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Moscovian conodonts from the Nevandi River Valley (Cantabrian Zone, North Spain)

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Abstract: Taxonomic and biostratigraphic data concerning Moscovian conodont faunas are reported from a section in the Nevandi River Valley (North Spain). *Idiognathodus* and *Idiognathoides* are the dominant genera. Other genera recorded in the section are *Declinognathodus, Gondolella*, *Neogondolella* and *Neognathodus*. Many of the investigated conodonts are integrated by cosmopolitan species but two new taxa belonging to the genus *Idiognathodus I. espinamaensis* and *I. mendezi* are erected. The conodonts coming from the lower part and the upper part of the section are assigned to the lower Moscovian and upper Moscovian respectively.

Keywords: conodonts, Moscovian, Carboniferous, Cantabrian Zone.

Resumen: Se dan a conocer datos taxonómicos y biostratigráficos de conodontos moscovienses de una sección del Valle del Río Nevandi (norte de España). La mayor parte de dichos fósiles son elementos P_1 con *Idiognathodus* e *Idiognathoides* como géneros dominantes. Otros géneros registrados son *Declinognathodus, Gondolella*, *Neogondolella* y *Neognathodus*. Muchos de los elementos investigados están integrados por especies cosmopolitas pero se crean dos nuevos taxones pertenecientes al género *Idiognathodus*: *I. espinamaensis* e *I. mendezi*. Los conodontos encontrados en la parte inferior y superior de la sucesión se asignan al Moscoviense inferior y superior respectivamente.

Palabras clave: conodontos, Moscoviense, Carbonífero, Zona Cantábrica.

The Picos de Europa Unit is located in the eastern part of the Cantabrian Zone (Julivert, 1971; Pérez Estaún et al., 1988) (Fig. 1). This structural unit exhibits a good Carboniferous succession comprising mainly marine limestones. Conodonts have been investigated for years in the Carboniferous of the area providing important biostratigraphic data mainly in Lower Mississipian and early Upper Pennsylvanian (for instance, Truyols et al., 1984; Méndez and Menéndez, 1985; Blanco Ferrera et al., 2005; Méndez, 2006).

The Nevandi River Valley Section is located in the South of the Picos de Europa Unit (Fig. 1) and consists of more than 800 m thickness of an entirely marine succession (Tournaisian-upper Moscovian in age), predominantly calcareous with abundant dolomite at several levels. The section crops out along the Nevandi River Valley (south of Puertos de Aliva) in the Espinama Council territory within the western part of the Cantabria Region (N Spain) (Fig. 2).

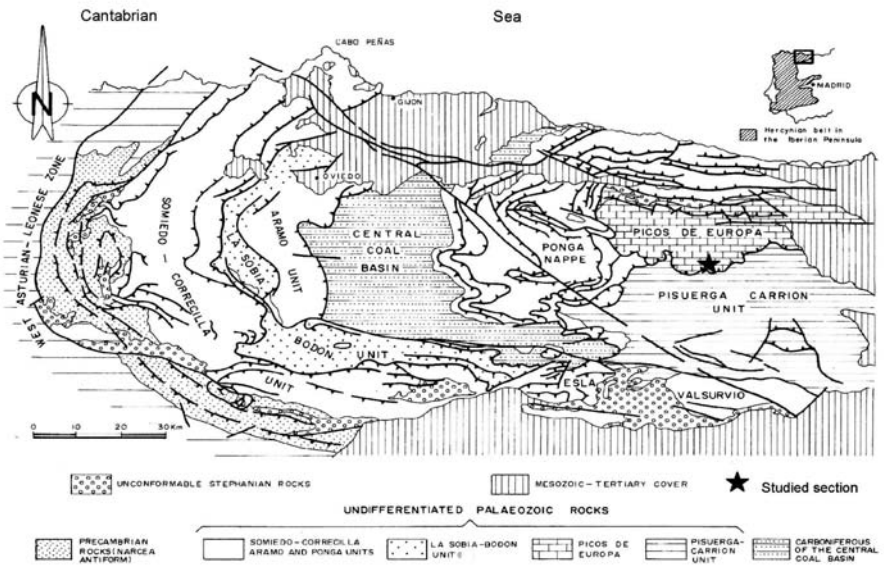

Figure 1. Geological sketch map of the Cantabrian Zone showing the position of the Río Nevandi Section (after Julivert 1971 and Pérez Estaún et al. 1988).

