Strud: old quarry, new discoveries. Preliminary report [Strud : Nouvelles découvertes dans une vieille carrière. Étude préliminaire]

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1. Introduction

The Strud quarry is located in the uppermost levels of the Dinant Synclinorium, Belgium. It exposes a part of the Upper Famennian (Upper Devonian) "Condroz sandstones", composed mainly of fine-grained, more or less micaceous, arkosic sandstones interlayered with thin shale or siltstone beds and, but rarely, with dolomite beds (these may occur either as evaporites or as immature dolcrete) (THOREZ & DREESEN, 1986).

In Belgium, most of the fossil-bearing beds in "Psammites du Condroz" are found in the Evieux Formation (FAIRON-DEMARET, 1996). The quarry was first investigated by HOCK (1878). He mentioned only the presence of remarkably well-preserved specimens of *Rhacophyton condrusorum* CRÉPIN, 1875. STOCKMANS, in 1948, published a monograph on the Upper Devonian plants of Belgium. He described several localities, including Strud. The aim of the present study is to update the data set concerning Strud and to date the quarry correctly.

2. Biostratigraphy

The Strud quarry has been recently and densely sampled for miospores. Two samples have provided a miospore association that preliminary study has indicated surprizingly to be the Lower GF spore biozone characterized by *Grandispora gracilis-Grandispora famenensis*. Commonly, this biozone dates the Monfort Formation which in other areas of the Dinant Synclinorium lies below the Evieux Formation. Here, the Evieux Formation is dated by the slightly younger VCo (*versabilis cornuta*) biozone and by the lithology described above.

Taking into account the actual Strud lithology and its miospore association, one may conclude that the sequence exposed in the quarry is in reality facies of an Evieux type and does correspond biostratigraphically to the Evieux Formation as was thought previously: the data clearly demonstrate that the Evieux facies has a diachronous character dependent on Upper Fammenian palaeogeography (THOREZ *et alii*, 2006).

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3. Fossil remains

The quarry has yielded various fossil remains. An important vertebrate assemblage including a mandible of the early tetrapod *Ichtyostega* (CLÉMENT *et alii*, 2004) has been found. The palaeozoological material found in the quarry is currently under study by Gaël CLÉMENT (Museum d'Histoire Naturelle, Paris).

The outcrop has also yielded plant remains. The first collection was made by F. STOCKMANS before 1950 and is housed at the Institut Royal des Sciences Naturelles de Belgique. The fossils are preserved as strongly oxidized, red- to brown-coloured compressions. The state of preservation does not allow any anatomical study.

The second collection (Pl. 1, figs. 1-7) is newly collected material and is housed in the collections of the University of Liège. The plants are less well-preserved than the older specimens. This can be explained by the fact that the Strud quarry has not been exploited for more than 100 years. The outcrop has thus been exposed to weathering processes for a long time.

STOCKMANS's floristic index mentions 5 taxa for the quarry. All are classical members of the "Evieux flora" (STOCKMANS, 1948; FAIRON-DEMARET, 1996). This index is summarized in Table 1.

Zosterophyllopside	**Gymnospermes**
Barinophyton citrulliforme	*Moresnetia zalesskyi*
Filicopside	*Pseudosporogonites hallei*
Zygopteridale	***Incertae sedis***
Rhacophyton condrusorum	Cf. *Calathiops sp.*

Table 1: Paleofloristic assemblage of Strud as described by STOCKMANS (1948).

Progymnospermes	**Gymnospermes**
Archaeopteris roemeriana	*Moresnetia zalesskyi*
Zosterophyllopside	*Pseudosporogonites hallei*
Barinophyton citrulliforme	*Condrusia rumex*
Filicopside	***Incertae sedis***
Zygopteridale	Cf. *Calathiops sp.*
Rhacophyton condrusorum	*Sphenopteris flaccida*
	Sphenopteris modavensis

Table 2: Paleofloristic assemblage of Strud as determined in this work.

The new collection increases the floristic index of the locality to 9 taxa (Table 2). It shows the presence of nearly all important upper Devonian plant groups: Progymnosperms, Ferns, Gymnosperms and Barinophytes.

Progymnosperms:

Archaeopteris remains are the only representatives of this group (Pl. 1, fig. 1). In contrast with a number of Belgian localities (FAIRON-DEMARET, 1996), *Archaeopteris* remains are rare at Strud. Only three fragments have been recovered. The organisation of their axis and the shape of their leaves are characteristic of the species *Archaeopteris roemeriana* (GÖPPERT) *sensu* STOCKMANS, 1948. This species should probably be synonymised with *Archaeopteris halliana* (GÖPPERT) DAWSON, 1871 (FAIRON-DEMARET *et alii*, 2001).

