



HAL
open science

Siphonodella leiosa (Conodonta), a new unornamented species from the Tournaisian (lower Carboniferous) of Puech de la Suque (Montagne Noire, France)

Louise Souquet, Carlo Corradini, Catherine Girard

► **To cite this version:**

Louise Souquet, Carlo Corradini, Catherine Girard. Siphonodella leiosa (Conodonta), a new unornamented species from the Tournaisian (lower Carboniferous) of Puech de la Suque (Montagne Noire, France). *Geobios*, 2020, 61, pp.55-60. 10.1016/j.geobios.2020.06.004 . hal-02934218

HAL Id: hal-02934218

<https://hal.science/hal-02934218>

Submitted on 6 Nov 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

1 ***Siphonodella leiosi* (Conodonts), a new unornamented species from the**
2 **Tournaisian (lower Carboniferous) of Puech de la Suque (Montagne Noire,**
3 **France)**

4
5 Louise Souquet^{a, b}, Carlo Corradini^c and Catherine Girard^{d, *}

6
7 ^a Centre de Recherche en Paléontologie - Paris, UMR CNRS 7207, CP 38, Muséum National
8 d'Histoire Naturelle, 75005 Paris, France

9 ^b Mécanismes Adaptatifs et Evolution, UMR CNRS 7179, Bâtiment Anatomie Comparée, CP
10 55, Muséum National d'Histoire Naturelle, 75005 Paris, France

11 ^c Dipartimento di Matematica e Geoscienze, Università di Trieste, via Weiss 2, 34128 Trieste,
12 Italy

13 ^d ISEM, Univ Montpellier, CNRS, EPHE, IRD, Montpellier, France. (* corresponding author:
14 Catherine.Girard@umontpellier.fr)

15
16 **Abstract**

17 A new conodont species, *Siphonodella leiosi*, is described from the lower Carboniferous
18 pelagic limestones of the Montagne Noire (France), deposited on North Gondwana in outer
19 platform environment. Specimens were obtained from one level dated to the *Siphonodella jii*
20 conodont Zone. The major difference from other siphonodellid conodonts known in this area
21 is that the elements of this new species have a practically entirely smooth and
22 unornamented platform, apart from the development of one or two low rostral ridge-like
23 nodes. Similar morphologies were generally observed in shallow marine deposits of the
24 same time frame from China, Russia and East and Central European areas. The new
25 discovery reinforces the idea that ornamentation of siphonodellids is not only related to
26 bathymetry, but that temperature could play an important role in the diversification and
27 radiation of unornamented species during the *Siphonodella jii* conodont Zone.

28
29 **Keywords**

30 Carboniferous, conodonts, *Siphonodella*, Montagne Noire

31

32 1. Introduction

33

34 The study of the Puech de la Suque pelagic section in the Montagne Noire (France)
 35 for high resolution stratigraphy through the Devonian/Carboniferous boundary resulted in
 36 an abundant and diverse conodont fauna collection (Feist et al., 2020). Conodonts are
 37 marine jawless vertebrates that lived from the late Cambrian to the Late Triassic. They are
 38 mainly known in the fossil record by their small teeth-like feeding structures called conodont
 39 elements. These elements are widely recognized as valuable tools for biostratigraphy, due to
 40 their abundance, high evolutionary rate, and good spatial and temporal record over long
 41 periods of time (Sweet, 1988).

42 Among conodonts, *Siphonodella* species are key stratigraphic markers to date the
 43 base of the Carboniferous. The first appearance datum of *Siphonodella sulcata* (Huddle)
 44 defines the base of the Carboniferous (Paproth et al., 1991). Other species of *Siphonodella*
 45 are used as index fossils for Tournaisian (lower Carboniferous) conodont zonations
 46 (Sandberg et al., 1978; Jii, 1985; Kaiser et al., 2009; Becker et al., 2016; Corradini et al., 2017;
 47 Hogancamp et al., 2019).

48 *Siphonodella* platform elements are usually ornamented, meaning that they bear
 49 nodes and ridges on the oral surface. The general shape of the platform and ornamentation
 50 are criteria used for taxonomy. *Siphonodella* is commonly associated with offshore open-
 51 marine environments with mesopelagic habitat (e.g. Austin, 1976; Ziegler & Sandberg, 1984;
 52 Savoy & Harris, 1993; Kalvoda et al., 1999; Kaiser et al., 2008). The ornamented
 53 *Siphonodella*: *Siphonodella bransonii* Ji, *Si. carinthiaca* Schönlaub, *Si. cooperi* Hass, *Si.*
 54 *crenulata* Cooper, *Si. duplicata* (Branson & Mehl), *Si. isosticha* Cooper, *Si. jii* Becker et al., *Si*
 55 *lobata* (Branson & Mehl), *Si. obsoleta* Hass, *Si. praesulcata* Sandberg, *Si. quadruplicata*
 56 (Branson & Mehl), *Si. sandbergi* Klapper and *Si. sulcata* (Huddle) are considered pelagic
 57 species.