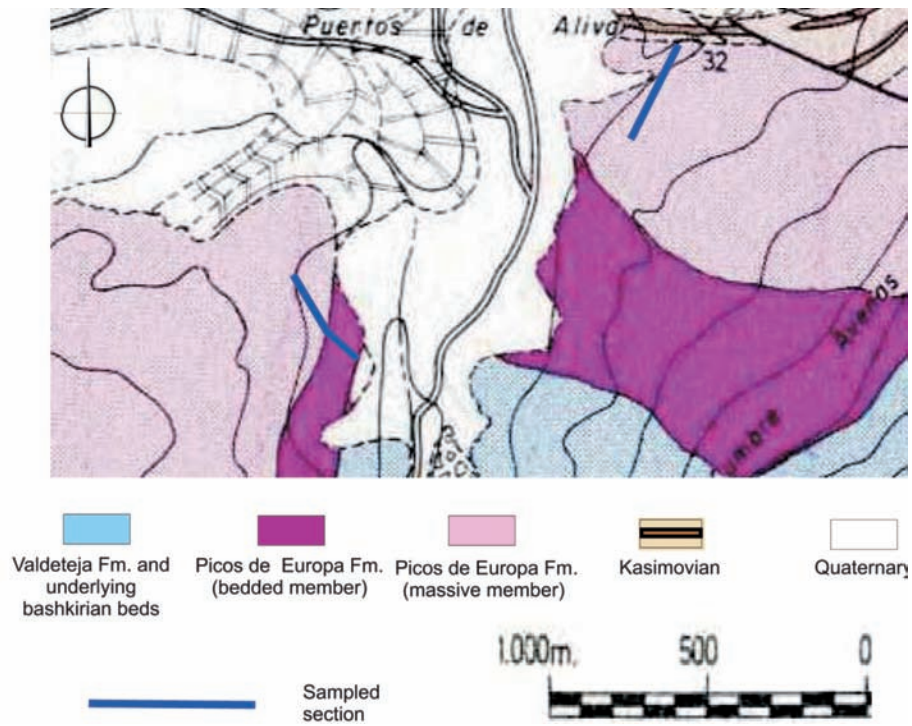

Figure 2. Geological map of the sampled area (after Marquínez, 1978).

Fusulinoideans, recorded for most of the succession except for its 171 lower meters, allowed Villa (1985) to distinguish intervals of Bashkirian, lower Moscovian and upper Moscovian age within the series. Moreover, the cited author proposed a correlation of the Nevandi section with another in the Picos de Europa Unit and Ponga Unit in the Cantabrian Mountains and considered subdivisions in terms of the Russian scale in the Moscovian levels of the Nevandi River section. The conodont faunas provided some degree of precision in terms of age mainly in the Lower-Middle Mississippian (Méndez and Menéndez, 1985).

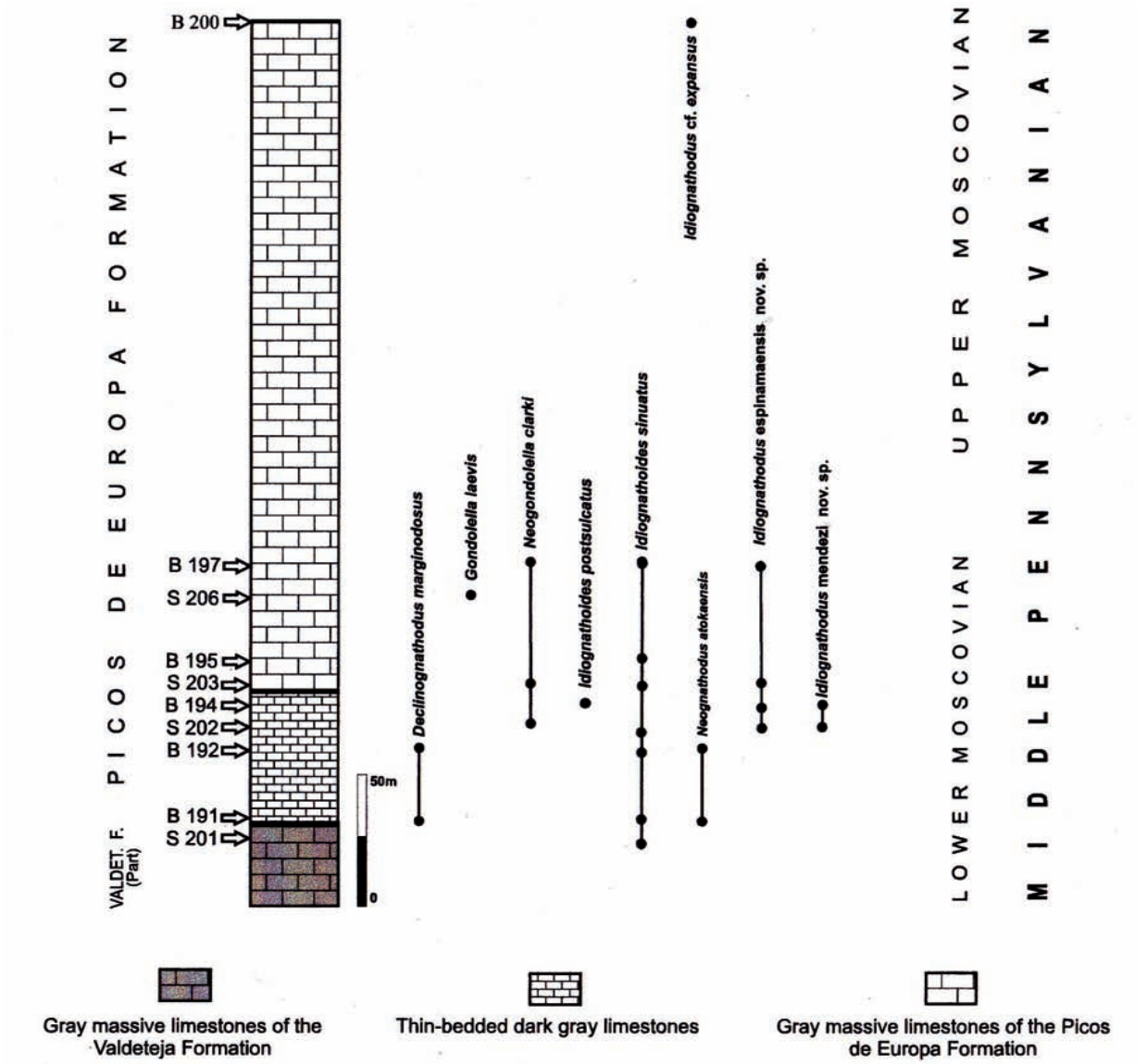

Figure 3. Conodont distribution along the Middle Pennsylvanian beds within the Nevandi River Valley Section.

Up to now, no descriptions have been made of the Moscovian conodonts of this section. In this work, material is illustrated and described, and two new species are erected.

