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Optically stimulated luminescence dating of relic charcoal kilns using sand-sized quartz: a status report

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Charcoal has been produced for centuries, even millenia, in and near forested areas in Europe. The relics are increasingly studied to inform, e.g., on forest composition and woodland exploitation, the effects of biochar on soil properties and plant nutrients, and carbon sequestration. All these studies require a chronological framework, which is most commonly established using radiocarbon (^{14}C) dating. In NW Europe, however, many relic charcoal kilns have been found to post-date 1650 CE. Owing to limitations imposed by the calibration curve for the last few centuries, ^{14}C dating results in wide age probability distributions; this implies that the method does not allow resolving the chronology for post-1650 CE features.

In this study, we report on our experiences with optically stimulated luminescence (OSL) dating as a complementary and alternative method to ^{14}C. The approach uses sand-sized quartz extracted from sediments that were heated during charcoal production. Our study comprises relic charcoal kilns on silty and sandy subsurfaces in Belgium (Sonian and Zoersel forest), The Netherlands (The Veluwe) and France (Grand-Est region). We first demonstrate that OSL dating can yield accurate and precise ages by comparing our results for pre-1650 CE features with independent (^{14}C) age information. Intricacies, possibilities and limitations are discussed. For most of the features, widely adopted OSL procedures can be applied; for one of the study areas (Zoersel forest, in the northern Belgian sand belt), dedicated analysis using single grains of quartz is the method of choice. We then apply our methodology to post-1650 CE features, for which ^{14}C dates and or historical information is available. We show that, for the majority of the investigated features, accurate OSL ages can be obtained with a precision that is similar or significantly better compared to independent age information. A considerable added value is the potential of OSL dating to distinguish between multiple features at one or comparable sites with an unprecendented time-resolution of 5 - 40 years (and 95.4% probability).

Keywords: OSL dating; radiocarbon dating; relic charcoal kiln; Modern age; natural resources.