L = 0.39-0.98mm; H = 0.18-0.47mm; E = 0.17-0.51mm

**Stratigraphic and geographic distribution.** Late Triassic (Norian), Hauptdolomit of the Quattervals Nappe, Eastern Lombardy, Italy.

#### Remarks on the ostracod fauna.

The discovery of ostracods in such a strongly recrystallized facies is exceptional.

The dark colour of the sediments bearing the studied ostracod fauna is indicative of anoxic conditions. Environmental indications can be integrated by the

analysis of the ostracod assemblage, which indicates the following points:

- low diversity assemblage (only five species) and a dominance of one species (almost 150 specimens of *Kerocythere quattervalsi* n.sp., of a total of about 200 specimens);

- on five recorded species three considered to be filter-feeders (*Rhombocythere dimorphica* n.sp., *Lutkevichinella keupera* ? (Will, 1969) and *Kerocythere quattervalsi* n.sp.).

A general relationship between the percentage of filter-feeding species and deposit feeders species and oxygen concentration of the water was established for the post Palaeozoic by Whatley (1990, 1991) and for the Palaeozoic by Lethiers & Whatley (1994, 1995). Their results are synthesised in Fig. 3. The number of specimens found in the Quattervals Limestone excludes a true anoxic paleoenvironment, whereas the composition of the assemblage allows us to suggest an oxygen concentration between 1 and 3 ml/l. The low degree of differentiation and the dominance of one species suggest stressed environmental conditions, which cannot exclude, beside the low-oxygenation of the basin, the occurrence of important salinity variations (hyper- or hypohaline conditions) in the depositional environment. The dominant species was probably much more competitive than the others and particularly well adapted to unfavourable conditions of the sea bottom. The occurrence and preservation of subtidal microbialitic mats was favoured by the fact that the only predators were represented by ostracods.

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