

EGU21-2335, updated on 21 May 2022

<https://doi.org/10.5194/egusphere-egu21-2335>

EGU General Assembly 2021

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Petrographic and geochemical fingerprinting of flints from the type-Maastrichtian (SE Netherlands and NE Belgium): implications for flint formation and provenance

Hannah Van der Geest¹, Johan Vellekoop^{1,2}, Pim Kaskes², Matthias Sinnesael³, John Jagt⁴, Patrick Degryse¹, and Philippe Claeys²

¹Department of Earth and Environmental Sciences, Division Geology, KU Leuven, Celestijnenlaan 200E, 3001 Leuven, Belgium

²Department of Chemistry, Analytical, Environmental and Geo-Chemistry, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium

³Department of Earth Sciences, Mountjoy Site, Durham University, South Road, Durham DH1 3LE, UK

⁴Natuurhistorisch Museum Maastricht, De Bosquetplein 6-7, 6211 KJ Maastricht, the Netherlands

The chalk deposits of the type-Maastrichtian, in the SE Netherlands and NE Belgium (the Liège-Limburg region), are characterized by abundant flint layers. Since prehistoric times, flints from this region have been used as raw materials for tool making. While the formation, cyclicity and lithostratigraphy of flint layers from the type-Maastrichtian have been previously studied, their stratigraphic, lateral and internal geochemical and petrological variability are still poorly constrained, posing challenges for tracing the provenance of flint tools. Therefore, in the context of the Maastrichtian Geoheritage Project, we are analysing *in-situ* flint samples macroscopically, microscopically and with micro-X-ray fluorescence (μ XRF). The flint samples were collected from a 50-m-thick interval from the Upper Cretaceous Gulpen Formation at the former ENCI quarry (NL) and the Hallembaye quarry (BE). In contrast to averaged outcomes of bulk or portable X-ray fluorescence techniques commonly used for provenance studies of flints in geoarchaeology, the use of μ XRF has the advantage of offering insights into the internal variability and heterogeneity of flints, by displaying relative distributions of major and trace elements within flint samples. Our preliminary results show that flint nodules from the Gulpen Formation can be subdivided based on composition. Flint layers in the middle part of this formation (Vijlen Member) show a high contribution of micrite, in addition to silica, and display a heterogeneous distribution of elements such as Ca, S, K, Fe, Rb and Sr, while flint layers from the overlying Lixhe 1-3 members consist predominantly of silica and have a more homogeneous distribution of chemical elements. Both types of flint layers contain biogenic inclusions, such as fragments of sponge spicules, echinoids, shells and benthic/planktic foraminifera, and other minerals, including iron sulphides and glauconite, but with a different abundance. The observed heterogeneity and variability within the flint nodules might not only be useful for tracing the provenance of flint tools, but could also provide insights into the complex formation of flints.