The lowest 31 meters investigated correspond to the upper part of the Valdeteja Formation and consist of gray massive limestones. The rest of the succession belongs to the Picos de Europa Formation (Fig. 3). This lithostratigraphic unit is a 305 m thick succession. It is subdivided into a lower member, about 50 m thick, made of thin-bedded dark gray limestones with some intervals of chert and an upper member made of gray massive limestones topped by a few meters of dolostones.

The conodont fauna and comments on the age of the succession

Most conodont specimens recovered are P_1 elements, generally well preserved, of the dominant genera *Idiognathodus* and *Idiognathoides*. Other genera recorded in the section are *Declinognathodus, Gondolella*, *Neogondolella* and *Neognathodus*. The investigated genera as a whole are integrated by cosmopolitan species and other forms that differ morphologically from those elsewhere.

Two new species: *Idiognathodus espinamaensis* and *I. mendezi* are described from the lower part of the section (Fig. 3).

At the moment, it is not possible to place the Bashkirian – Moscovian boundary using the conodonts recovered in the section. The lowest conodont sample (S 201) with *I. sinuatus* can be reported to the lowermost Moscovian according to the fusulinoideans found by Villa (1985) below, not far from the stratigraphic level where sample S 201 was collected.

The cosmopolitan species *Declinognathodus marginodosus* (Grayson) and *Neognathodus atokaensis* Grayson are recorded from the Vereyan in Russia and Ukraine (Nemyrovska, 1999; Goreva and Alekseev in Makhlina et al., 2001).

The genus *Idiognathoides* disappeared at the lowest Desmoinesian in the United States (Barrick et al., 2004) and is not recovered above the Podoslkian Russian substage in the Cantabrian Mountains. In this section the last record of the genus at the level of the sample B 197 could indicate a Kashirian or a Podolskian age at the maximum (Fig. 3).

It is noteworthy the position of *Idiognathodus* cf. *I. expansus* close to the top of the investigated succession. *I. expansus* is reported from uppermost Desmoinesian in the Midcontinent (USA) (Barrick and Walsh, 1999). Recently, we have recovered this species from Myachkovian in the Cantabrian Mountains (Méndez, unpublished). We suggest a Myachkovian (Russian substage) age for the last metres of the investigated series in this study (Fig. 3).

It is no possible to consider detailed subdivisions in terms of the Russian scale, but the conodonts coming from the lower part and the upper part of the section are assigned to the lower Moscovian and upper Moscovian respectively (Fig. 3).

Systematic palaeontology

The material illustrated and described here is made of P_1 elements and deposited in the Department of Geology (Palaeontology) of the University of Oviedo (DPO).

Genus *Declinognathodus* Dunn, 1966
Type species *Cavusgnathus nodulifera* Ellison and Graves, 1941
Declinognathodus marginodosus (Grayson, 1984)
Figs. 4f, 4g

V**.**1981 *Declinognathodus noduliferus noduliferus* (Ellison and Graves); Méndez and Menéndez-Álvarez, fig. 3: 2.

*± 1984 *Idiognathoides marginodosus* n. sp.; Grayson, Pl. 1, figs.3, 4, 9, 10, 11, 14, only; Pl.2, figs.8, 9, 17, only.

.1999 *Declinognathodus marginodosus* (Grayson, 1984); Nemyrovska, p.54, Pl. 2, figs.2, 8, 11-12, 17.

.1990 *Declinognathodus marginodosus;* Grayson; Pl. 4, figs. 9, 13, only.

.1990 *Declinognathodus marginodosus* (Grayson); Nemirovskaya, p.42, Pl. 1, figs. 5-11.

.2001 *Declinognathodus marginodosus* (Grayson); Makhlina et al.; Pl.XIII, figs.21-25; Pl. XIV, figs. 6, 8, only.

Material: 12 specimens in a variable state of preservation: DPO 41747 (sample B 191, Picos de Europa Formation, bedded member); DPO 41748, DPO 14220 (sample B 192, Picos de Europa Formation, bedded member).

Description: Platform long and slender. The platform consists of two parapets decorated with nodules or short ridges. A through generally deep extends between the parapets. In some specimen the trough is crossed by two ridges at the maximum at the end of it. The carina is very short, strong and generally nodular. This structure begins at the end of the blade at the ventral termination of the platform, bends to the rostral parapet and joins with it. A small structure made from a short ridge or a few nodes is placed at one side of the carina at the ventral termination of the platform on the rostral parapet and in most of the specimens meet with the end of the carina on the parapet.

Remarks: The position of a small structure made from nodules or a short ridge at the ventral termination of

