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2.4.1 Brutia Formation - BRT

Lower Paleozoic

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Brutia Formation (Herbosch & Verniers, 2014) (added 22/12/2014) (slightly adapted for Nivelles Member on 19/02/2015)
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Authors: Named after a locality south of Gembloux, Orneau valley (Delcambre & Pingot, Chastres-Gembloux map 2002). The Brutia Formation is subdivided in two members: a lower Member named Les Goutteux Member and the upper volcanic Nivelles Member (Delcambre & Pingot, 2002 p. 31). The hamlet of Goutteux (1 km to the SSW of Hennuyères station) was described by Leriche (1924 p. 24) who mentioned the "tranchée du Goutteux" and a small quarry in the hamlet (SGB 115W68). The volcanic level has already been described by Dumont (1848) and is often cited in the old literature as "eurite" (see Corin, 1965). The "Eurite de Nivelles" observed in the Thisne valley and the "Eurite de Grand-Manil" observed in the Orneau valley, belong to the same stratigraphic level (Corin, 1965; Verniers et al., 2001).

Description: The lower **Les Goutteux Member** (new name) contains medium to dark grey slate (mudstone), compactly bedded that become darker in the upper part. In the first third of the member, a grey mudstone that shows dark grey tubular lenses (about 5 mm wide and 2-3 cm long; Herbosch & Verniers, 2014 Plate 3). These very characteristic structures are interpreted as bioturbations (*Chondrites* sp. or "*fucoïdes*" of authors) and they are observed in the Orneau valley (Delcambre & Pingot, Chastres-Gembloux map, 2002; Herbosch, 2005 Fig. 4 outcrop y and z) and in the Coeurq valley (Hennuyères; Herbosch et al., Ittre-Rebecq map, 2014). The upper part of the formation, named the **Nivelles Member**, consists of a 40 to 50 m thick interstratified volcanic rocks, described in literature as eurites (metarhyolite or ignimbrite?). The Nivelles Member, consisting entirely of 'eurites', is formed by fine-grained quartzitic tuffs, very hard, white, light pink or yellow (Corin, 1965; Linnemann et al., 2012). The volcanic rocks show some black slate centimetric inclusion coming from the underlying slate of the lower member. It has been mined in the vicinity of Nivelles for kaolinite by the ceramic industry (Ladeuze, 1990).

Stratotype: For the "Eurite de Grand-Manil" type area in the Orneau valley, Gembloux, hamlet of Grand-Manil, between the localities Try-al-Vigne and Brutia (Delcambre & Pingot, 2002 fig. 17). For the "Eurite de Nivelles" type area in the Thines valley, between Monstreux and Nivelles (Herbosch & Lemonne, 2000; Hennebert & Eggermont, 2002). Stratotype has not yet been designated. For the lower Les Goutteux Member the more representative outcrop is to the SW of Hennuyères in an old quarry observed on the E-side of the Brussels-Mons railway 24,600 km (50°38'39.61" N/4°10'13.52" E). For the "Eurite de Grand-Manil" the type area is in an abandoned quarry at Grand-Manil, Orneau valley (Delcambre & Pingot, 2002 Fig. 17) (50°33'39.61" N/4°40'49.92" E). For the "Eurite de Nivelles" the type area is in the Thines valley, between Monstreux and Nivelles (Verniers et al., 2002; Herbosch & Lemonne, Nivelles-Genappe map, 2000; Hennebert & Eggermont, Braine-le-Comte – Feluy map, 2002). A representative outcrop is an old quarry along the E-side of the highway Brussels-Mons (50°36'09.57" N/4°17'48.30" E).

Area: Outcrop area: Orneau valley and Thines valley (Monstreux-Nivelles); Coeurq valley (Map Rebecq-Ittre, Herbosch et al., 2014). Absent in the Sennette valley, removed by the South Fauquez Fault.

Thickness: In the Orneau valley between 80 and 100 m for the entire formation, with about 40 to 60 m for the first member and 40 m for the "Eurite de Grand-Manil" (Delcambre & Pingot, 2002) and about 50 m for the "Eurite de Nivelles" in the Thines valley (Herbosch & Lemonne, 2000; Hennebert & Eggermont, 2002). The lower and upper boundaries are unknown.

Age: Trilobites in the lower/middle part of the formation were described by Malaise (1903) without giving an age. Graptolites described in black slate below the "Eurite of Grand-Manil" in the Orneau valley belong to the *Coronograptus cyphus* Biozone (Elles in Maillieux, 1930a). But graptolites found in the same level by Gerlache (1956) and determined by Bulman as *Climatograptus scalaris* indicate the *acuminatus* Biozone (second graptolite zone of the Rhuddanian; Melchin et al., 2012). The latter determination seems more probable as the graptolites described from within the "Eurite de Nivelles" indicate undoubtedly a *Cystograptus vesiculosus* Zone (Rickards in Verniers & Van Grootel, 1991) which is the third graptolite zone of the Rhuddanian (Melchin et al., 2012). The determinations from both valleys indicate an upper Rhuddanian (Early Llandovery) age for the Nivelles Member. The chitinozoans from the mottled mudstone of the lower member are dominated by *Belonechitina cf gamachiana*, indicating a mid or late Ashgill, possibly a Hirnantian age (Samuelsson & Verniers, 1999, 2000). In the Harelbeke borehole (SGB 83E446) an Hirnantian chitinozoan fauna has been discovered by Van Grootel (1995). Vanmeirhaeghe (2006a) confirms that the chitinozoans are well correlated with the *Spinachitina taugourdeai* Zone, which is situated in the lower *N. extraordinarius* Zone of the Hirnantian Stage. Recently, the study of a newly discovered outcrop in the upper part of the Goutteux Member SSW of Hennuyères (Herbosch et al.,

Ittre-Rebecq map, 2014; Mortier *et al.*, 2012, Mortier, 2014) shows the index fossil *Spinachitina oulebsiri* together with *Herchochitina* spp., *Belochitina* spp. and *Spinachitina verniersi*. This implies that the Les Goutteux Member is not younger than Ordovician in age (Paris *et al.*, 1999) and the presence of *S. oulebsiri* indicates an upper Hirnantian age (Vandenbroucke *et al.*, 2009). In conclusion the Brutia Formation **crosses the Ordovician-Silurian boundary** and belongs to the **interval between the uppermost Katian (?) and the Hinantian to upper Rhuddanian**.

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