Application of a handheld X-ray fluorescence analyser to trace the provenance of Roman monuments of Neogene lithotypes to quarries in the Leitha Mountains, Hainburg Mountains and along the south-west border of the Vienna Basin

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This study shows results of geochemical pXRF-data of a closed data set from selected calcareous and mixed calcareous-siliciclastic lithotypes of ornamental and building stones, mainly attributed to corallinean Leitha Limestone, its succeeding reworked and variegated deposits known as Detrital Leitha Limestone, as well as to younger or lateral interconnected oolites, coquinas and low calcitic sandstones. They altogether represent shallow marine deposits in the Central Paratethys Sea in the Middle to Upper Miocene (16–5 my). Certain analytical reasons require comparing quantities in the geochemical compositions just within the presented dataset.

The stones in focus were prominent building and ornamental stones in former centuries and embody the stonemason culture during various historic periods e.g. in Vienna (St. Stephen's Cathedral, Vienna State Opera). A still active quarry at Sankt Margarethen im Burgenland provides replacement material. The heritage value of these appreciated freestones is emphasised by their use for various cultural monuments and for buildings and infrastructure already when this region was part of Imperium Romanum. The interdisciplinary archaeological-geological project CarVin (Stone Monuments and Stone Quarrying in the Carnuntum - Vindobona Area, G. Kremer) provided the opportunity to relate archaeological stone objects with native quarries from the nearest possible locations by using this non-destructive analysing technique. The aim was to compare fine-grained archaeological stone objects with samples of similar lithologies from investigated outcrops for potential likenesses. In the present dataset we include 300 archaeological objects and 155 geological samples, each measured at least twice. We used the NITON XL3t 900s GOLDD Air of AnalytiCON Instruments. Its Mining Mode was used to measure main, minor and trace elements with an atomic mass from Magnesium upwards. The internal software converts the composition into percentage. Therefore compositional data analysis recommends a statistical centered log-ratio transformation. Scatterplots with certain elements by pairs show significant distributions. A preceding hypothetical grouping of the measured geological samples draws upon their lithology and their affinity to specifically defined quarry regions (see https://meetingorganizer.copernicus.org/EGU2018/EGU2018-18923.pdf). The grouping of the geological samples shows a good expression in the Ca-Sr plot and Sr-Ti allows a good differentiation as well. However, the attempt to differentiate between two specific areas – Leitha
Mountains northeast and southwest – seems improbable. The expressed situation concerning the majority of the archaeological objects shows some similarities but also conspicuous differences: a clear depletion in Ba, Ca and Mg and partly in Mn and Sr linked with a striking enrichment in sulphur. Without further analysing methods we make environmental effects liable for that.

Although more measurements per sample and object would have improved the study, the results from the pXRF method are supportive for petrological examinations. Nonetheless, a very sensitive handling and chemical data evaluation is critical with this method (analysing influences, surface conditions).