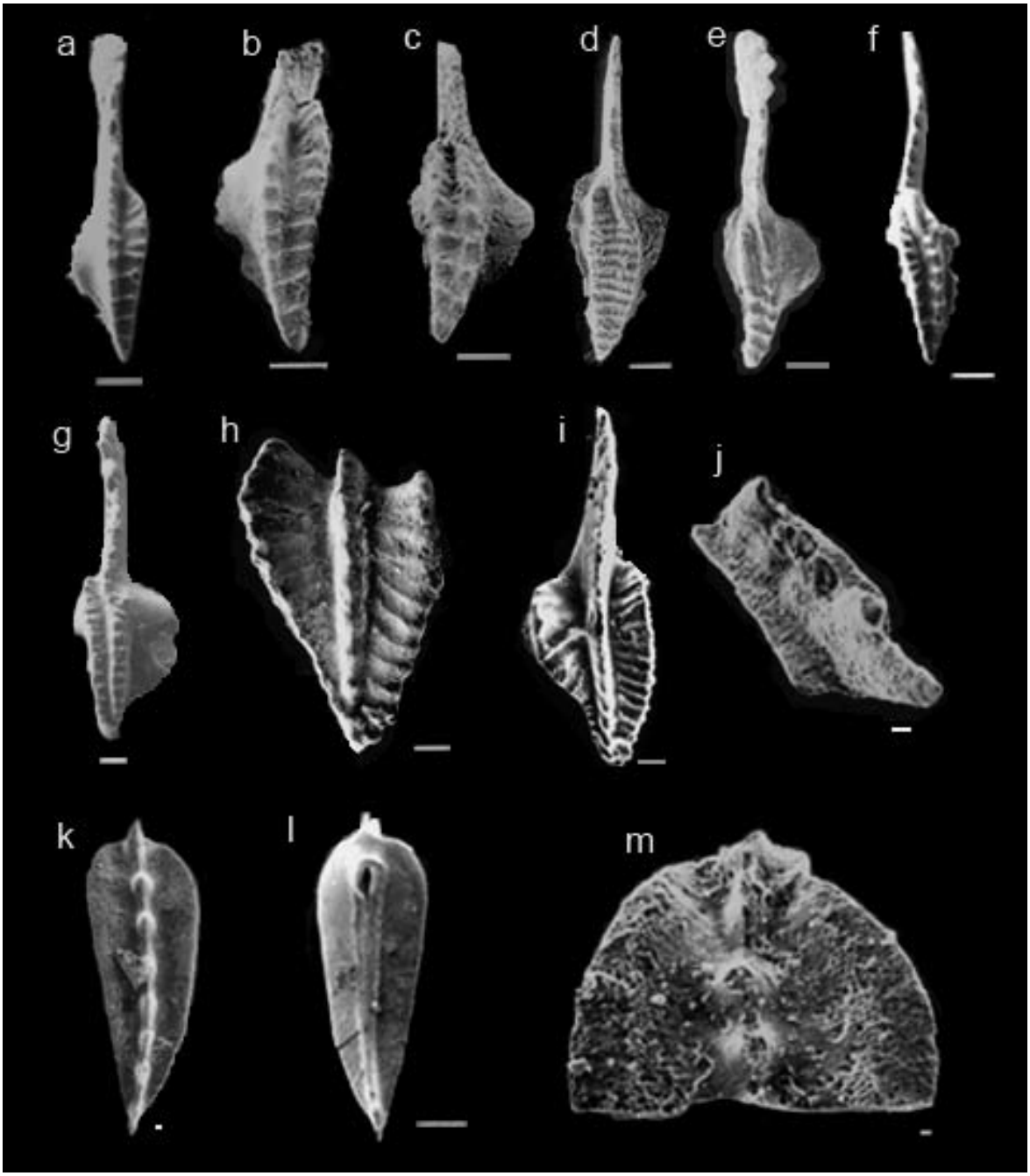

Figure 4. **a-d**. *Idiognathoides sinuatus* Harris and Hollingsworth, 1933, **a,** oral view, sinistral element. Picos de Europa Formation (bedded member), sample B 192 (DPO 41776); **b**, oral view, sinistral element. Picos de Europa Formation (bedded member), sample B 191 (DPO 41775); **c**, oral view, dextral element. Picos de Europa Formation (bedded member), sample S 202 (DPO 41777); **d**, oral view, dextral element. Picos de Europa Formation (bedded member), sample B 191 (DPO 41775). **e**, *Idiognathoides postsulcatus* Nemyrovska, 1999, oral view. Picos de Europa Formation (bedded member), sample B 194 (DPO 14225); **f-g** *Declinognathodus marginodosus* (Grayson, 1984), **f**, oral view. Picos de Europa Formation (bedded member), sample B 192 (DPO 14220); **g**, oral view. Picos de Europa Formation (bedded member), sample B 192 (DPO 41748); **h-i**, *Neognathodus atokaensis* Grayson, 1984, **h**, oral view. Picos de Europa Formation (bedded member), sample B 191 (DPO 41781); **i**, oral view. Picos de Europa Formation (bedded member), sample B 192 (DPO 41782). **j**, *Gondolella laevis* Kossenko and Kozitskaya, 1975, oral inclined view. Picos de Europa Formation (massive member), sample S 206 (DPO 126337). **k-m** *Neogondolella clarki* (Koike, 1967), **k**, oral view. Picos de Europa Formation (bedded member), sample S 202 (DPO 126343); **l**, aboral view (same specimen); **m**, oral view of a broken specimen. Picos de Europa Formation (bedded member), sample S 202 (DPO 41783). All illustrated specimens are P_1 elements. Scale bar = 100 µ, except figs **j**, **k** and **m** = 10 µ. DPO is the repository number at the Department of Geology (Palaeontology), University of Oviedo, Spain.

the platform at one side of the carina allow us to assign our material to *Declinognathodus marginodosus* (Grayson) from the Pennsylvanian of the Arbuckle Mountains (southern Oklahoma, USA). Grayson (1984) erected the species and placed it in the genus *Idiognathoides* Harris and Holligsworth but as other authors we think that a part of the material assigned by the author to that genus can be better placed in *Declinognathodus* Dunn because a very short, although distinguishable, carina exists and is bended (or declined) to one side. On the contrary Grayson (1984) minimized this morphology.

Genus *Gondolella* Stauffer and Plummer, 1932
Type species *Gondolella elegantula* Stauffer and Plummer, 1932
Gondolella laevis Kossenko and Kozitskaya, 1975
Fig. 4j
(A synonymy list was provided by Méndez et al., 1998 for this species)

Material: One specimen, deteriorated in his aboral part showing a portion of the keel only: DPO 126337 (sample S 206, lower part of the massive member of the Picos de Europa Formation).

Description: In oral view, element with platform relatively wide, smooth, slightly concave with thin margins. Carina denticulated, extended along the centre of the platform; denticles robust, confluent in their base; one of them, apical denticle, is more high, more robust situated near the dorsal termination of the platform and inclined to the outside of this structure, in line with the rest of the denticles.

