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**FIELD GUIDE TO THE PRE-CLEAVAGE
DEFORMATION AND STRATIGRAPHY
OF THE JODOIGNE AREA**

**Cambrian slump deformation and evidence
for the Asquempont Detachment System along
the N-side of the core of the Brabant Massif**

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**Cambrian slump deformation and evidence for the Asquempont Detachment System
along the N-side of the core of the Brabant Massif**

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FIELD GUIDE TO THE PRE-CLEAVAGE DEFORMATION AND STRATIGRAPHY OF THE JODOIGNE AREA: CAMBRIAN SLUMP DEFORMATION AND EVIDENCE FOR THE ASQUEMPONT DETACHMENT SYSTEM ALONG THE N-SIDE OF THE CORE OF THE BRABANT MASSIF

Abstract. This field guide gives an insight into the Lower Palaeozoic geology of the Geete outcrop area in the surroundings of Jodoigne. Five selected outcrops or groups of outcrops are visited. These are the northern Dongelberg Quarry at Dongelberg, the Les Fosses Quarry at Opprebais (Incourt), outcrops along the Rue du Maka at Jauchelette, outcrops along the Rue du Vieux Moulin at Jodoigne and the outcrop below the town hall at Jodoigne. In each case, a detailed description is provided of the lithology, lithostratigraphy and structural architecture, followed by remarks and interpretation.

The geological observations from these field trip stops are used to illustrate lithological differences between the Blanmont Formation and the different facies of the Jodoigne Formation, to demonstrate the presence of steeply plunging and gently plunging folds, to illustrate the common occurrence of pre-cleavage folds, interpreted as slump folds, and to outline our arguments for the newly proposed stratigraphic position of the Jodoigne Formation. The cartographic proximity of the Lower Cambrian Blanmont Formation and the Middle to Upper Cambrian Jodoigne Formation is explained by means of the Asquempont Detachment System.

The observations and their implications are placed in the broader context of the Belgian Lower Palaeozoic.

Key-words: tectonics, folds, lithostratigraphy, Lower Palaeozoic, outcrop, Belgium.

1. Introduction and scope

Despite its considerable size, extending from Jodoigne in the north to Glimes in the south, the Geete outcrop area has usually been neglected by recent studies. This outcrop area, however, is the only Lower Palaeozoic outcrop area situated to the north of the central axis of the Anglo-Brabant Deformation Belt (**Fig. 1**), and is the only area that exposes the enigmatic, Cambrian, Jodoigne Formation, of which the stratigraphic position is highly disputed.

Two main opinions exist about the stratigraphic position of the Jodoigne Formation (**Fig. 2**). One group of researchers considers the Jodoigne Formation as being older than the Blanmont Formation, whereas a second group of researchers suggests a Middle to Upper Cambrian stratigraphic position. The first opinion is favoured by Dumont (1848), Malaise (1900; cf. Malaise, 1883), Kaisin (1919), de la Vallée Poussin (1931), Raynaud (1952), Mortelmans (1955, 1977), Lecompte (1957) and Verniers *et al.* (2001). The main argument for this hypothesis is the relative outcrop position within the Brabant Massif with respect to the other Cambrian formations. However, as pointed out by Michot (1980), the outcrops of the Jodoigne Formation are situated “on the northern limb of the Brabant Anticlinorium” (on the map of Legrand, 1968) and therefore should be younger than the Blanmont Formation. The second opinion, in which the Jodoigne Formation is considered as Middle to Upper Cambrian, is favoured by Malaise (1911), Fourmarier (1921), Legrand (1968), Michot (1980), Vanguetaine (1992) and De Vos *et al.* (1993). However, as correctly pointed out by Raynaud (1952), if this were the case, the magnetite-bearing Tubize Formation should

be expected between the Blanmont Formation and the Jodoigne Formation in the Geete outcrop area. A magnetic field survey of Raynaud (1952) did not show magnetic anomalies between both formations, leading him to favour the first opinion. Also the most recent formal stratigraphical synthesis of the Brabant Massif (Verniers *et al.*, 2001) favours the first hypothesis, but also in this work no truly convincing arguments are put forward.

