ARCHAEOLOGICAL CHERTS´ ORGANIC MATTER COMPOSITION ANALYSIS COMBINING GC/MS AND SPECTROSCOPY TECHNIQUES

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Introduction

Vibrational spectroscopic techniques (Raman and Infrared spectroscopy among others), in combination with other elemental techniques as X-ray Spectrometry, demonstrate to be powerful analytical tools when the characterisation of archaeological chert samples is required [1].In nature, there is a link between the presence of organic matter and the origin of chert samples. In this sense, the characterisation of the organic matter content in chert samples using Gas Chromatography/Mass Spectrometry (GC/MS) is needed in order to obtain all the information about archaeological chert samples, as it can provide relevant data about source catchment areas, artefact displacement or the way in which the artefacts were employed.

Experimental

The analysed sedimentary cherts were collected from different rock formations of Cretaceous to Cenozoic age in the Vasco-Cantabrian region (Western Pyrenees), and were formed in continental, shallow-marine and deep-marine depositional settings.

For the determination of organic content different analytical procedures were used in order to extract information about soluble (bitumen) and insoluble (kerogen) organic matter. Bitumen was extracted with dichloromethane using ultrasound focused energy and then analysed by means of retention time locked GC/MS. This way we were able to obtain qualitative results from the direct comparison of chromatrograms [2].

According to the content of insoluble organic matter, the isolation of kerogen was conducted by the standard hydrofluoric acid/hydrochloric acid extraction procedure [3]. Further treatment of the isolated kerogens involved ultrasonic extraction with dichloromethane in order to remove any residual trapped bitumen and then were analysed by means of Attenuated Total Reflectance Spectroscopy (ATR). The measure conditions were 4s, 40 accumulations and a spectral resolution of 4 cm^{-1} in the spectral range of 600-4000 cm^{-1}

Results

Chemometric analysis of the obtained results by means of Principal Components Analysis allows observing differences between hydrocarbon contents depending on the chert´s depositional settings. According to this, it seems that continental depositional samples have preserved more organic matter with little alteration. Moreover, the hydrocarbon profiles are dominated by high molecular-weight (>n-C_{25}) n-alkanes, alkyl and methylalkylcyclohexanes and isoprenoid groups.

On the other hand, direct measurements of isolated kerogen samples carried out using ATR spectroscopy, showed the kerogen´s characteristics bands at 2920 cm^{-1}, 2850 cm^{-1}, 1700 cm^{-1}, 1600 cm^{-1} and 1200 cm^{-1}.

Conclusions

The organic analysis of archaeological chert samples could be a powerful strategy in order to explain the origin and transformations of cherts. In this way, different geological contexts have been studied and distinguished. However, more quantitative analyses are required in order to quantify organic composition and the origin of the organic matter present in the chert samples.

Acknowledgements

This work was supported by.the Research Project CGL2008-00009/BTE and HAR-2008-05797/HIST of the Spanish Ministry of Science and Innovation, M.Olivares is grateful to the University of the Basque Country for a PhD. Fellowship.

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