No microsculpture is observed.

Remarks: The morphology of the element described above shows similarities with the original material of *Gondolella laevis* Kossenko and Kozitskaya (upper Moscovian of the Donets Basin). The species was recorded from different levels in the Pennsylvanian (Méndez et al., 1998).

Genus *Idiognathodus* Gunell, 1931
Type species *Idiognathodus claviformis* Gunnell, 1931
Idiognathodus espinamaenis n. sp.
Figs. 5b, c, d, e

Material: 13 specimens well preserved in general, one of them the holotype: DPO 41749 (sample S 203, Picos de Europa Formation, massive member) (Fig. 3); the rest are paratypes from the same formation: DPO 41753, DPO 41755-41758 (sample S 202, bedded member); DPO 41750-41752, 41754 (sample S 203, massive member); DPO 41759-41760 (sample B 194, bedded member); DPO 41761 (sample B 197, massive member).

Locus typicus: Nevandi River Valley, western of the Cantabria Region. Located on the western slope of the valley, between Invernales de Igüedri to the south and Puertos de Aliva to the north (Fig. 2). The locality is inside the Espinama Council territory.

Stratum typicum: Silicified, gray, bedded limestone with crinoids, located in the upper part of the bedded member of the Picos de Europa Formation.

Derivatio nominis: After Espinama, the place-name of the council where the section is located.

Diagnosis: A species of the genus *Idiognathodus* characterized by a rounded caudal lobe, field of transverse ridges on the platform flat, subtriangular, without any depressed area and adcarenal ridges of the same length.

Description: In oral view, platform long, significantly curved and sharply pointed. Rostral margin convex; caudal margin moderately concave. Two lobes are developed on both sides of the platform near its ventral end; caudal lobe arranged like a semi-circular pattern with a variable number of nodes; rostral lobe elongated with a few nodes. Short, moderate carina. Adcarinal ridges well developed extended a short distance in the ventral direction of the unit; a trend to lateral development is observed. Field of the transverse ridges on the platform subtriangular with a moderate number of ridges, flat without any depressed area.

Microornamentation of polygonal aspect was observed in a few specimens (Fig. 5d).

Remarks: The morphology of the rostral lobe, length of the adcarinal ridges and platform outline are the main differences with *Idiognathodus mendezi*, n. sp. described in this work.