Apart from the uncertainty regarding the stratigraphic position of the Jodoigne Formation, also the structural architecture remained largely unknown until very recently. Fourmarier (1921) already pointed out the presence of steeply plunging folds within the Jodoigne Formation in the Geete outcrop area: “*Sur la rive gauche de la Geete, en face du Moulin, dans un petit chemin creux, on peut observer des plissements très aigus des couches. Les plis sont déversés vers le Sud. On voit parfaitement que tous ces petits plis ont un ennoyage vers l'Ouest, extrêmement prononcé et atteignant parfois presque la verticale*” (**Fig. 3**). However, although during the last decade steeply plunging, syn-cleavage folds have been documented in detail from within the Cambrian parts of both the Senne-Sennette outcrop area and the Dyle-Thyle outcrop area (Sintubin *et al.*, 1998; Debacker *et al.*, 2004a, 2005a; Piessens *et al.*, 2004), until very recently the question remained as to what extent the folds described by Fourmarier in the Geete outcrop area indeed have a syn-cleavage origin and whether the presence of these folds has regional implications. According to Fourmarier (1921) himself, for instance: “*Comme il s'agit de chiffonnages très localisés, il ne faudrait pas accorder une importance trop grande à cette observation et l'ériger en règle générale pour tous le pays*”.

