Facies characterization of the Gulpen and Maastricht formations (late Campanian–early Danian) in the Eys01 borehole, South Limburg, the Netherlands

Rinde Kooij[1], Mateus Kroth[1,2], Eva De Boever[2], Mariana Pimenta[1], Dennis J. Schreiber[1], Geert-Jan Vis[2], and João P. Trabucho Alexandre[1]
[1]Department of Earth Sciences, Universiteit Utrecht | [2]TNO – Geological Survey of the Netherlands

Background

The Eys01 borehole was drilled in 2018, near the village of Eys, South Limburg, and has not been previously described in the literature. Here, we present a facies characterization of the Gulpen and Maastricht formations in the cored interval of the Eys borehole. These deposits where formed in an epeiric shallow marine setting and consist of intensely bioturbated mixed carbonate and siliciclastic material.

Take-home message

Variability in lithology is lower in the Maastricht Formation than in the Gulpen Formation. The Maastricht Formation consists mainly of carbonate deposits, whereas the Gulpen Formation consists of both carbonate and siliciclastic deposits. Mixing of carbonate and siliciclastic deposits in the Gulpen Formation occurs on two different scales: interbedding of siliciclastic and carbonate beds and compositional mixing in beds due to pervasive bioturbation. The latter occurs only in intervals of the core where siliciclastic beds are present.

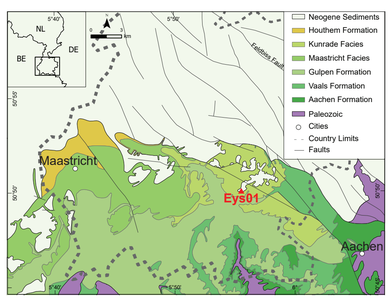

Figure 1 | Location of the Eys01 borehole. The Maastricht Formation has been divided in the maastricht and kunrade 'facies'. The Maastricht Formation in the Eys borehole consists exclusively of kunrade 'facies'.

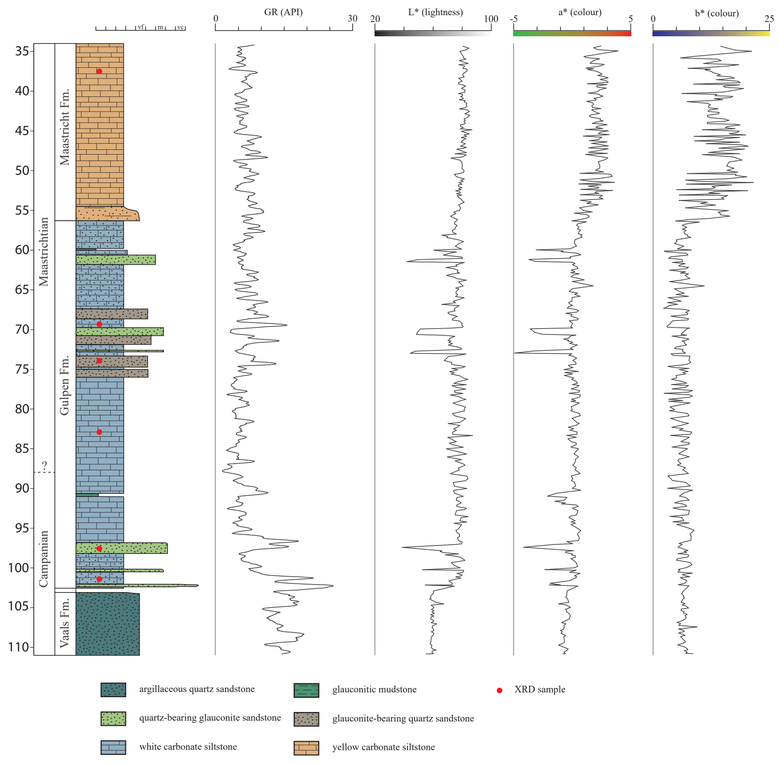

Figure 2 | Stratigraphic column of the Eys01 borehole. The Eys borehole consists of carbonate, siliciclastic, and mixed lithologies. The Gulpen Formation consists of mixed lithologies and contains two intervals of interbedded siliciclastic and carbonate beds. Siliciclastic beds are quartz and glauconite rich. Glauconitic beds can be easily recognized in the colour data, where they appear as both darker (low L* values) and greener (low a* values). The middle part of the Gulpen Formation is purer relative to carbonate content, which is reflected in the lower gamma ray values. There is a clear shift in colour between the Gulpen and Maastricht formations, with the latter being yellower (higher b* values) and redder (higher a* values). The Maastricht Formation represents relatively pure carbonate lithologies.