58 In Eastern and Central Europe, Russia, and China, species of *Siphonodella* that have a
 59 smooth oral surface without ornamentation have been described. These include:
 60 *Siphonodella belkai* Dzik, *Si. bella* Kononova & Migdisova, *Si. dasaibaensis* Ji, *Si. eurylobata* Ji,
 61 *Si. homosimplex* Ji & Ziegler, *Si. kalvodai* Kaiser, Kumpan & Cigler, *Si. levis* Ni, *Si. puchovki*
 62 Zhuravlev, *Si. quasinuda* Gagiev Kononova & Pazuhin, *Si. simplex* Ji, *Si. sinensis* Ji and *Si.*
 63 *uralica* Zhuravlev (e.g. Coen & Groessens, 1996; Dzik, 1997; Gagiev et al., 1987; Ji, 1987; Ji &

64 Ziegler, 1992; Kaiser et al., 2017; Kononova & Lipnjagov, 1976; Li et al., 2014; Lipnjagov,
65 1979; Malec, 2014; Matyja, 1976; Qie et al., 2014; Qin et al., 1988; Zhuravlev & Plotitsyn,
66 2017; Zhuralev, 2019). They are found in Tournaisian neritic carbonate platform and slope
67 facies, especially in the eastern and northern part of the Paleotethys realm. A “shallow-
68 water” conodont zonation utilizing unornamented siphonodellids was proposed (Ji, 1987;
69 1988; Qie et al., 2014). In China (Ji, 1987; 1989), as well as in Russia (Zhuravlev, 2017),
70 ornamented siphonodellids co-occur with unornamented species, allowing the correlation of
71 “deep” and “shallow” water zonations.

72 Recently, Kaiser et al. (2017) found unornamented species (*Si. belkai* and *Si. kalvodai*)
73 from the *jii* Zone in western part of Paleotethys. *Siphonodella belkai* was described from
74 Kowala, Poland (Dzik, 1997 ; Malec, 2014). Kaiser et al. (2017) concluded that unornamented
75 siphonodellids were able to invade the western part of the Paleotethys, but not north
76 Gondwanan areas, due to the presence of the large Paleotethys ocean, nor eastern
77 Laurussia, probably due to a terrestrial barrier.

78 One layer of strata in the *Siphonodella jii* Zone from the north Gondwana area in the
79 Puech de la Suque section (Montagne Noire, France) yielded siphonodellid specimens that
80 have an outline close to ornamented siphonodellids from this age, but differed in having a
81 smooth and unornamented platform. This occurrence is coincident with the increased
82 diversity within the genus *Siphonodella* observed at a global scale during the *Si. jii* Zone. This
83 paper describes a new unornamented *Siphonodella* species, as well as the ecological and
84 environmental significance of this taxon.

85

86 **2. Geological setting**

87 The Puech de la Suque section is located on the southeastern slope of the Puech de la
88 Suque hill, near St Nazaire de Ladarez in the Montagne Noire (France) 43°29'59.7"N
89 3°05'54.8"E (Fig. 1(A)). This outcrop is tectonically inverted (Fig. 1(B)). The end-Famennian
90 shales deposited during the regressive event of the Hangenberg Crisis are overlain by the
91 Tournaisian succession recording transgressive trend from middle platform to basinal
92 settings (Girard, 1994; Feist et al., 2020). The shales are superseded by the reappearance of
93 carbonate sedimentation with 2m of gray-yellowish, nodular, dm-thick bedded mudstone to
94 wackestone. These limestones contain ostracods (Lethiers & Feist, 1991) and conodonts

95 (Boyer et al., 1968; Girard, 1994, Kaiser, 2005; Feist et al., 2020), and are topped by well-
96 bedded thin intercalations of cherts.

97

98 **3. Material**

99 New samples from the Puech de la Suque section yielded unornamented
100 siphonodellid specimens from bed PS20, exclusively, located 1.2 meter above the base of the
101 Carboniferous (Girard, 1994; Feist et al., 2020). The conodonts were extracted from this level
102 in the laboratory of the University of Montpellier (France). Two kilograms of rock were
103 dissolved using formic acid (10%) and then rinsed through 100µm and 1mm sieves.
104 Conodonts were removed from the insoluble residue using a binocular microscope (Nikon
105 SM8). Among the fifty *Siphonodella* specimens, nine were unornamented. The nine
106 specimens were imaged using an X-ray microtomograph (µCT) Phoenix nanotomeS on the
107 AniRA-Immos platform of the SFR Biosciences (UMS 3444, ENS Lyon) at a cubic voxel
108 resolution of 1 µm. All specimens, holotypes and paratypes (UM PSQ 1 to UM PSQ 9), were
109 housed in the collections of the University of Montpellier, and their 3D reconstructions (UM
110 PSQ 1 to UM PSQ 9) were deposited in MorphoMuseum (Souquet et al., 2020).

111

112 **4. Systematic Paleontology**

113 Phylum Chordata Bateson, 1886

114 Class Conodonta Pander, 1856

115 Order Ozarkodinida Dzik, 1976

116 Family Elictognathidae Austin & Rhodes, 1981

117 Genus *Siphonodella* Branson & Mehl, 1944

118 **Type species:** *Siphonognathus duplicata* Branson & Mehl, 1934

119

120 *Siphonodella leiosi* sp. nov.

121 Figure 2

122 **HOLOTYPE:** dextral P1 element (UM PSQ 2), figured in Fig. 2(B).

123 **PARATYPES:** Figured P1 elements (UM PSQ 1, 3 to 9).

124 **STRATUM TYPICUM:** Bed of sample PS20.