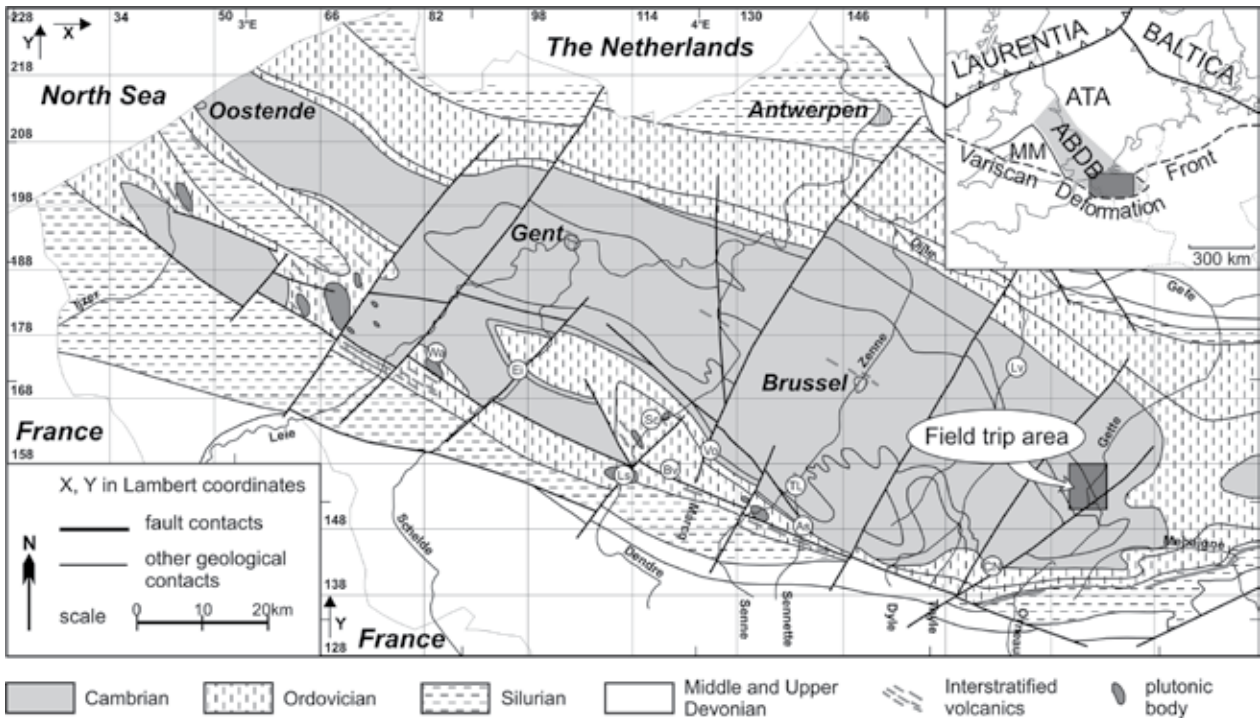


Fig. 1. Geological subcrop map of the Brabant Massif (after De Vos *et al.*, 1993 and Van Grootel *et al.*, 1997) showing the position of the visited Geete outcrop area. The upper right inset shows the position of the Brabant Massif within the Anglo-Brabant Deformation Belt (ABDB) along the NE-side of the Midlands Microcraton (MM) in the context of Avalonia (ATA), Baltica and Laurentia. Localities referred to in the text are indicated: Waregem (Wa), Eine (Ei), Lessines (Ls), Schendelbeke (Sc), Bever (Bv), Vollezele (Vo), Asquempont (As), Tubize and Lembeek (TL), Cortil-Noirmont (CN), Leuven (Lv).

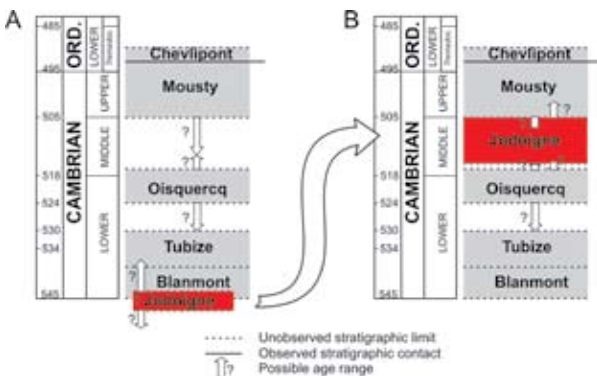


Fig. 2. Stratigraphic subdivision of the Cambrian and lowermost Ordovician of the Brabant Massif with the probable position of the Jodoigne Formation highlighted, according to (A) Verniers *et al.* (2001), and (B) according to Herbosch *et al.* (2008) as most recent work. It is the latter stratigraphic subdivision of the Cambrian that is advocated herein. Note that the possible age range of the Jodoigne Formation, as represented by the arrows, allows for an overlap with the lower part of the Mousty Formation.

During the last five years we have performed detailed fieldwork in the Geete outcrop area. This work was executed partly in the framework of the construction of the new geological map Jodoigne-Jauché at scale 1/25000 (Herbosch *et al.*, submitted), which is presented during the field trip. This detailed field work, of which the main results have been published in Debacker *et al.* (2006) and Herbosch *et al.* (2008), has resulted in a thorough revision

of the Cambrian stratigraphy (see **Fig. 2B**), which, contrary to previous hypotheses, is backed-up by several lines of evidence, and, moreover, has resulted in an unravelling of the structural complexity of the area. These results also contributed significantly to the construction of the new, still unpublished, geological map of the Flemish part of the Brabant Massif (cf. Piessens *et al.*, 2005), presented also at the Geologica Belgica international meeting 2009 at Ghent. Furthermore, with our revised Cambrian stratigraphy, a much more straightforward link can be made between the Cambrian of the Brabant Massif and the Cambrian of the Stavelot-Venn Inlier, thus bridging the apparent gap between the Anglo-Brabant Deformation Belt and the Ardennes Inliers.

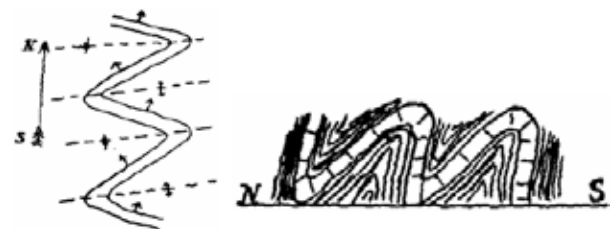


Fig. 3. Initial observations by Fourmarier (1921) of steeply plunging folds within the Jodoigne Formation at Jodoigne, or in the vicinity of stop 4 (see text). Left: floor observation, right: section observation.

During this fieldtrip we visit outcrops of both the Blanmont Formation and the Jodoigne Formation, demonstrate the

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