ABSTRACT. The Givetian Stage in the Givet area is represented by the main part of the Hanonet Fm, the Trois-Fontaines Fm, the Terres d’Haus Fm, the Mont d’Haus Fm, the Fromelennes Fm and the lowest part of the Nismes Fm. During Eifelian-Givetian transition, the sedimentary systems evolved from a mixed siliciclastic-carbonate ramp to a carbonate platform dominated by cyclic tidal-flat and lagoonal wackestones with local patch reefs or coralgal banks. The shelf had an ESE-WNW trend and extended from the Avesnois basin (northern France) in the west to Aachen (western Germany). The sedimentation in the Ardennes consists of shallow water regressive metric (around 5 m or less) cycles. Stromatopores, corals, brachiopods, algae and cyanobacteria are abundant. Due to this general shallow water setting, the base of the Givetian Stage has been defined by the IUGS Subcommission on Devonian Stratigraphy in a GSSP in southern Morocco referring to the first occurrence of the condodont species Polygnathus hemiansatus. The conodont species Icriodus obliquimarginatus appears approximately at the same level in Belgium.

KEYWORDS: Givetian, lagoons, tidal flats, patch reefs, coralgal banks, carbonate platform.


1. Name

Givetian (English), Givetiaan (Dutch), Givetium (German), Givetien (French)

2. Age

391.8 to 385.3 Ma from Gradstein & Ogg (2004).

3. Author

Gosselet (1879) : Description géologique du canton de Maubeuge. Annales de la Société Géologique du Nord, 6 : 129-211. Introducing the name « Givetien », Gosselet (1879, p.132) refers to his description of the Givet Limestone (Gosselet, 1876) : « Le Calcaire de Givet est évidemment celui qui forme les escarpements des bords de la Meuse, au Sud de Givet, sous la forteresse de Charlemont et qui se suit sans interruption depuis Givet dans les Ardennes jusqu’à Rocquigny dans le Nord. ».

4. Historical type area

Escarpsments on the north-western banks of the River Meuse, to the south-west of Givet (France), along RN 51 between les Trois-Fontaines and St-Hilaire, topographic

Figure 1. Type section of the Givet Limestone on the left bank of the Meuse River, south of Givet. 1 = Trois-Fontaines Formation; 4 = Fromelennes Fm.
5. Description

According to the definition of the Global Stratotype Section and Point (GSSP) for the base of the Givetian (Walliser et al., 1995) and for the base of the Frasnian (Klapper et al., 1987), the Givetian Stage in the Givet area is represented by the main part of the Hanonet Fm, the Trois-Fontaines Fm, the Terres d’Haurs Fm, the Mont d’Haurs Fm, the Fromelennes Fm and the lowest part of the Nismes Fm. Biostromal beds and fine grained micritic limestones prevail. Two shaly parts with nodular limestones occur, the Terres d’Haurs Fm and the Flohimont Mbr of the Fromelennes Fm.

6. Historical background

A very detailed summary of the various concepts of the ‘Givetian’ and ‘Calcaire de Givet’ terms was published by Sartenaer & Errera (1972). In a special volume of the BRGM, Service Géologique National de France, devoted to French stratotypes, Brice (1980) gave an historical overview of the term Givetian and its lithostratigraphic and biostratigraphic characteristics. Herein attention is paid only to the most important changes in the meaning of the term Givetian. For more detailed information the reader is referred to the two above-mentioned references.

According to Gosselet (1879, p. 130, 131) the term ‘Givétien’ he introduced corresponds to the ‘Calcaire de Givet’, exposed along the Meuse River south of Givet, which he described earlier (1876). Using the current lithostratigraphic terminology, the ‘Givétien’ of Gosselet (1879) includes the Trois-Fontaines Fm (without the 5-6 m of dark bluish limestones at the base), the Terres d’Haurs Fm, the Mont d’Haurs Fm and the Fromelennes Fm without the Fort Hulobiet Mbr. Currently current lithostratigraphic terminology will be used for describing the major changes in the concept of the term Givetian.

Between 1884 and 1900 Gosselet used the term Givetian in a more restricted meaning. It is only represented by the Trois-Fontaines Fm (without the 5-6 m of limestones at the base), the Terres d’Haurs Fm, the Mont d’Haurs Fm and the Fromelennes Fm without the Fort Hulobiet Mbr. This current lithostratigraphic terminology will be used for describing the major changes in the concept of the term Givetian.