125

126 **TYPE LOCALITY:** Puech de la Suque section, Montagne Noire, France.

127

128 **DERIVATIO NOMINIS:** From the Greek *leios*: slick, smooth

129

130 **OCCURRENCE:** *Siphonodella jii* Zone (lower Tournaisian).

131

132 **MATERIAL:** 9 specimens from Puech de la Suque section.

133

134 **DIAGNOSIS:** A species of *Siphonodella* whose P1 element is characterized by an asymmetric
135 unornamented platform with a unilateral rostral ridge composed of nodes on the inner side.
136 The lower side bears a wide pseudokeel.

137

138 **DESCRIPTION:** The P1 element of *Siphonodella leiosi* sp. nov. is characterized by an
139 asymmetric smooth platform arched downward with apex of arch at position of the pit.
140 Inner platform lanceolate and outer platform ovate. The short rostral ridge on the inner
141 platform is composed of 3 to 5 discrete nodes. The anterior part of outer platform is strongly
142 reduced. The short free blade bears partially fused and laterally flattened sharp denticles.
143 Low incurved carina with nodes on posterior part of the platform. The aboral side of the
144 element (lower view) is typical of the *Siphonodella* genus. It presents a wide pseudokeel
145 which narrows anteriorly to the pit, the latter being placed slightly more posteriorly than the
146 middle of the element.

147

148 **REMARKS:** The species differs from other taxa of *Siphonodella* by the lack of ornamentation,
149 the shape of the very large and unornamented platform, and presence of the lateral rostrum
150 ridge composed of nodes. Very reduced nodes may be developed on some specimens on the
151 outer platform. This new species shows similar outline compared to ornamented species
152 from Montagne Noire, but does not have ornamentation on the platform excepting one or
153 two rostral ridge(s) that converge toward the carina. *Siphonodella leiosi* sp. nov. differs from
154 unornamented species from the eastern part of the Paleotethys by the larger rostrum with
155 well-differentiated nodes which converge towards the carina. Kalvoda et al. (2015, fig. 5(3))
156 illustrated an element from the *jii* Zone of Lesní lom, Moravia, that is similar to our element
157 illustrated in Fig. 2(l), being slightly different by the more strongly developed rostral ridges.

158 This form may enter in the variability of *Si. leiosi*. The occurrence of the species in Moravia is
159 confirmed by the recovery of another specimen from the same section and biozone (T.
160 Kumpan, pers.com).

161

162

163 5. Discussion

164

165 Due to their global geographical distribution most of the species of the genus
166 *Siphonodella* are used for stratigraphic subdivision of the uppermost Famennian and lower
167 Tournaisian (e.g. Sandberg et al., 1978). The ornamented taxa are interpreted as inhabitants
168 of offshore environments. Distinctive features include platform outline, development of a
169 keel, nature of the rostrum and rostral ridges, as well as the nature of nodes and ridges on
170 the inner and outer platform.

171 At the beginning of the Tournaisian, unornamented *Siphonodella* species are present
172 on the eastern border of the Paleotethys. Two regions of endemism are recognized: South
173 China and western Asia (Tajikistan, Kazakhstan, and Urals) (Figure 3(A)).

174 From the *jii* Zone, around 1.5 My after the Devonian/Carboniferous boundary (Davydov
175 et al. 2012) an important radiation of ornamented siphonodellids (Sandberg et al., 1978)
176 occurs worldwide (Kaiser et al., 2017 for a review). A diversification of endemic
177 unornamented species was also observed in China and Russia (Ji, 1985 ; Zhuravlev, 2017). At
178 the same time, unornamented species appeared on the western border of the Paleotethys
179 realm for the first time with the recognition of *Si. belkai*, *Si. kalvodai*, and *Si. leiosi* sp. nov.
180 (Figure 3(B)).

181 The *jii* Zone is a period of radiation of ornamented siphonodellids with the first
182 occurrence of the cosmopolitan species *Si. jii*, *Si. cooperi*, *Si. obsoleta* and *Si. carinthiaca*. In
183 China and Russia (s. l.), the unornamented species also radiated and diversified, with *Si.*
184 *belkai* and *Si. dasaibaensis* in China (Ji & Ziegler, 1992., Li et al., 2014); and *Si. semichatovae*
185 and *Si. ludmilae* in Russia (Zhuravlev, 2017).

186 Based on the stratigraphic distribution of taxa in different regions it is possible to
187 suppose the migration route of some species along the Palaeotethys: *Si. belkai* (Kaiser et al.,
188 2017), is known in China and is present from the base of the *jii* Zone in western and eastern

189 parts of the Paleotethys, and becomes abundant in eastern Europe only in the upper part of
190 the *jii* Zone (Kaiser et al., 2017).

191 The Devonian / Carboniferous boundary coincides with a major regressive phase followed by
192 a deepening during the Tournaisian (Girard, 1994; Haq & Schutter, 2008). The migration and
193 dispersion of smooth species could be synchronous with transgressive periods. This scenario
194 was suggested by Narkiewicz & Sculc (2004) and Kaiser et al. (2017) to explain dispersion of
195 conodont faunas throughout the Tethys.