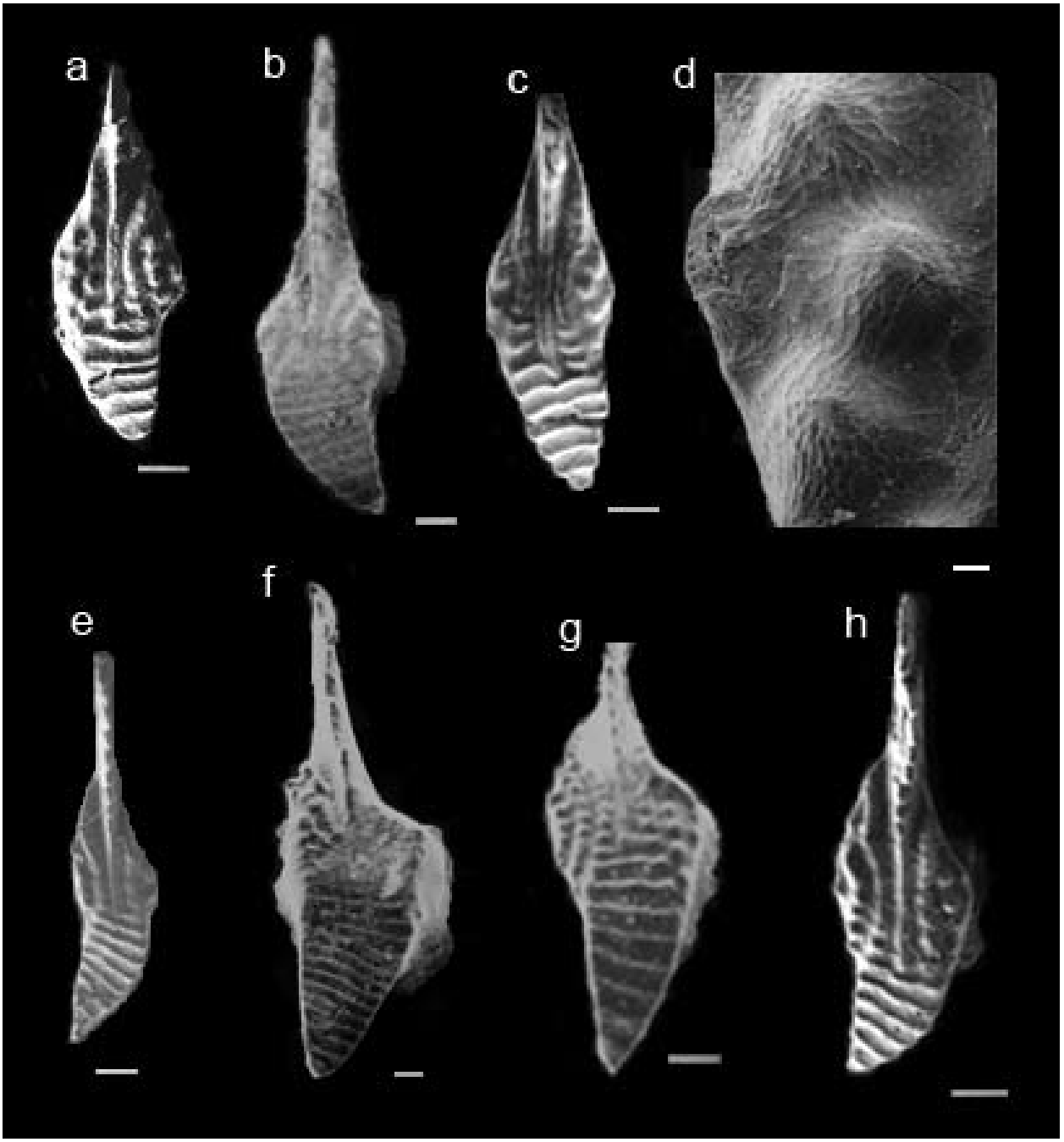

Figure 5. **a**. *Idiognathodus* cf. *I. expansus* Stauffer and Plummer, 1932, oral view. Picos de Europa Formation (top of the massive member), sample B 200 (DPO 41773). **b-e**. *Idiognathodus espinamaensis* nov. sp., **b**, oral view, holotype. Picos de Europa Formation (massive member), sample S 203 (DPO 41749). **c**, oral view, paratype. Picos de Europa Formation (bedded member), sample S 202 (DPO 41753). **d**, detail of microornamentation on the caudal lobe of the same specimen. **e**, oral view, paratype. Picos de Europa Formation (massive member), sample B 197 (DPO 41761). **f-h**. *Idiognathodus mendezi* nov. sp. **f**, oral view, holotype. Picos de Europa Formation (bedded member), sample B 194 (DPO 41762). **g**, oral view, paratype. Picos de Europa Formation (bedded member), sample B 194 (DPO 41763). **h**, oral view, paratype. Picos de Europa Formation (bedded member), sample B 194 (DPO 41767). All illustrated specimens are P_1 elements. Scale bar = 100 µ**,** except fig.**d** = 10 µ. DPO is the repository number at the Department of Geology (Palaeontology), University of Oviedo, Spain.

The specimens described can be compared to *Idiognathodus incurvus* Dunn 1966, from the Morrowan of the southwestern of the United States. However, the surface of the field of the transverse ridges on the platform is flat in the Spanish material and no groove or concavity are observed like the specimens illustrated by Dunn. In addition, two morphological characters in *I. espinamaensis* are different from the American material: the carina is more short and the caudal lobe, arranged like a semi-circular pattern.

Idiognathodus mendezi n. sp.
Figs. 5f, g, h

Material: 11 well preserved specimens, one of them the holotype: DPO 41762 (sample B 194, Picos de Europa Formation, bedded member) (Fig. 3); the rest are paratypes from the same formation and member: DPO 41763-41770 (sample B 194) and DPO 41771-41772 (sample S 202).

Locus typicus: Nevandi River Valley, western of the Cantabria Region. Located on the western slope of the valley, between Invernales de Igüedri to the south and Puertos de Aliva to the north (Fig. 2). The locality is inside the Espinama Council territory.

*Stratum typicum***:** Dark gray bedded limestone near the top of the bedded member in the Picos de Europa Formation.

*Derivatio nominis***:** After Méndez, the surname of my son Carlos Méndez Rodríguez.

Diagnosis: A species of the genus *Idiognathodus* characterized by an asymmetric platform. The rostral lobe is located on a prominent shoulder close to the ventral termination of the platform. Adcarenal ridges different in length: the caudal one is more long.

Description: In oral view, platform asymmetric. Rostral margin strongly convex near ventral termination of the platform, then straight; caudal margin straight for most its lenght, convex close to the ventral termination of the platform. Lobes very different; rostral lobe showing a ridge with the form of an shoulder made from fused moderate nodes mainly in adult forms; caudal lobe elongated, ending at the ventral termination of the platform or slightly further away with several nodes of moderate size; adcarinal ridges convex towards the carina; rostral adcarenal ridge ending near to the ventral end of the platform; caudal adcarenal ridge ending any further. Carina short. Field of the transverse ridges on the platform subtriangular with a significant number of cross ridges.

Microornamentation of polygonal aspect was observed in a part of the material integrating this species.

Remarks: The morphology of the rostral lobe, unequal length of the adcarinal ridges and asymmetry of the platform are the main differences with *Idiognathodus espinamaensis*, n. sp. described in this work.

Idiognathodus mendezi shows similarity with one of the specimens figured in Proctor (1991, fig. 16: 12) like *I. incurvus* M1 from the Atokan of the Dimple Limestone in the Marathon Basin, USA, mainly in the extension of the adcarenal ridge and morphology of the rostral lobe but our form has the field of the transverse ridges on the platform, triangular, lacks of the slight concavity on it and shows a more short carina.

Idiognathodus aljutovensis Alekseev, Barskov and Kononova, 1994 from the lower Moscovian of Central Russia have a much more symmetric platform with the adcarinal ridges ending more close than in our new species.

Idiognathodus cf. *Idiognathodus expansus* Stauffer and Plummer, 1932.
Fig. 5a

Material: 1 specimen: DPO 41773 (sample B 200, Picos de Europa Formation, top of the massive member).

Description: In oral view, platform wide, slightly curved, significantly convex in oral direction. Rostral margin moderately convex; caudal margin expanded in its ventral part then straight. Two different lobes displayed in the unit; caudal lobe close to the rhomboid shape, expanded away from platform in its ventral part with several moderate nodes arranged in two rows; rostral lobe elongated with a few moderate nodes. Adcarenal ridges convex to the carina extended some distance in the ventral direction of the unit. Carina short,

strong. Field of the transverse ridges on the platform tongue-like with a few strong transverse ridges without defined inclination.

Remarks: Stauffer and Plummer (1932) originally described and figured *I. expansus* from a locality (Mineral Wells) of the latest Desmoinesian of Texas, USA. The only specimen we have exhibits similarity with the morphology of one of the specie`s cotype re-illustrated by Barrick and Walsh (1999, fig. 2: 2) mainly related to the rostral lobe and the ventral length of the adcarinal ridges. The paucity of our material allows us to left it in open nomenclature.

