Application of SR-FTIR Microspectroscopy to Biological Samples

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Introduction

Palynomorphs are organic-walled acid-resistant microfossils of varying taxonomic affinity. Palynomorphs have a wide-ranging usage in the geosciences from fossil fuel exploration, stratigraphical, palaeoenvironmental and palaeocological studies[1]. It has been observed by electron microscope studies that the surface ornamentation, such as processes on complex palynomorphs, have the same ultrastructure as the vesicle wall and seem to be formed by the walls extension[2]. The aim of this study was to determine if the cyst walls have the same chemistry as the surface ornamentation of complex palynomorphs and by virtue of these results determine the preservation of cytological complexcity throughout the sedimentary record.

Experimental

Samples and preparation

The mega-spores were collected from the Devonian Ghadamis Basin, western Libya, the *Tasmanites* were collected from the Carboniferous Tasmania Basin, Tasmania, Australia, and the *T. pelagica* Lower Oligocene marine sediments, Upper Rhine Graben, SW Germany. Microfossil cysts were liberated from rock, and sediment matrix by HCl/HF digestion. Cysts were individually isolated from the organic residue using a bionocular microscope.

Results and Discussion

This study represents the first attempt to map individual palynomorphs to gain an understanding between the morphology and chemical composition. Although, only a few spectra and chemical maps generated thus far, the spectra acquired from the Mega-acritrachs, *Tasmanites* sp. and *T. pelagica* are intriguing.

These microfossils are all chemically composed of an aliphatic hydrocarbon skeleton with various functional group differences. In particular the *Tasmanites* contain abundant carbon-oxygen groups.

Figure 1 presents a chemical map generated from the Mega-acritarch. It can be clearly seen that the aliphatic hydrocarbon composition is homogeneous throughout the microfossil notwithstanding the morphological differences between the cyst wall and ornamentation. Despite these differences in ultrastructure chemically, the palynomorphs are homogeneous.

The observation of a homogenous chemical composition of palynomorphs of varying geological age and taxonomic affinity supports the selective preservation pathway of organic material in the sedimentary record.

This is in agreement with the concept that micro-organisms biosynthesise resistant biopolymers of one type for protection from environmental stresses respective of morphology. Upon sedimentation and subsequent diagenesis these biopolymers become slectively preserved in the sedimentary record.

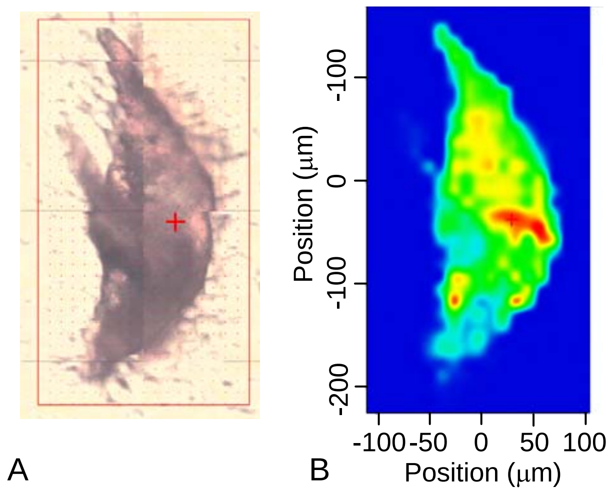

Figure 1. (A) Optical micrograph of a Mega-acritrach, *Tasmanites* sp. B) Chemical map produed by measuring the area underneath the ν(CH) region (3000 – 2800 cm^{-1}).

Conclusions

This is the first study to document that palynomorphs with complex morphological structures are indeed chemically homogeneous. In terms of the bigger picture, this provides evidence for the selective preservation pathway of organic material in the sedimentary record.

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