196 The *Siphonodella jii* Zone is also characterized by the first occurrence of two new
197 species on the western part of the Paleotethys: *Si. leiosi* (this study), and *Si. kalvodai*. Kaiser
198 et al. (2017, p. 17) noted that *Si. kalvodai* resembles *Si. belkai* (M1 and M2), « but differs in
199 having a crenulated outer margin and by rostral ridges only on the anterior part of the
200 platform ». It cannot be excluded that *Si. kalvodai* evolved from *Si. belkai* or from the same
201 ancestor on western part of Paleotethys when local environmental conditions became
202 favorable.

203 The history of *Siphonodella leiosi* is different as it does not resemble any other
204 described species (except minor similarities in the outline with *Si. duplicata* ?), nor from east
205 Paleotethys. As smooth species are supposed to prefer shallow-waters, the radiation and
206 development of unornamented species all around the Paleotethys could be due to a global
207 regression. However, this contradicts the scenario that suggests a transgressive phase
208 allowing the migration of *Si. belkai* from the eastern part of the Paleotethys to the western
209 part. Furthermore, biofacies and sedimentological analyses of sections in Montagne Noire
210 (Girard, 1994; Feist et al., 2020) confirm a deepening through the basal Tournaisian after the
211 major regression associated with Hangenberg Crisis just before the Devonian/Carboniferous
212 boundary.

213 From the Devonian/Carboniferous boundary to the *jii* Zone, there is an increase in
214 temperature of approximately 2-3°C, which remained stable thereafter (Buggisch et al.,
215 2008). The diversification of unornamented siphonodellids was coincident with the warmest
216 time. Shallow seas must be warmer than deep seas, and unornamented species have an
217 equatorial repartition in the beginning of the Carboniferous. Associated, or not, with depth,
218 the temperature could have played a role in development and selection of smooth
219 siphonodellids.

220

221 **Conclusions**

222 A smooth siphonodellid was found in North Gondwana in the Montagne Noire (France) for
 223 the first time. This new species *Siphonodella leiosi* is characterized by an asymmetric smooth
 224 platform, a short rostral ridge on the inner platform composed of 3 to 5 discrete nodes, an
 225 anterior part of outer platform strongly reduced. The radiation and development of
 226 unornamented species all around the Paleotethys could be due to global changes in
 227 temperatures, associated, or not, to change in water depth.

228

229 **References**

- 230 Austin, R.L., Rhodes, F.H.T., 1981. Systematic descriptions, in: Moore, R.C., Robison, R.A. (Eds.),
 231 Treatise on Invertebrate Paleontology. Geological Society of America, Boulder, p. 196.
- 232 Austin, R.L., 1976. Evidence from Great Britain and Ireland concerning West European Dinantian
 233 conodont paleoecology, in: Barnes, C.R. (Ed.), Conodont paleoecology. Geological Association of
 234 Canada Special Paper, Montreal, pp. 201-224.
- 235 Bateson, W., 1886. Memoirs: the ancestry of the Chordata. Journal of Cell Science 2, 535-572.
- 236 Becker, R.T., Kaiser, S.I., Aretz, M., 2016. Review of chrono-, litho- and biostratigraphy across the
 237 global Hangenberg Crisis and Devonian–Carboniferous Boundary, in: Becker, R.T., Koenigshof, P.,
 238 Brett, C.E. (Eds.), Devonian Climate, Sea Level and Evolutionary Events. The Geological Society of
 239 London, London, pp. 355-386.
- 240 Boyer, F., Krylatov, S., Le Fèvre, J., Stoppel, D., 1968. Le Dévonien supérieur et la limite
 241 Dévonien/Carbonifère en Montagne Noire (France). Lithostratigraphie. Biostratigraphie
 242 (conodontes). Bulletin du Centre de Recherches de Pau-SPNA 2, 5-33.
- 243 Branson, E.B., Mehl, M.G., 1934. Conodont studies number three. The University of Missouri studies.
 244 A quarterly of research VIII, 171-259.
- 245 Branson, E.B., Mehl, M.G., 1944. Conodonts, in: Shimer, H.W. and RR Shrock, R.R. (Ed.), Index Fossils
 246 of North America.
- 247 Buggisch, W., Joachimski, M.M., Sevastopulo, G., Morrow, J.R., 2008. Mississippian $\delta^{13}\text{C}_{\text{carb}}$ and
 248 conodont apatite $\delta^{18}\text{O}$ records — Their relation to the Late Palaeozoic Glaciation.
 249 Palaeogeography Palaeoclimatology Palaeoecology 268, 273-292.
- 250 Coen, M., Groessens, E., 1996. Conodonts from the Devonian-Carboniferous transition beds of
 251 central Hunan, South China. Mémoires de l'Institut Géologique de l'Université de Louvain 36, 21-
 252 28.
- 253 Corradini, C., Spalletta, C., Mossoni, A., Matyja, H., Over, J.D., 2017. Conodonts across the
 254 Devonian/Carboniferous boundary: A review and implication for the redefinition of the boundary
 255 and a proposal for an updated conodont zonation. Geological Magazine 154, 888-902.
- 256 Davydov, V.I., Korn, D., Schmitz, M.D., 2012. The Carboniferous period, in: Gradstein, F.M., Ogg, J.G.,
 257 Schmitz, M.D., Ogg, G.M. (Eds.), The Geologic Time scale 2012. Elsevier, pp. 603-651.
- 258 Dzik, J., 1976. Remarks on the evolution of Ordovician conodonts. Acta Paleontologica Polonica 21,
 259 395-455.
- 260 Dzik, J., 1997. Emergence and succession of Carboniferous conodont and ammonoid communities in
 261 the Polish part of the Variscan sea. Acta Paleontologica Polonica 42, 57-170.
- 262 Feist, R., Cornée, J.-J., Corradini, C., Hartenfels, S., Aretz, M., Girard, C., 2020. The Devonian–
 263 Carboniferous boundary in the stratotype area (SE Montagne Noire, France). Palaeobiodiversity
 264 and Palaeoenvironments. <https://doi.org/10.1007/s12549-019-00402-6>.