Genus *Idiognathoides* Harris and Hollingsworth, 1933
Type species *Idiognathoides sinuatua* Harris and Hollingsworth, 1933
Idiognathoides postsulcatus Nemyrovska, 1999
Fig. 4e

V**.** 1981 *Idiognathoides sulcatus sulcatus* Higgins and Bouckaert; Méndez and Menéndez-Álvarez, fig. 3: 7.

± 1984 *Idiognathoides marginodosus* n. sp. Morphotype C; Grayson, Pl.1, figs.16, 18, Pl.2, fig.19, only.

± 1985 *Idiognathoides sulcatus* Higgins and Bouckaert, 1968; van den Boogaard and Bless, fig. 9: 7, only.

*1999 *Idiognathoides postsulcatus* n. sp.; Nemyrovska p. 70, Pl.3, figs.9, 18.

Material: One well preserved specimen: DPO 14225 (sample B 194, Picos de Europa Formation, bedded member).

Description: In oral view, platform elongate, narrow composed of two long parapets. The free blade joins to the rostral parapet at its ventral end and the caudal parapet terminates as a free margin. Rostral parapet with a slight curvature; its ventral part is swollen and its dorsal part is made from a few discrete nodes. Caudal parapet like the rostral one but with its ventral part more swollen. The most dorsal nodes on the parapet tend to join. Shallow narrow trough between the parapets.

Remarks: The kind of swelling on the parapets, length of the platform and the trough morphology allow us to include our specimen in *Idiognathoides postsulcatus* Nemyrovska, 1999 from the lower Moscovian of the Donets Basin, Ukraine.

Idiognathoides sinuatus Harris and Hollingsworth, 1933
Figs. 4a, b, c, d

*1933 *Idiognathoides sinuata* n. sp.; Harris and Hollingsworth; p.201, Pl. 1, fig. 14.

.1933 *Idiognathoides corrugata* n. sp.; Harris and Hollingsworth; p. 202, pl.1, figs. 7, 8a, b.

.1933 *Idiognathoides attenuata* n. sp.; Harris and Holligsworth; p. 203, pl. 1, figs. 9a, b.

.1980 *Idiognathoides sinuatus* Harris and Hollingsworth, 1933; Bender, Pl. 1, figs. 17-33.

V**.** 1981 *Idiognathoides sinuatus* Harris and Hollingsworth; Méndez and Menéndez-Álvarez; fig. 3: 6.

V**.** 1981 *Idiognathoides attenuatus* Harris and Hollingsworth; Méndez and Menéndez-Álvarez; fig. 3: 4.

.1981 *Idiognathoides sinuatus* Harris and Hollingsworth; Landing and Wardlaw, Pl. 2, figs. 8-21.

± 1984 *Idiognathoides sinuatus* Harris and Hollingsworth; Grayson, Pl. 4, figs., 13, 14, 19, 20, only.

.1984 *Idiognathoides corrugatus* (Harris and Hollingsworth); Grayson, Pl. 4, figs. 4, 10.

.1985 *Idiognathoides corrugatus-sinuatus* (Harris and Hollingsworth, 1933); Higgins, Plate 6.4, figs. 1, 2, 3, 5.

.1985 *Idiognathoides sinuatus* Harris and Hollingsworth, 1933; van den Boogaard and Bless, fig. 9: 1-4.

± 1995 *Idiognathoides sinuatus* Harris and Hollingsworth; Nemirovskaya and Alekseev, Pl. 1, fig. 16, only.

± 1995 *Idiognathoides corrugatus* (Harris and Hollingsworth); Nemirovskaya and Alekseev, Pl. 1, fig. 11, only.

.1999 *Idiognathoides corrugatus* (Harris and Hollingsworth, 1933); Nemyrovska, Pl. 3, figs. 2-4, 21; Pl. 4, fig. 8.

.1999 *Idiognathoides sinuatus* Harris and Hollingsworth, 1933; Nemyrovska, Pl.3, figs.3, 8, 10, 13.

.2001 *Idiognathoides sinuatus* Harris et Hollingsworth, 1933; Alekseev and Goreva in Makhlina et al., Pl. XIII, figs.7-9; Pl. XIV, figs. 1-5.

.2001 *Idiognathoides corrugatus* Harris and Hollingsworth; Kulagina et al.; Pl.9, figs. 2, 3; Pl. 10, figs. 5-7.

.2001 *Idiognathoides sinuatus* Harris and Hollingsworth; Kulagina et al., Pl. 9, fig.1, Pl. 10, figs. 3, 4.

.2003 *Idiognathoides corrugatus* Harris and Hollingsworth, 1933; Wang and Qi, Pl.1, fig.22.

.2003 *Idiognathoides sinuatus* Harris and Hollingsworth, 1933; Wang and Qi, Pl. 1, fig. 22, Pl. 2, fig. 17.

Material: 34 specimens relatively well preserved: DPO 41774 (sample S 201, Valdeteja Formation, uppermost part); DPO 41775 (sample B 191, Picos de Europa Formation, bedded member); DPO 41776 (sample B 192, Picos de Europa Formation, bedded member); DPO 41777 (sample S 202, Picos de Europa Formation, bedded member); DPO 41778 (sample S 203, Picos de Europa Formation, massive member); DPO 41779, DPO 14224 (sample B 195, Picos de Europa Formation, massive member); DPO 41780 (sample B 197, Picos de Europa Formation, massive member)

Description: Dextral and sinistral elements show some morphological differences; they integrate a parasymmetric pair and we describe them apart.