Figure 2. Part of topographic map 1:10,000 Agimont 58/3 (slightly reduced) showing the location of the type section of the Givet Limestone. 1 = Trois-Fontaines Fm; 2 = Terres d’Haurs Fm; 3 = Mont d’Haurs Fm; 4 = Fromelennes Fm. The positions of 1 and 4 are also shown in Fig. 1.
different explanatory notes of the Belgian Geological map between 1896 and 1929, the Givetian includes the Trois-Fontaines Fm (without the 5-6 m of limestone at the base), the Terres d’Haux Fm and the Mont d’Haux Fm (these three formations are represented by Gva on the Belgian maps) and the Fromelennes Fm (= Gvb on the Belgian maps). Since Maillieux (1910) many Belgian authors have used the term Givetian in a more restricted meaning including the Trois-Fontaines Fm, the Terres d’Haux Fm and the Mont d’Haux Fm. They assign the Fromelennes Fm to the Frasnian. Sartenaer & Errera (1972) define a Givet Group (= Calcaire de Givet) composed of the Trois-Fontaines Fm, the Mont d’Haux Fm and the Fromelennes Fm. They propose that a Givetian stage should approximately represent the period of time for deposition of the Givet Limestone. This approach has been followed by most Belgian authors since 1972. Prétat & Tourneur (1991) introduced the Terres d’Haux Fm corresponding to the uppermost part of the Trois-Fontaines Fm and the lowest part of the Mont d’Haux Fm sensu Sartenaer & Errera (1972).

In 1981 the IUGS Subcommission on Devonian Stratigraphy (SDS) decided to retain the name Givetian as international chronostratigraphic term for the upper stage of the Middle Devonian. However, in the type area for the name of the stage, the Givetian is mainly represented by shallow water platform carbonates. Corals, stromatoporoids and brachiopods, at some levels, are the most common fossil groups, useful for regional-interregional biostratigraphy but not for worldwide correlation. The base of all Devonian stages, with the exception of the Lochkovian, have been defined by SDS using conodonts because they provided the best results for worldwide correlation. The base of the Givetian stage was defined in a Global Stratotype Section and Point (GSSP) in southern Morocco referring to the first occurrence of the conodont species Polygnathus hemiansatus; another conodont Icriodus obliquimarginatus appears approximately at the same level (Walliser et al., 1995). Conodonts are generally sparse in the Givet Limestone and the underlying Hanonet Fm. However, Bultynck & Hollevoet (1999) demonstrated that the index species and also I. obliquimarginatus first occur near the top of the lower part of the Hanonet Fm as described herein. Coen-Aubert (1992) recorded the two conodont species in the lower part of Fm “X” in Nismes. The base of the Frasnian (= top of Givetian) has been defined by SDS (Klapper et al., 1987) in a GSSP (Montagne Noire, Southern France) by the first occurrence of an early morphotype of the conodont Ancyrodelia rotundiloba. This species appears slightly above the base of the Nismes Fm in many sections of the Ardennes (Bultynck et al., 1988).

7. Lithology

The Givetian of the type area is represented by the main part of the Hanonet Fm, The Trois-Fontaines, Terres d’Haux, Mont d’Haux and Fromelennes formations and the lowest part of the Nismes Fm (Fig. 3).

7.1. Hanonet Fm

The top of the lower part of this Fm is of Early Givetian age as indicated above. The Fm consists of blackish, argillaceous, pyritic nodular thin limestone beds with thin calcareous shale beds (lower part), dark thin bluish limestones beds with corals (middle part), and two biostromal units (stromatoporores, rugose and tabulate corals) separated by an interval with argillaceous limestones and shales (upper part) (Fig. 4). Thickness: 30 to 70 m. Lateral variations: important since the biostromal units can be reduced or can pass to large reefal lenses (bioherms) on a scale of less than a few kilometers. These lenses belong to Fm X (Coen-Aubert, 1991).

Figure 4. Uppermost part of the Hanonet Fm with dark nodular limestone beds alternating with thin calcareous shale beds overlaid by the basal limestone beds of the Trois-Fontaines Fm. Mont d’Haux section, the location is shown in Fig. 2.
7.2. Trois-Fontaines Fm

Well-bedded greyish thin limestones with (1) crinoidal beds at the base, locally coral-rich, (2) stromatoporoid-coralgal biostrome capped locally by *Stringocephalus* coquinoid beds, (3) very fine-grained, locally laminar limestones with a few bioclastic interstratified thin beds. Large thickness variations from 10 to 40 m for units 1-2, and 20 m to 60 m for units 3-4. No important facies variations except west of the Xhoris Fault of the SE flank of the Dinant Synclinorium where there is an increasing influx of terrigenous material. Lower boundary: first ‘pure’ limestone bed above the dark shaly limy beds of the Hanonet Fm. For mapping purposes (Dumoulin & Coen - in press), the base of the Trois-Fontaines Fm is considered as the base of the ‘first biostrome’ sensu Préat *et al.* (1984). Upper boundary: base of the Terres d’Hauers Fm.