Ferns:

This group is represented by *Rhacophyton condrusorum* (Pl. 1, fig. 4). It was the first plant to have been described from the quarry (HOCK, 1878). The remains of this plant consist of large rachis without fertile parts or vegetative endings. In other beds from the same quarry, HOCK (1878) described very fine and well preserved *Rhacophyton* fertile parts.

Spermatophytes:

They consist of three different taxa: *Moresnetia zalesskyi* STOCKMANS, 1948, emend. FAIRON-DEMARET et SCHECKLER, 1987 (Pl. 1, figs. 6-7), *Condrusia rumex* STOCKMANS, 1948 (Pl. 1, fig. 3) and *Pseudosporogonites hallei* STOCKMANS, 1948 (see STOCKMANS, 1948, Pl. XI, fig. 18). *Moresnetia* and *Pseudosporogonites* dominate this assemblage.

4. Discussion

Based on megafossils only, the locality is attributed to Famennian biozone number 7 of EDWARDS *et alii* (2000). If a palynological age of mid GF is confirmed, the locality would represent the earliest occurrence of cupulate early seed plants, if we exclude the poorly understood Russian *Moresnetia* mentioned by JURINA (1988) in the OG Russian Frasnian miospore zone.

Plate 1:
figure 1. *Archaeopteris roemeriana* (GÖPPERT) STOCKMANS, ULg n° 15201, scale: 0.5 cm.
figure 2. *Sphenopteris modavensis* STOCKMANS 1948, ULg n° 15221, scale: 1 mm.
figure 3. *Condrusia rumex* STOCKMANS, ULg n° 15222, scale 1 mm.
figure 4. *Rhacophyton* sp. CRÉPIN, ULg n° 15203, scale 1 cm.
figure 5. *Sphenopteris flaccida* STOCKMANS 1948, ULg n° 15215, scale 5 mm.
figures 6-7. *Moresnetia zalesskyi* STOCKMANS, ULg n° 15216 and 15217, scales 0.5 mm.

The greatest diversity among the plants observed in the quarry is found in the spermatophytes, represented by 3 very different genera: the classical *Moresnetia zalesskyi*, and the less well-known *Condrusia rumex* and *Pseudosporogonites hallei*. These three seed-plant genera illustrate a wide range of morphological variation both in the cupule and in the integument (FAIRON-DEMARET & SCHECKLER, 1987; PRESTIANNI, 2005; PRESTIANNI *et alii*, 2006a), representing three distinct architectural schemes (HILTON, 1999; PRESTIANNI, 2005).

Such diversity in a group suggests a long evolutionary story. The origin of seed plants is thus presumably to be found earlier in the geological record. The description of the proto-seed *Runcaria heinzellinii* (GERRIENNE *et alii*, 2004), the discovery of a highly diversified Givetian megaspore assemblage (PRESTIANNI *et alii*, 2006b; VILLE de GOYET *et alii*, 2007) and the two seed megaspores *Spermasporites allenii* MARSHALL et HEMSLEY, 2003 and *Granditetrasporites zharkovae* ARKHANGELSKAYA et TURNAU, 2003 are all supplementary indications of the probable Middle Devonian origin of the seed plant lineage.

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References

ARKHANGELSKAYA A.D. & TURNAU E. (2003).- New dispersed seed-megaspores from the mid-Givetian of European Russia.- *Review of Paleobotany and Palynology*, Amsterdam, vol. 127, n° 1, p. 45-58.

ARNOLD C.A. (1939). – Observations on fossil plants from the Devonian of Eastern North America. IV. Plants remains from the Cattskill Delta deposits of Northern Pennsylvania and Southern New-York.- *Contribution Museum Paleontology, University of Michigan*, vol. V, p. 271-314.

CLÉMENT G., AHLBERG Per E., BLIECK A., BLOM H., CLACK J.A., POTY E., THOREZ J. & JANVIER P. (2004).- Palaeogeography: Devonian tetrapod from western Europe.- *Nature*, London, vol. 427, p. 412-413.

CRÉPIN F. (1875).- Description de quelques plantes fossiles de l'étage des Psammites du Condroz (Dévonien supérieur).- *Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique*, Bruxelles, 2ème série, T. XXXVIII, p. 356-366.

DAWSON J.W. (1871).- The fossil plants of the Devonian and Upper Silurian formations of Canada.- *Geological Survey of Canada*, Montréal, 923 p.