Dextral element: In oral view, platform long, pointly at the end of its dorsal part with two parapets (rostral and caudal). A concavity more or less developed (in with and length) is present in between of the parapets although some specimen can display a nearly flat dorsal part of the platform. The blade in the ventral part of the element joins to the rostral parapet with a moderate curvature. This parapet continues with a convex border. Caudal parapet with variable outline ending at the termination of its ventral part as a free margin. Both parapets covered with numerous strong transverse ridges that cross the concavity in between of the parapets.

Sinistral element: In oral view, platform long, pointly at the end of its dorsal part with two parapets (rostral and caudal). A deep trough of variable length is extended in between of the parapets. A variable number of strong transverse ridges cross the trough. The blade in the ventral part of the element joins to the rostral parapet with a slight curvature. The parapet continues with a moderate convex border; is narrow or more developed, expanded or vertical, with transverse ridges. Caudal parapet with a variable outline, expanded with transverse ridges.

Microsculpture was observed in one of the specimens at 350 magnifications on the most ventral part of the platform.

Remarks: *I. sinuatus* displays variable morphology as described above either in dextral and sinistral P_1 elements and this fact have been observed elsewhere as well.

Our concept of *Idiognathoides sinuatus* is coincidental with that of Lane (1968) or Landing and Wardlaw (1981), so we consider dextral and sinistral P_1 as an asymmetrical pair.

Genus *Neognathodus* Dunn, 1970
Type species: *Polygnathus basleri* Harris and Hollingsworth, 1933
Neognathodus atokaensis Grayson, 1984
Figs. 4h, i

± 1941 *Gnathodus wapanuckensis* (Harlton); Ellison and Graves, Pl.2, fig. 14, only.

± 1970 *Neognathodus basleri* (Harris and Hollingsworth); Dunn, p. 336, Pl. 64, fig. 14, only.

± 1975 *Neognathodus bothrops* Merrill; Merrill, p. 69, fig.17: 65, only.

*± 1984 *Neognathodus atokaensis* n. sp.; Grayson, p. 52, Pl. 1, fig. 8; Pl. 2, figs. 1, 5a, 5b, 10-12, 16, 21, 23, Pl.3, figs. 1a, 1b, 7a, 7b, 11, 16, 18, 22.

± 1987 *Neognathodus atokaensis* Grayson; Grayson, Merrill and Miller (eds). Pl.8, figs.30, 37, 40, only.

•1990 *Neognathodus atokaensis*; Grayson, Pl. 4, figs. 14-16.

•1992 *Neognathodus atokaensis* Grayson; Sutherland and Grayson, Pl. 2, fig.15.

± 2001 *Neognathodus atokaensis* Grayson; Goreva and Alekseev, in Maklhina et al. Pl. XIII, figs. ?10, 11, ?12, 13-15, Pl. XIV, figs. 20, 21, only.

•2009 *Neognathodus atokaensis* Grayson; Kulagina et al. in, Puchkov et al. Pl. 8, fig. 4.

Material: Three specimens relatively well preserved from the bedded member of the Picos de Europa Formation: DPO 41781 (sample B 191); DPO 41782 (sample B 192).

Description: Platform wide, arrow-like, dorsally pointed with two distinct parapets inclined to the carina which is placed in sub-central position. Carina strong and nodular, ends at the dorsal extreme of the unit or is very close. Caudal parapet, long, with moderately convex margin, extending from the ventral termination of the platform to the dorsal extreme decorated with numerous strong, transverse ridges that appears to radiate from a same point. Rostral parapet wider in its ventral part where is strongly convex then is gradually reducing and finish near the dorsal end of the unit but do not fuse with it. This parapet may have different transverse ridges and at its most dorsal part have small ridges or nothing. Caudal parapet joins with carina at moderately higher level than the rostral parapet. In the complete specimen the ventral termination of the platform bends downward to the aboral side.

Remarks: The shape of the platform and parapets, length of the carina and character of the most dorsal portion of the rostral parapet allow us to include our material in *Neognathodus atokaensis* Grayson from the Pennsylvanian of the Arbuckle Mountains (southern Oklahoma, USA).

Genus *Neogondolella* Bender and Stoppel, 1965
Type species *Gondolella mombergensis* Tatge, 1956
Neogondolella clarki (Koike, 1967)
Figs. 4k, l, m
(A synonymy list was provided by Méndez et al., 1998 for this species)

Material: Seven specimens not equally preserved: DPO 14221, DPO 126343, DPO 41783 (sample S 202, Picos de Europa Formation, bedded member); DPO 126342 (sample S 203, Picos de Europa Formation, massive member); DPO 41784 (sample B 197, Picos de Europa Formation, massive member).

Description: In oral view, platform of elements elongate, wide, depressed in the centre with both margins approaching in the ventral part. Ventral end of platform acute; dorsal end rounded. Carina extended along the centre of the unit with denticles not very high and robust ending in a more developed apical denticle, very close to the dorsal termination of the platform; sometimes, a more reduced denticle is associated with the apical one, located at the dorsal end of the unit.

In aboral view, basal cavity close to the dorsal end, broad, deep with a loop around it closed near the dorsal end and opened on the reverse side where is united to a grooved keel. Grooved keel extended along the centre of the aboral surface of the platform surrounded by a elongated area that is gradually narrowing and rising towards the ventral end. Elongated area surrounding the keel meets the basal cavity so that all elements form a unit.

Micro-ornamentation of polygonal aspect can be observed in oral view on the caudal and rostral sides of the platform and its rims, in most of the material (Figs. 4k, m.). In addition, some other features like holes are observed on the oral surface of the platform and on the aboral side of it as well (included the grooved keel and the basal cavity) (Fig. 4m.). The meaning of the cited features, observed in a limited number of specimens, would require an additional amount of P_1 elements of *N. clarki*

Remarks: The morphology of the P_1 element of this species is comparable to that of the different Pennsylvanian findings worldwide.

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