

## Accepted Manuscript

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PII: S0026-265X(15)00277-5  
DOI: doi: [10.1016/j.microc.2015.11.007](https://doi.org/10.1016/j.microc.2015.11.007)  
Reference: MICROC 2306

To appear in: *Microchemical Journal*

Received date: 15 August 2015  
Revised date: 4 November 2015  
Accepted date: 4 November 2015



Please cite this article as: Tiziana Lombardo, Daniel Grolimund, Anna Kienholz, Vera Hubert, Marie Wörle, The use of flint-stone fragments as “fire-strikers” during the Neolithic period: Complementary micro-analytical evidences, *Microchemical Journal* (2015), doi: [10.1016/j.microc.2015.11.007](https://doi.org/10.1016/j.microc.2015.11.007)

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# The use of flint-stone fragments as “fire-strikers” during the Neolithic period: Complementary micro-analytical evidences.

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## ABSTRACT

The construction of an underground parking garage in the centre of Zurich (Zurich Opéra Parking, Switzerland) unearthed remains of seven Neolithic settlements from the 4<sup>th</sup> and 3<sup>rd</sup> millennium BC. The greatest number of prehistoric finds were retrieved from the 3175 BC layer (Horgen culture). Among the findings several thousands of flint-stone fragments were excavated. According to archaeologists' interpretation, based on wear patterns, some of them were certainly used to produce fire. Remarkably, a limited number of the flint-stones revealed additional characteristic metallic traces of potential anthropogenic origin. The contingent relation of these fragments to the fire-production was to be elucidated. An advanced, non-destructive micro-analytical approach was needed to characterise these unusual features. Seven flints were thus analysed by laboratory-based  $\mu$ -XRF and RAMAN spectroscopy complemented by two-dimensional microscopic chemical imaging based on combined  $\mu$ -XRD –  $\mu$ -XRF analysis using micro-focused synchrotron radiation. The complementary results showed that all flint-stones, even the most doubtful, presented abundant traces of Fe-sulphide which were almost exclusively pyrite. Only sporadic indications towards the presence of trace amounts of marcasite and chalcopyrite were found. Furthermore, during the excavation, Fe-sulphide ore pieces were found in the same layer as the flint-stones. Geologically, these iron nodules appeared to be non-native to the setting in which they have been observed. The Fe-sulphide ore was also undoubtedly recognised as pyrite, indicating its potential use, conjointly with the flints, to kindle fire in a more efficient manner by the Neolithic populations at Lake Zurich more than 5000 years ago.

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