OSTRACODES, ROCK FACIES AND MAGNETIC SUSCEPTIBILITY OF THE Givetian / Frasnian Transition at Sourd d’Ave (Dinant Synclinorium, Belgium)

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The Sourd d’Ave is a classic reference section in the type region for the definition of the Givetian and Frasnian Stages. This section exposes the Givet Group / Frasnes Group boundary. The Givet Group is represented by the upper part of the Moulin Boreux Member (=Mbr) and by the Fort Hulobiet Mbr belonging both to the Fromelennes Formation (=Fm). The Frasnes Group is represented by the Pont d’Avignon Mbr, by the Sourd d’Ave Mbr and by the base of the La Prée Mbr belonging all to the Nismes Fm.

The upper part of the Moulin Boreux Mbr visible in the Sourd d’Ave section is composed of 8 m of built-up limestones with massive and branched stromatoporoids. The Fort Hulobiet Mbr, is composed of 28 m of calcareous shales and argillaceous limestones. The Pont d’Avignon Mbr corresponds to a 45 cm-thick nodular argillaceous limestone. The Sourd d’Ave Mbr is 9.3 m thick and made up of calcareo-argillaceous nodular shales with rare small argillaceous limestone beds. Finally the base of the La Prée Mbr consists of shales with rare calcareo-argillaceous nodules.

The position of the Givetian / Frasnian boundary in the Dinant Synclinorium is still in debate, and is fixed arbitrarily herein at the Givet Group / Frasnes Group boundary where the first thin calcareous argillaceous limestones have been identified.

The uppermost part of the Fromelennes Fm. in the Sourd d’Ave section is composed of 6 m of built-up limestones with massive and branched stromatoporoids. The Fort Hulobiet Mbr, is composed of 28 m of calcareous shales and argillaceous limestones. The Pont d’Avignon Mbr corresponds to a 45 cm-thick nodular argillaceous limestone. The Sourd d’Ave Mbr is 9.3 m thick and made up of calcareo-argillaceous nodular shales with rare small argillaceous limestone beds. Finally the base of the La Prée Mbr consists of shales with rare calcareo-argillaceous nodules.

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The transition Givet / Frasnes Group is abrupt in the Sourd d’Ave section, and the environment became exclusively and durably marine. In the Pont d’Avignon Mbr, the relative proportion of polysaccaridic and metacarpids indicates a well oxygenated marine environment a little below fair-weather wave-base level. In the Sourd d’Ave Mbr, the depth increases as showed by the ascendance of metacarpids comparatively to polysaccaridic, and in the base of the La Prée Mbr, with the deepening, ostracodes became more rare. Finally in another section located in the prolongation of the Sourd d’Ave section, metacarcinoid ostracodes (Planulidae) proxy for hypoxic water conditions (CASIER, 2004) have been identified.

The Givet Group / Frasnes Group transition has been recently studied at Nismes, close to Frasnes (CASIER & PREAT, 2009), and at Flisimont, close to Givet (MAILLET, 2010). The only significant change as deduced from the ostracode fauna and the sedimentology in the three sections is the transition from lagoonal and semi-restricted environments to open marine environments close to the Givet Group / Frasnes Group boundary. But at Sourd d’Ave this change is abrupt and takes place exactly at this boundary. On the contrary, in the Nismes and Flisimont sections, this change corresponding to the entry of Polygenia bekxmanni bekxmanni, occurred in the upper part of the Fromelennes Fm. In fact, there is a hiatus at the Givet Group / Frasnes Group boundary emphasized by an irregular contact in the Sourd d’Ave section.

Based on the study of the Sourd d’Ave and Nismes sections, only 13 out of 56 species identified in the Givetian survived the Frasnes Event. The important modification of the environment at the Givet Group / Frasnes Group boundary is mostly responsible for this change.