- 265 Gagiev, M.H., Kononova, L.I., Pazukhin, V.N., 1987. Conodonts, in: Maslov, V.A. (Ed.), Fauna and
 266 Biostratigraphy of the Devonian-Carboniferous boundary deposits in Bertschogura (Mugodzhary),
 267 pp. 91-97.
- 268 Girard, C., 1994. Conodont biofacies and event stratigraphy across the D/C boundary in the
 269 stratotype area (Montagne Noire, France), in: Königshof, P., Werner, R. (Eds.), Willi Ziegler-
 270 Festschrift I. Courier Forschung-Institut Senckenberg, Frankfurt a. M., pp. 299-309.
- 271 Haq, B.U., Schutter, S.R., 2008. A chronology of Paleozoic sea-level changes. *Science* 322, 64-68.
- 272 Hogancamp, N.J., Stolfus, B.M., Cramer, B.D., Day, J.E., 2019. A revised conodont zonation of the
 273 Tournaisian (Kinderhookian to lower Osagean) and implication for stratigraphic correlation in
 274 North America. In: Cramer, B.D., Clark, R.J., Day, J.E. (Eds.), The Devonian-Carboniferous boundary
 275 in the type area of the Mississippian. Iowa Geological Survey Guidebook 30, 11-17.
- 276 Ji, Q., 1985. Study on the phylogeny, taxonomy, zonation and biofacies of *Siphonodella* (conodonta).
 277 Bulletin of the Institute of Geology, Chinese Academy of Geological Sciences 11, 51-75.
- 278 Ji, Q., 1987. The Devonian-Carboniferous boundary in shallow-water facies areas of China as based
 279 on conodonts. *Acta Geologica Sinica* 61, 11-22.
- 280 Ji, Q., et al. 1989. The Dapoushang section: an excellent section for the Devonian-Carboniferous
 281 boundary stratotype in China. Science Press, Beijing, China.
- 282 Ji, Q., Ziegler, W., 1992. Introduction to some Late Devonian sequences in the Guilin area of Guangxi,
 283 South China. Courier Forschung-Institut Senckenberg 154, 149-177.
- 284 Kaiser, S.I., 2005. Mass extinctions, climatic and oceanographic changes at the Devonian-
 285 Carboniferous boundary, Fakultät für Geowissenschaften. Ruhr-Universität Bochum, p. 156.
- 286 Kaiser, S.I., Becker, R.T., Spalletta, C., Steuber, T., 2009. High-resolution conodont stratigraphy,
 287 biofacies and extinctions around the Hangenberg Event in pelagic successions from Austria, Italy
 288 and France. *Paleontographica Americana* 63, 97-139.
- 289 Kaiser, S.I., Kumpan, T., Cígler, V., 2017. New unornamented siphonodellids (Conodonta) of the lower
 290 Tournaisian from the Rhenish Massif and Moravian Karst (Germany and Czech Republic). *Neues*
 291 *Jahrbuch für Geologie und Paläontologie Abhandlungen* 286, 1-33.
- 292 Kaiser, S.I., Steuber, T., Becker, R.T., 2008. Environmental change during the Late Famennian and
 293 Early Tournaisian (Late Devonian-Early Carboniferous): implications from stable isotopes and
 294 conodont biofacies in southern Europe. *Geological Journal* 43, 241-260.
- 295 Kalvoda, J., Bábek, O., Malovaná, A., 1999. Sedimentary and Biofacies Record in Calciturbidites at the
 296 Devonian-Carboniferous Boundary in Moravia (Moravian-Silesian Zone, Middle Europe). *Facies* 41,
 297 141-158.
- 298 Kalvoda, J., Kumpan, T., Babek, O., 2015. Upper Famennian and Lower Tournaisian sections of the
 299 Moravian Karst (Moravo-Silesian Zone, Czech Republic): a proposed key area for correlation of the
 300 conodont and foraminiferal zonations. *Geological Journal* 50, 17-38.
- 301 Kononova, L.I., Lipnjagov, O.M., 1976. Occurrence of new conodonts from Lower Carboniferous of
 302 the Russian Platform and Don Basin. *Paleontologičeskij Žurnal* 4, 118-119 (in Russian).
- 303 Lethiers, F., Feist, R., 1991. Ostracodes, stratigraphie et bathymétrie du passage Dévonien-
 304 Carbonifère au Viséen inférieur en Montagne Noire, France. *Geobios* 24, 71-104.
- 305 Li, Z., Peng, Z., Cheng, L., Wang, C., Wang, B., 2014. New material of the early Carboniferous
 306 Conodonts from the lower member of the Baping Formation in Nandong, Guangxi, China. *Acta*
 307 *Micropalaeontologica Sinica* 31, 271-284.
- 308 Lipnjagov, O.M., 1979. The conodonts of Ct1a and Ct1b of the Donetz Basin. *Service Geologique de*
 309 *Belgique, Professional Papers* 162, 41-49.
- 310 Malec, J., 2014. The Devonian/Carboniferous boundary in the Holy Cross Mountains (Poland).
 311 *Geological Quarterly* 58, 217-234.
- 312 Matyja, H., 1976. Biostratigraphy of the Devonian-Carboniferous passage beds from some selected
 313 profiles of NW Poland. *Acta Geologica Polonica* 26, 489-539.