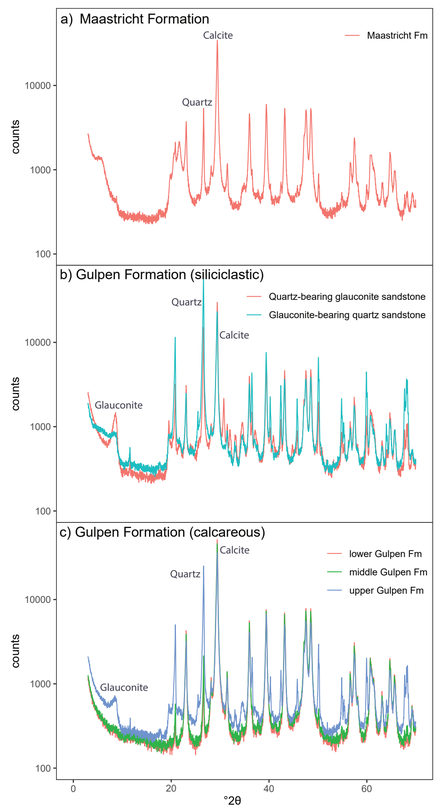

Figure 3 | XRD results of the Gulpen and Maastricht formations. Note that the counts axis is logarithmic. The Maastricht Formation contains quartz, but is dominated by calcite. The middle Gulpen is dominated by calcite and contains little siliciclastic material. In the lower and upper Gulpen Formation there is interbedding of siliciclastic- and carbonate beds. The upper part of the Gulpen Formation is richer in quartz and glauconite compared to the lower Gulpen Formation due to a higher degree of bioturbation bringing in siliciclastic material and causing homogenization with the surrounding rock.