Ostracodes

For the study of ostracodes, 47 new samples were collected in the Sourd d’Ave section, and approximately 1,130 carapaces, valves and fragments have been extracted. More than 500 ostracodes collected by CASIER (1977, 1987) and MILHAU (1983) in the Sourd d’Ave section were also reviewed. Forty-five ostracode species are identified in the Fromelennes Fm and 27 in the Nismes Fm, and they belong exclusively to the Eifelian Mega-Assemblage.

In the Moulin-Boreux Mbr, ostracodes are generally poorly preserved, and frequently coated by the algae activity indicative of shallow environments. In two samples, the monospecificity occurs with the genus Cryptophyllus, indicative of semi-restricted water conditions. In the base of the Fort Hulobiet Mbr, ostracodes are very abundant and diversified and they are indicative of marine environments below fair weather wave-base. In the middle and especially in the upper part of the Fort Hulobiet Mbr, ostracodes are absent in several samples. This is probably indicative of more stressful lagoonal conditions related to an increase of the aridity of the climate in the Late Givetian. Nevertheless these lagoonal conditions are sometimes interrupted by semi-restricted water conditions (monospecific assemblage with the genus Cavelinula) and even by agitated marine episodes (thick shelled and frequently broken podocoids).

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Rock facies

Systematic sampling has been carried out in order to establish the evolution of the environmental conditions and to determine the facies transition. This lead to the examination of 21 thin sections which allowed recognition of 13 microfacies types paralleling the standard sequence of MAMET & PREAT (1989) from open marine shallow to restricted supratidal near emersion. The Boreux Mbr and the Fort Hulobiet Mbr display restricted facies (ephyporoid, stomatoporoid and algal biostromes and bindstones, lutesfacies with desiccation lumps) with poorly fossiliferous beds interbedded with higher energy peloidal and sometimes oolitic grainstone facies. Laminite horizons, sometimes with small-sized LLH-stromatolites are uncommon, and they are associated with dolomitizations showing pseudomorphs of evaporite minerals. These evaporite facies become common in the upper part of the Fort Hulobiet Mbr suggesting the palaeosalinity may be becoming more arid at the GtF transition. The boundary between the Givetian and the Frasnian Group which is very distinct on the section is therefore characterized by a transition from restricted evaporative facies to open marine interbedded marly shales and nodular limestones. A meter-scale cyclicity is very pervasive throughout the Givetian part of the section. Cyclicity was determined by assessing the vertical stacking of facies, the base of a cycle being identified by the initial backstepping of less restricted facies-type over a restricted facies-type. Cycles have open or semi-restricted subbasal bases with stromatoporoids, corals, and restricted supratidal tops with common "algal chips". They record a decrease in circulation, a decrease in diversity of organisms, which are endemic (cyaminobacteria, stromatoliths, ostracodes, gastropods, echinoderms), and an increase in energy upwards through the cycles. Horizon rich in ostracodes are commonly seen representing the impingement of storms in the low energy wave-base. From a roughly 10 km distance. To better constrain and understand the origin of the observed at the top of magnetic susceptibility evolutions. A clear decreasing trend of the $X$ is discernable at the end of the Givetian and the Frasnian Group.

A total of 339 samples were collected for the study of low-field magnetic susceptibility ($X$) in the Sourd d'Ave section. The $X$ values range between $6 \times 10^{-6}$ and $4.5 \times 10^{-4}$ kg. The highest $X$ values are present in the Fort Hulobiet Mbr and observed at the top of magnetic susceptibility evolutions. A clear decreasing trend of the $X$ is discernable at the end of the Fort Hulobiet Mbr and the $X$ values remain weaker in the sediments at the base of the Frasnian. Nevertheless, the $X$ values are quite high and remain around $1 \times 10^{-6}$ kg throughout the Frasnian. To better constrain and understand the origin of the signal, magnetic mineralogical analyses have been launched through hyderson measurements and thermomagnetic curves revealing the presence of ferromagnetic t.f. and paramagnetic minerals controlling the $X$ signal.
References