- 314 Narkiewicz, K., Szulc, J., 2004. Controls on migration of conodont fauna in peripheral oceanic areas.
 315 An example from the Middle Triassic of the Northern Peri-Tethys. *Geobios* 37, 425-436.
- 316 Pander, C.H., 1856. Monographie der fossilen Fische des Silurischen Systems der russisch-baltischen
 317 Gouvernements. Königlich Preussischen Akademie der Wissenschaften, St Petersburg.
- 318 Paproth, E., Feist, R., Flajs, G., 1991. Decision on the Devonian-Carboniferous boundary stratotype.
 319 Episodes 14, 331-336.
- 320 Qie, W.K., Zhang, X., Du, Y., Yang, B., Ji, W., Luo, G., 2014. Conodont biostratigraphy of Tournaisian
 321 shallow-water carbonates in central Guangxi, South China. *Geobios* 47, 389-401.
- 322 Qin, G., Zhao, R., Ji, Q., 1988. Late Devonian and Early Carboniferous conodonts from northern
 323 Guangdong and their stratigraphic significance. *Acta Micropalaeontologica Sinica* 5, 57-71.
- 324 Sandberg, C.A., Ziegler, W., Leuteritz, K., Brill, S.M., 1978. Phylogeny, speciation and zonation of
 325 *Siphonodella* (Conodonta, Upper Devonian and Lower Carboniferous). *Newsletters on*
 326 *Stratigraphy* 7(2), 102-120.
- 327 Savoy, L.E., Harris, A.G., 1993. Conodont biofacies and taphonomy along a carbonate ramp to black
 328 shale basin (latest Devonian and earliest Carboniferous), southernmost Canadian Cordillera and
 329 adjacent Montana. *Canadian Journal of Earth Sciences* 30, 2404-2422.
- 330 Scotese, C.R., 2016. Tutorial: PALEOMAP PaleoAtlas for GPlates and the PaleoData Plotter
 331 Program, <http://www.earthbyte.org/paleomap-paleoatlas-for-gplates/>.
- 332 Souquet L., Corradini C., Girard C., 2020. 3D models related to the publication: *Siphonodella leiosi*
 333 (Conodonta), a new unornamented species from the Tournaisian (lower Carboniferous) of Puech
 334 de la Suque (Montagne Noire, France). *MorphoMuseuM* e115. doi: 10.18563/journal.m3.115
- 335 Sweet, W.C., 1988. The Conodonta: Morphology, taxonomy, paleoecology, and evolutionary history
 336 of a long-extinct animal phylum. *Oxford Monographs on Geology and Geophysics*, Oxford, New
 337 York, p. 212.
- 338 Zhuravlev, A.V., 2017. A new species of the conodont genus *Siphonodella* Branson & Mehl (late
 339 Tournaisian). *Estonian Journal of Earth Sciences* 66, 188-192.
- 340 Zhuravlev, A.V., Plotitsyn, A.N., 2017. The symmetry of the rostrum as a key to taxonomy of
 341 advanced *Siphonodella* (Conodonta, Early Carboniferous). *Stratigraphy* 14, 457-474.
- 342 Zhuravlev, A.V., 2019. A new species of shallow-water *Siphonodella* (Conodonta) from the
 343 Tournaisian (Lower Carboniferous) of Pechora-Zozhva upliuft, Timan-Pechora basin. *Vestnik IG*
 344 *Komi SC UB RAS* 4. doi: 10.19110/2221-1381-2019-4-25-28
- 345 Ziegler, W., Sandberg, C.A., 1984. *Palmatolepis*-based revision of upper part of standard Late
 346 Devonian conodont zonation, in: Clark, D.L. (Ed.), *Conodont biofacies and provincialism*.
 347 Geological Society of American special Paper, Boulder/Colorado, pp. 179-194.

348
 349

350 **Acknowledgment**

351 We warmly thank Anne-Lise Charruault and Jean-Jacques Cornée for their fieldwork, and
 352 Sabrina Renaud (LBBE, Lyon) for discussions. We acknowledge the contribution of SFR
 353 Biosciences (UMS3444/CNRS, US8/ Inserm, ENS de Lyon, UCBL) AniRa-ImmOs facility. We
 354 particularly thank Mathilde Bouchet for her kind assistance during the scanning sessions.
 355 The research was supported by the Project Marcon (Labex CeMEB). This is contribution ISEM
 356 2020-109.

357

358 **Figure captions**

359 Figure 1: A. Location of the studied area, the Montagne Noire (France). B. View of the
360 inverted beds exposed in Puech de la Suque. C. Log of the lithological succession in the
361 Puech de la Suque (PS) with occurrence of the species of *Siphonodella*. Conodont Zones after
362 Corradini et al. (2017).