Maastricht Fm

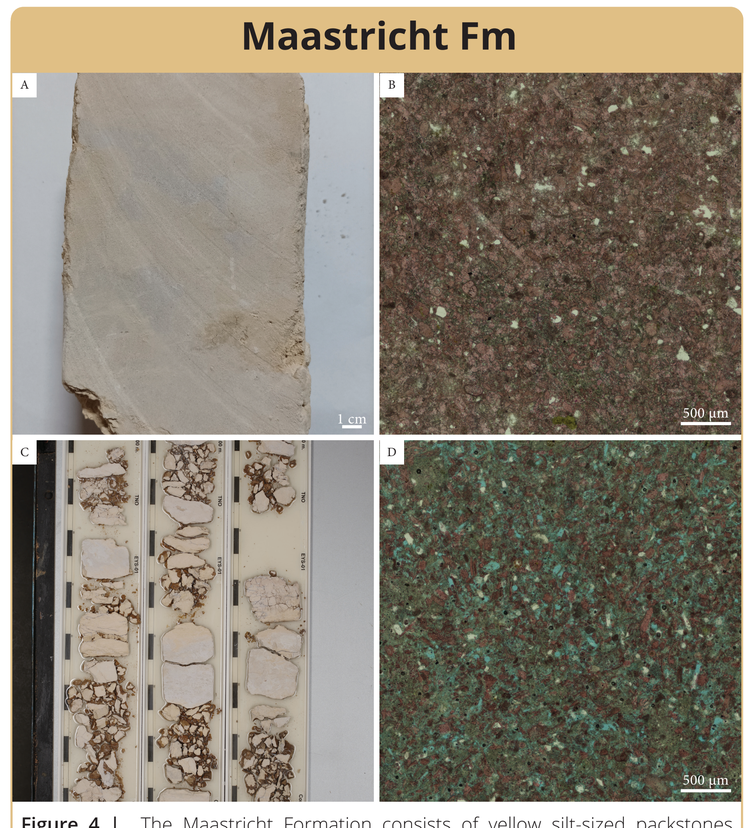

Figure 4 | The Maastricht Formation consists of yellow silt-sized packstones and grainstones (A–D) . These rocks are very pure carbonate and contain almost no siliciclastic material (<3%) (B & D). The rocks are heavily bioturbated (BI 4–5). Cementation varies throughout the core, resulting in harder and softer layers, which is characteristic of the kunrade 'facies' of the Maastricht Formation. **Calcite in all thin sections is red due to staining with Alizarin Red S. Pore space in all thin sections is coloured blue.**

Gulpen Fm: quartz-bearing glauconite sandstone

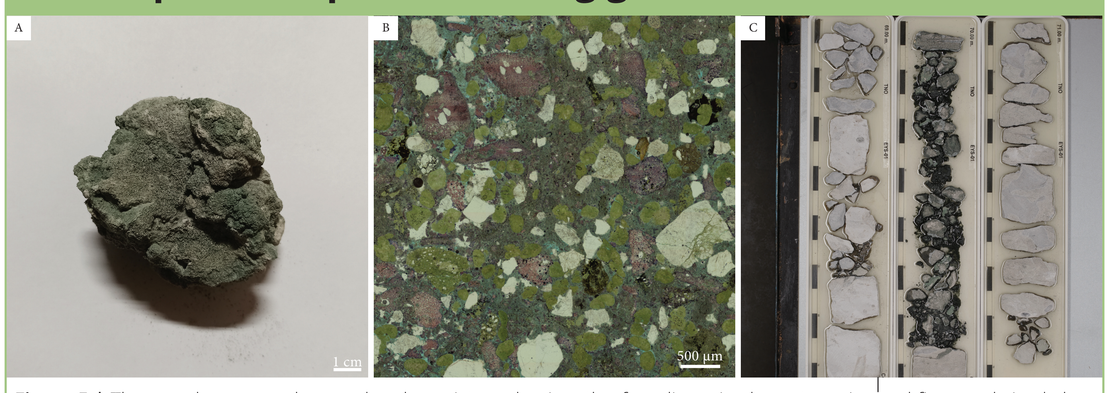

Figure 5 | These rocks are poorly sorted and consist predominantly of medium-sized quartz grains and fine sand-sized glauconite peloids, lithoclasts, and varying amounts of bioclasts (A & B). Intervals of this facies are only a few tens of cm thick and poorly consolidated (C).

Gulpen Fm: glauconite-bearing quartz sandstone

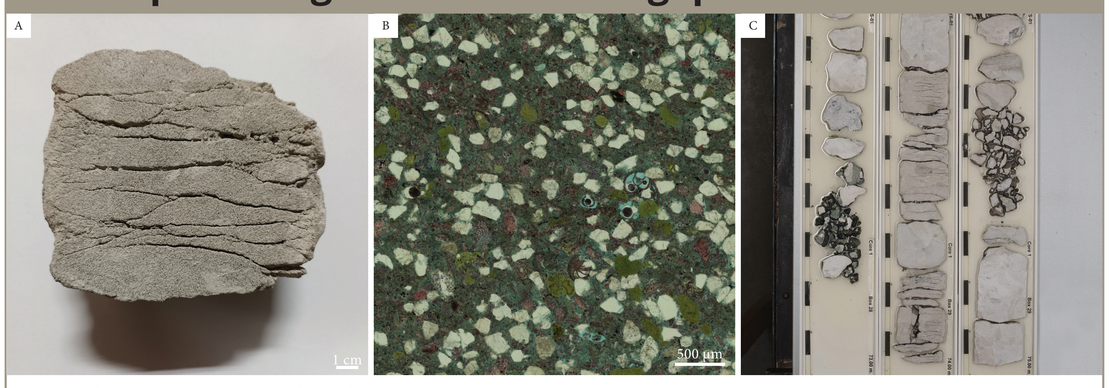

Figure 6 | These rocks consist of very fine to fine–sand sized quartz grains with a clay-rich matrix and varying amounts of glauconite peloids and bioclasts (A & B). The rocks are highly bioturbated (BI 4–5). Intervals of this facies are only a few tens of cm thick (C).