7.3. Terres d’Hauers Fm

Well- to medium-bedded shaly and darkish limestones with crinoids, corals, brachiopods and trilobites. The base of the formation consists of a well stratified or ‘patch reef’ coralgal biostrome interstratified with decimetric calcshales. Lateral variation: as for the Trois-Fontaines Fm there is an increase of terrigenous material at the southeast. Lower boundary: coralgal biostrome with mas-
sive rugose and tabulate corals, upper boundary: base of the Mont d’Haurs Fm. Thickness: around 60-70 m.

7.4. Mont d’Haurs Fm

Medium- to thick-bedded biostromal (stromatopores, rugose and tabulate corals, brachiopods), alternating with fine-grained micritic limestones and dolomitic shales and limestones (Fig. 5). Lower boundary: first massive biostromal bed with abundant stromatopores and corals. Upper boundary: base of the Fromelennes Fm. Thickness: 160 m at Givet.

7.5. Fromelennes Fm

Thin-, medium- and thick-bedded limestones and shaly limestones with increasing shale levels towards the top. Three members have been defined (Coen-Aubert, 1991): Flohimont Mbr, 29 m of brachiopod-rich argillaceous limestones with shaly intervals at the top; Moulin Boreux Mbr, 82 m of biostromal and massive cryptagal limestones, Fort Hulobiet Mbr, 24 m of calcshales and argillaceous bioclastic limestones (Fig. 6). Lower boundary: first brachiopod-rich argillaceous bed overlying the massive biostromal bed of the preceding formation. Upper boundary: base of the Nismes Fm (beginning with the ‘Zone des Monstres’ i.e. nodular limestone with very abundant large brachiopods). Lateral variations: the Fm is 15 m thicker to the east, and decreases to the NE. In the Philippeville Massif the thickness is about 80 m.

8. Sedimentology and palaeogeography

The general evolution is transgressive over the Old Red Continent from late Emsian to late Frasnian and parallels the global eustatic curve of Johnson et al. (1985) for the Devonian System of Euramerica with a few discrepancies observed in late Givetian and middle Frasnian times. On a larger European scale, the transgression was in a northerly direction, reaching the southern Ardennes by lower Eifelian and western Germany by the middle Givetian. During Eifelian-Givetian transition, the sedimentary systems consisted of the evolution from a mixed siliciclastic-carbonate ramp to a carbonate platform (Kasimi & Préat, 1996) dominated by cyclic tidal-flat and lagoonal wackestones with local patch reefs or coralline banks. The transition of the ramp to the platform system is diachronous since both systems were locally coeval in southern Belgium and northern France (Préat, 2004). The shelf had an ESE-WNW trend and extended from the Avesnois basin (northern France) in the west to Aachen (western Germany) in the east. Isolated carbonate complexes developed East of the Rhine river in the Rheinische Schiefergebirge, and in southwest England. The platform had a complex internal structure and the reefs were positioned either on the shelf-edge, within the shelf or upon topographic highs within the basin. Synsedimentary tectonism (France, Belgium, England?) and volcanism (Germany) are conspicuous. The development of this barrier-reef system enabled back-reef sedimentation to occur in a broad-shelf lagoon (Préat & Boulvaïn, 1988).
13.1 Microfaunas and Microfloras

Microfaunas and microfloras are important for palaeoenvironmental analyses and can be used for precise age determination as they are facies related. Semi-restricted lagoons (Trois-Fontaines Fm, Mont d’Haus Fm and Fromelennes Fm) have abundant dasyclads, calcispheres, palaeocopine calcispheres, cyanobacteria and nodular codiaceans (Préat et al., 1984; Préat & Mamet, 1989). Restricted lagoons have calcispheres (Trois-Fontaines Fm), cyanobacteria, spongiostromids (Mont d’Haus Fm), few dasyclades and umbellinids (Fromelennes Fm). Microcodiaceans developed in lagoons associated with pre-evaporitic conditions or in supratidal environments with vadose cementation. The algal diversity is higher around the Eifelian-Givetian boundary interval which is characterized by udoteaceans (Paralititania bai-lexensis, Pseudopalaeoporella lummatonensis) (Mamet & Préat, 1985), ‘giant’ dasyclad Givetianella tienii (Mamet & Préat, 1982) and giant ‘phylloid’ Resteignella resteignensis (Mamet & Préat, 1983).