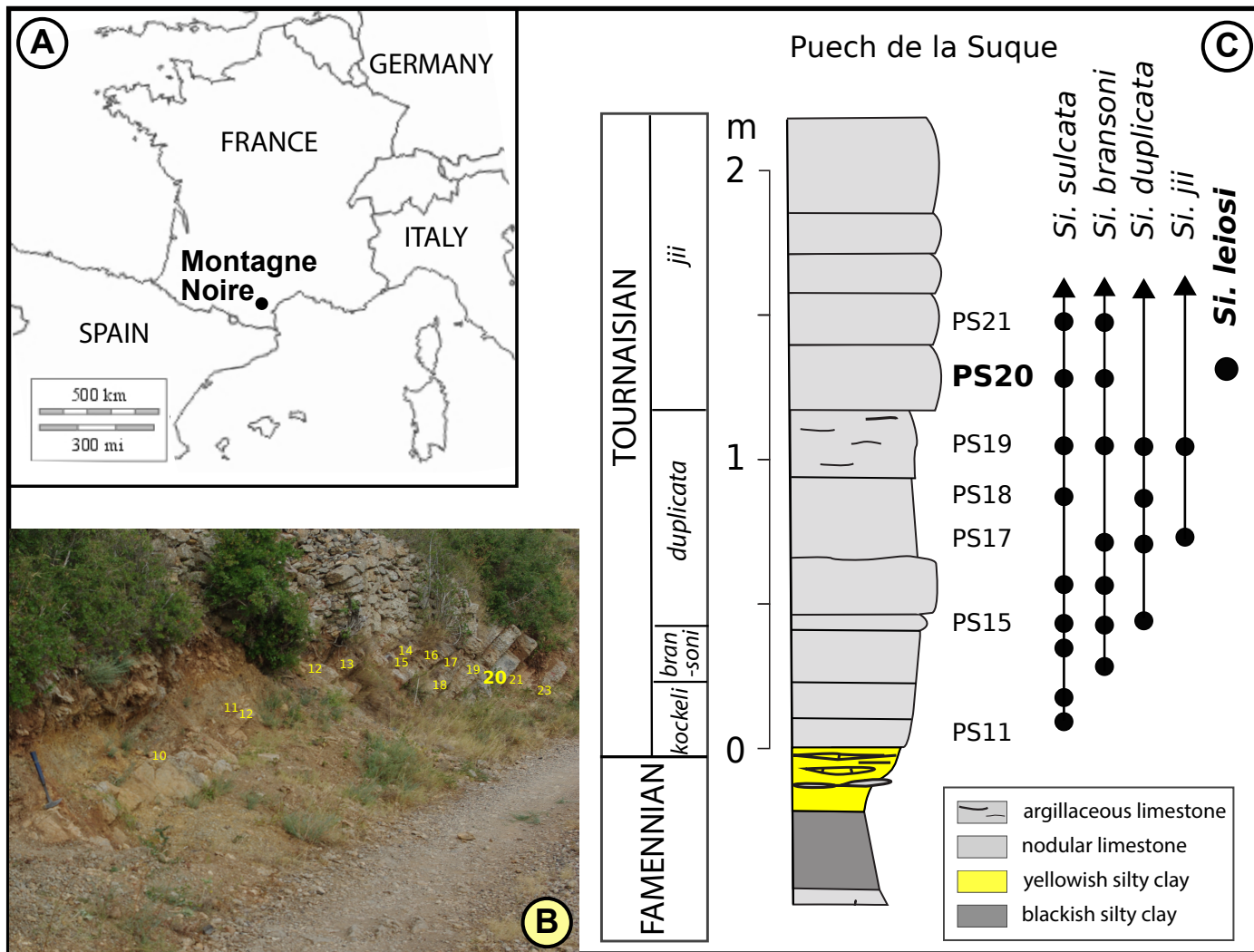
363

364 Figure 2: *Siphonodella leiosi* new species. From right to left: upper, lower and lateral views of
365 P1 element (UM PSQ 1 to 9). A: Paratype UM PSQ 1; B: Holotype UM PSQ 2; C: Paratype UM
366 PSQ 3; D: UM PSQ 4; E: UM PSQ 5; F: UM PSQ 6; G: UM PSQ 7; H: UM PSQ 8; I: UM PSQ 9.
367 Scale bar: 500 μm .

368

369 Figure 3: Tournaisian paleogeographic maps with the main currents and their directions
370 (Scotese, 2016) showing the paleogeographic distribution of unornamented siphonodellids
371 (A) from the *Protognathodus kockeli* Zone to the *Si. duplicata* Zone), and (B) during the
372 *Siphonodella jii* Zone (Corradini et al., 2017). In bold, species not present before the *Si. jii*
373 Zone. Illustrations of the siphonodellids from Ji & Ziegler (1992), Kaiser et al. (2017);
374 Zhuravlev & Plotitsyn (2017), and this study. Rep.: Republic, Pr.: *Protognathodus*, Si.:
375 *Siphonodella*.