Gulpen Fm: calcareous

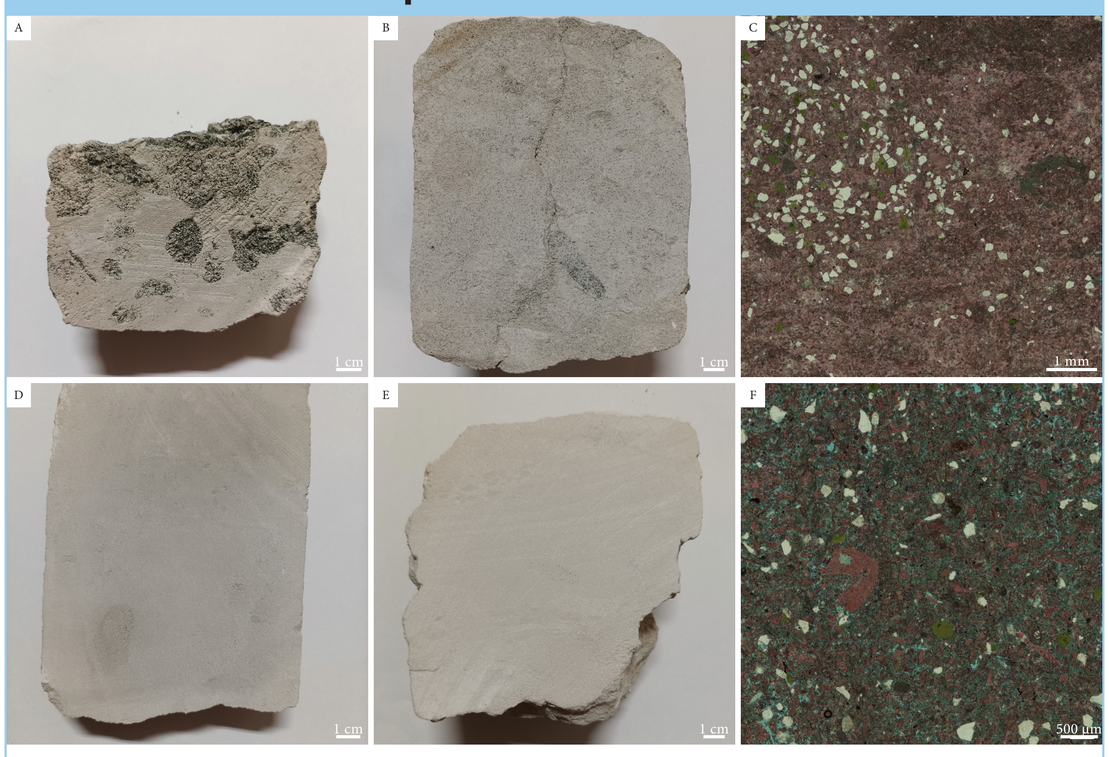

Figure 7 | The Gulpen Formation consists of white, coarse silt-sized packstones and grainstones. These rocks are heavily bioturbated (BI 3–5), with burrows that are sometimes filled with medium-grained, poorly sorted quartz grains and fine-grained glauconite peloids. The amount of siliciclastic material that fills in burrows differs throughout the Gulpen Formation depending on the availability of siliciclastic material. In intervals of the Gulpen Formation where siliciclastic beds are interbedded with carbonate beds (lower and upper Gulpen), burrows are filled in with siliciclastic material (A - C). Depending on the degree of bioturbation, homogenization of the rock takes place in which case siliciclastic material is not confined to burrow infills but present throughout the fabric (B). Siliciclastic beds are absent in the middle part of the Gulpen Formation, and burrows are filled in with material similar to the surrounding rock, resulting in a more pure carbonate rock (D & E).

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