EDWARDS D., FAIRON-DEMARET M. & BERRY C.M. (2000).- Plant megafossils in Devonian stratigraphy: a progress report. *In*: BULTYNCK P. (ed.) Subcommission on Devonian Stratigraphy – Fossil groups important for boundary definition.- *Courier Forschungsinstitut Senckenberg*, Frankfurt, n° 220, p. 25-37.

FAIRON-DEMARET M. (1996).- The plant remains from the Late Famennian of Belgium: a review.- *The Palaeobotanist*, Lucknow, vol. 45, p. 201-208.

FAIRON-DEMARET M., LEPONCE I. & STREEL M. (2001).- *Archaeopteris* from the Upper Famennian of Belgium: heterospory, nomenclature, and palaeobiogeography.- *Review of Paleobotany and Palynology*, Amsterdam, vol. 115, p. 79-97.

FAIRON-DEMARET M. & SCHECKLER S.E. (1987).- Typification and redescription of *Moresnetia zalesskyi* STOCKMANS, 1948, an early seed plant from the Upper Famennian of Belgium.- *Bulletin de l'Institut Royal des Sciences naturelles de Belgique*, Bruxelles, (Sciences de la Terre), vol. 57, p. 183-199.

GERRIENNE P., MEYER-BERTHAUD B., FAIRON-DEMARET M., STREEL M. & STEEMANS P. (2004).- *Runcaria*, a Middle Devonian Seed Plant Precursor.- *Science*, Washington, vol. 306, p. 856-858.

GÖPPERT H.R. (1860).- Über die fossile Flora der silurischen, der devonischen und unteren Kohlenformation oder des sogenannten Uebergangsgebirges.- *Verhandlung Kaiserlischen Leopoldina Caroliana Akademie Naturforschung*, Jena, Bd. XXVII, p. 425-606.

HILTON J. (1999).- A Late Devonian plant assemblage from the Avon Gorge near Bristol: taxonomic, phylogenetic and stratigraphic implications.- *Botanical Journal of the Linnean Society*, London, vol. 129, p. 1-52.

HOCK M.G. (1879).- Communication du 16 septembre 1879.- *Annales de la Société géologique de Belgique*, Liège, vol. VI, p. XCVIII-XCIX.

JURINA A.L. (1988).- The Middle and Late Devonian floras of northern Eurasia.- *Transactions of the Palaeontological Institute*, Moskva, vol. 227, 176 p. (in Russian).

MARSHALL J.E. & HEMSLEY A.R. (2003).- A Mid Devonian seed-megaspore from East Greenland an the origin of the seed plants.- *Palaeontology*, London, vol. 46, part 4, p. 647-670.

PRESTIANNI C. (2005).- *Condrusia*: a novel Famennian pre-ovulate structure.- Abstract No. P1477, XVII International Botanical Congress, Vienna, 17th-23rd July 2005, p. 471.

PRESTIANNI C., STREEL M., GERRIENNE P. & HILTON J. (2006a).- New observations on the late Devonian Plant assemblage from Strud, Southern Belgium.- A life of ferns and gymnosperms, Montpellier, 6th-8th April

2006, p. 19.

PRESTIANNI C., VILLE DE GOYET F. de, BREUER P., STEEMANS P. & GERRIENNE P. (2006b).- Ovulate structure early origin and diversification: did something happen during the Givetian?- 7th Palaeobotany-Palynology conference, Praha, 6th-11th September 2006, p. 109.

STOCKMANS F. (1948).- Végétaux du Dévonien supérieur de la Belgique.- *Mémoires du Musée Royal d'Histoire Naturelle de Belgique*, Bruxelles, vol. 110, 84 p.

THOREZ J. & DREESEN R. (1986).- A Model of a regressive depositional system around the old red continent as exemplified by a field trip in the upper Famennian "Psammites du Condroz" in Belgium.- *Annales de la Société géologique de Belgique*, Liège, vol. 109, n° 1, p. 285-323.

THOREZ J., DREESEN R. & STREEL M. (2006).- Famennian. *In*: DEJONGHE L. (ed.), Current status of chronostratigraphic units named from Belgium and adjacent areas.- *Geologica Belgica*, Bruxelles, vol. 9, n° 1-2, p. 27-45.

VILLE de GOYET F. de, BREUER P., GERRIENNE P., PRESTIANNI C., STREEL M. & STEEMANS P. (2007).- Middle Devonian (Givetian) megaspores from Belgium (Ronquières) and Libya (A1-69 borehole).- *Carnets de Géologie - Notebooks on Geology*, Brest, Memoir 2007/01, Abstract 11 (CG2007_M01/11), p. 68-73.