9.5 Algae

Rich algal microfloras (blue-green, green and red algae) are present throughout the Givetian. They cannot be used for precise age determination as they are facies related. Semi-restricted lagoons (Trois-Fontaines Fm, Mont d’Haus Fm and Fromelennes Fm) have abundant dasyclads, calcispheres, palaeocopine calcispheres, cyanobacteria and nodular codiaceans (Préat et al., 1984; Préat & Mamet, 1989). Restricted lagoons have calcispheres (Trois-Fontaines Fm), cyanobacteria, spongiostromids (Mont d’Haus Fm), few dasyclades and umbellinids (Fromelennes Fm). Microcodiaceans developed in lagoons associated with pre-evaporitic conditions or in supratidal environments with vadose cementation. The algal diversity is higher around the Eifelian-Givetian boundary interval which is characterized by udoteaceans (Paralititania bai-lexensis, Pseudopalaeoporella lummatonensis) (Mamet & Préat, 1985), ‘giant’ dasyclad Givetianella tienii (Mamet & Préat, 1982) and giant ‘phylloid’ Resteignella resteignensis (Mamet & Préat, 1983).

The stratigraphic ranges of Givetian acritarchs, spores, corals, brachiopods and conodonts have been incorpo-
rated in a Middle Devonian Composite Standard established using the graphic correlation method (Gouwy & Bultynck, 2003).

10. Chronostratigraphy

Correlation with the internationally agreed IUGS chronostratigraphic time scale is based on conodonts (Fig. 7). Polygnathus hemiansatus, the index species for the base of the Givetian, occurs near the top of the lower part of the Hanonet Fm (Bultynck & Hollevoet, 1999). Due to shallow water facies, conodonts are sparse at that level. But because also Icriodus obliquimarginatus first occurs at the same level, the positioning of the boundary is considered reliable.

An early morphotype of Ancyrodella rotundiloba, the index taxon for the base of the Frasnian (= top of the Givetian), occurs 1.50m above the base of the Nismes Fm in Nismes in rich conodont faunas and in a phylogenetic succession (Bultynck et al., 1988). Different parts of the Givet Limestone can be correlated with the Devonian conodont standard zonation. The Trois-Fontaines Fm belongs to the hemiansatus Zone and the Terres d’Haus and the lower part of the Mont d’Haus Fm to the timorensis Zone (= lower part of Lower varcus Zone) (Bultynck, 1987). The uppermost part of the Mont d’Haus Fm and the lower part of the Flohimont Mbr belong to the rhenanus/varcus Zone (= upper part of Lower varcus Zone) and the upper part of this member is assigned to the anatus Zone (= Middle varcus Zone) (Bultynck et al., 2001). The Fort Hulobit Mbr is assigned to the lowest part of the falsiovalis Zone (Bultynck et al., 2000).

11. Geochronology

No radiometric data are available.

12. Structural setting

The Givet area belongs to the southern border of the Dinant Synclinorium. This latter is located in the northern part of the Ardennes allochton and forms part of the Rhenoberycanian belt of the Mid-European Variscides. The outcrops occur in several folds characterized by N-NE disymmetrical structures with subhorizontal elongated flanks (‘plateurs’) and subvertical short flanks (‘dressants’). These structures display a slightly S-SE dipping schistosity. The amplitude and wavelength of the folds occur are on a kilometric scale (Lacquement et al., in press).

Figure 7. Generalized lithostratigraphic cross-section of uppermost Eifelian, Givetian and lowermost Frasnian formations across the southern and south-eastern border of the Dinant Synclinorium (after Bultynck & Dejonghe, 2001).
13. Reference sections in Belgium and GSSP

The GSSP boundary for the Eifelian–Givetian is located in a section at Jebel Mech Irdane in the Tafcilat of Morocco (Walliser et al., 1995). The position of the boundary was selected by the Subcommission on Devonian Stratigraphy in 1992 to coincide with the level at which Polygnathus foliatus changes to Polygnathus hemisphaerius (conodonts). In Belgium, the old Resteigne quarry (Préat et al., 1984) is the best section showing over 200 m the Hanonet Fm, the Trois–Fontaines Fm, the Terres d’Haus Fm and the lower part of the Mont d’Haus Fm. The stratotype section of the Nismes Fm (Bultynck & Coen, 1999) shows the Fort Hulobiet Mbr of the Fromelennes Fm in direct contact with the Nismes Fm. The Sourd d’Ave outcrop exposes the upper part of the Fromelennes Fm and its contact with the Nismes Fm.

14. Main contributions


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