Figure 1



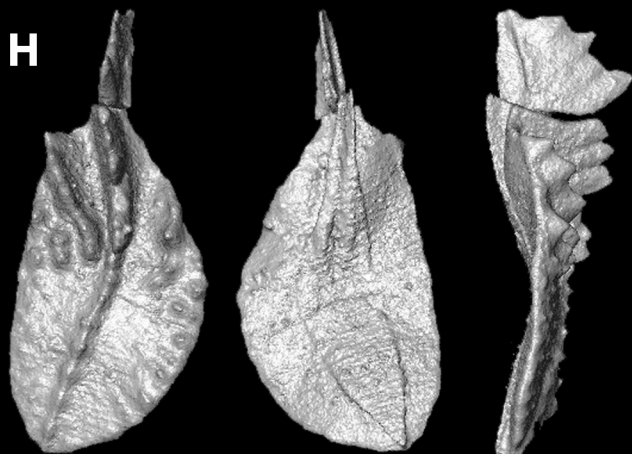
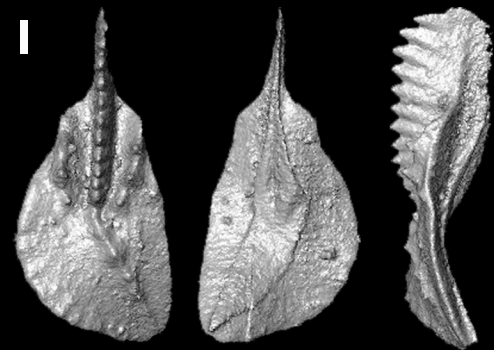
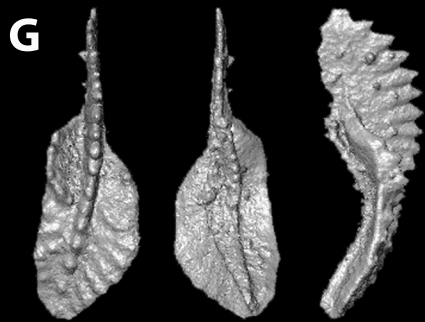
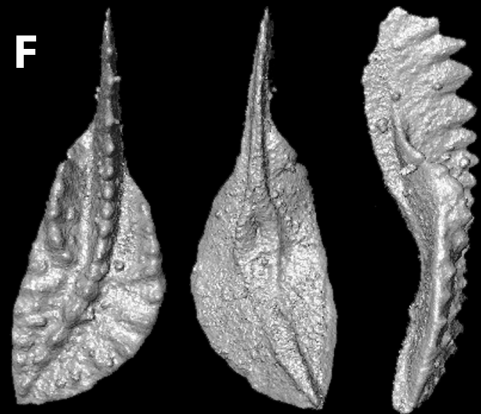
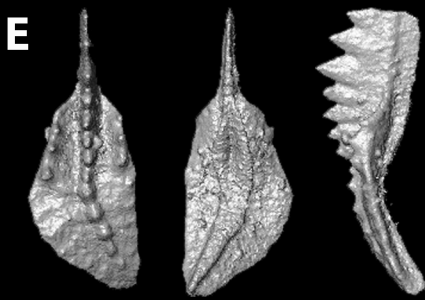
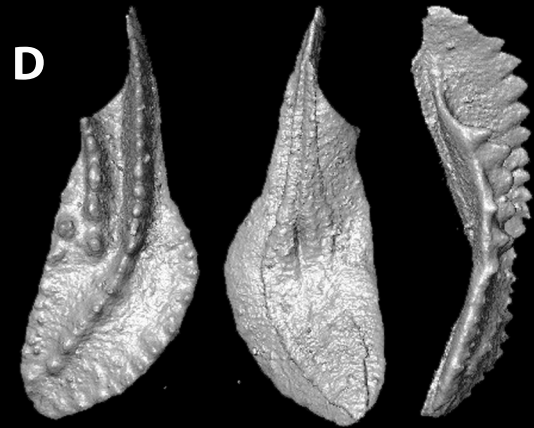
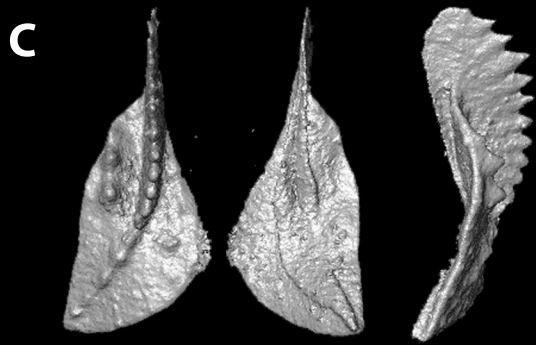
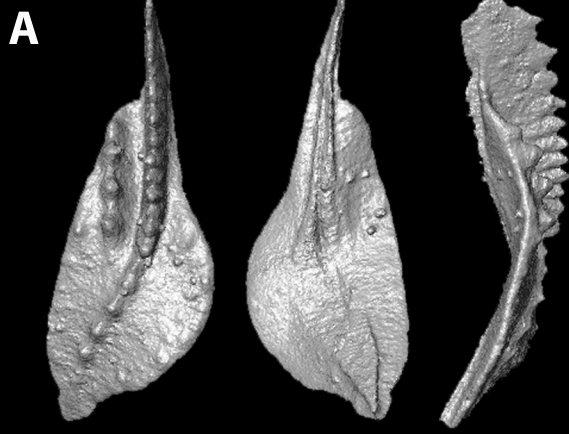


Figure 3

