# MOLECULAR CHARACTERIZATION OF EARLY CAMBRIAN METAZOAN EGGS USING MICRO-FTIR SPECTROSCOPY AND PYROLYSIS-GC×GC-TOFMS

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The "Cambrian explosion" becomes distinct by the rapid emergence and radiation of diverse metazoan phyla at the beginning of the Cambrian. The Yangtze Platform of South China bears a wide range of transitional Neoproterozoic-Cambrian sedimentary sequences, some of which yielded exceptional early Cambrian fossil *lagerstätten,* such as the Orsten-type deposit Kuanchuanpu (Shaanxi Province) with 3D-preserved phosphatized metazoan eggs, embryos and hatchlings. The metazoan embryos provide a unique opportunity to reveal the origination and development of early animal evolution. These micro-fossils have been studied extensively using different microscopic techniques and X-ray nanofocus-computed tomography (nCT) to reveal their biological affinity and ontogeny (Steiner et al., 2004, 2014). Previous studies suggest that organic matter is still preserved inside the phosphatized egg-membrane of some eggs and embryos (Chen et al., 2007; Steiner et al., 2014), although they were phosphatized during early stage of diagenesis. Here we report a detailed organic geochemistry of those organic remains using micro-FTIR spectroscopy and pyrolysis-GC×GC-TOFMS to evaluate the macromolecular composition of the preserved organic matter inside those eggs (mostly assignable to *Olivooides multisulcatus*). Samples were collected from the early Cambrian Kuanchuanpu Formation of Shizhonggou section (Shaanxi Province) South China. Eggs and embryos were liberated from carbonates by dissolution in buffered 10% acetic acid and subsequently hand-picked under a binocular microscope from the residue. Organic matter was separated from the phosphatized eggs using diluted HCl acid (4%) and analysed using micro-FTIR spectroscopy and pyrolysis-GC×GC-TOFMS. The micro-FTIR spectroscopic signals from these eggs include both aliphatic and aromatic components. The aliphaticity is indicated by prominent alkyl group bands between 2800 $cm^{-1}$ to 3000 $cm^{-1}$. The prominent absorption signals at 700-900 $cm^{-1}$ are due to aromatic CH out of plane deformation.The pyrolysis products consist of aliphatic, aromatic and nitrogen-bearing compounds. Aliphatic compounds are dominated by a series of *n*-alkenes and *n*-alkanes ranging from $C_{10}$ to $C_{32}$. The major aromatic compounds are alkylated benzenes and alkylated phenols. $C_1$–$C_{19}$ Alkylbenzenes were identified by selective ion detection at *m/z* 91 + 105. The most important finding of the present study is the presence of nitrogen-bearing compounds including acetamide, triazole, pyridine, methyl pyridine, benzylnitrile, indole and methyl indole (Fig. 1). These compounds are commonly derived from protein moiety. The survival of proteins can be attributed to an existence of extraordinary taphonomic conditions by the replacement of mostly outer organic tissues of those eggs by apatite prior to the compaction of sediments. We speculate that phosphatized outer egg membrane facilitated the preservation of proteinaceous moiety through deep time.

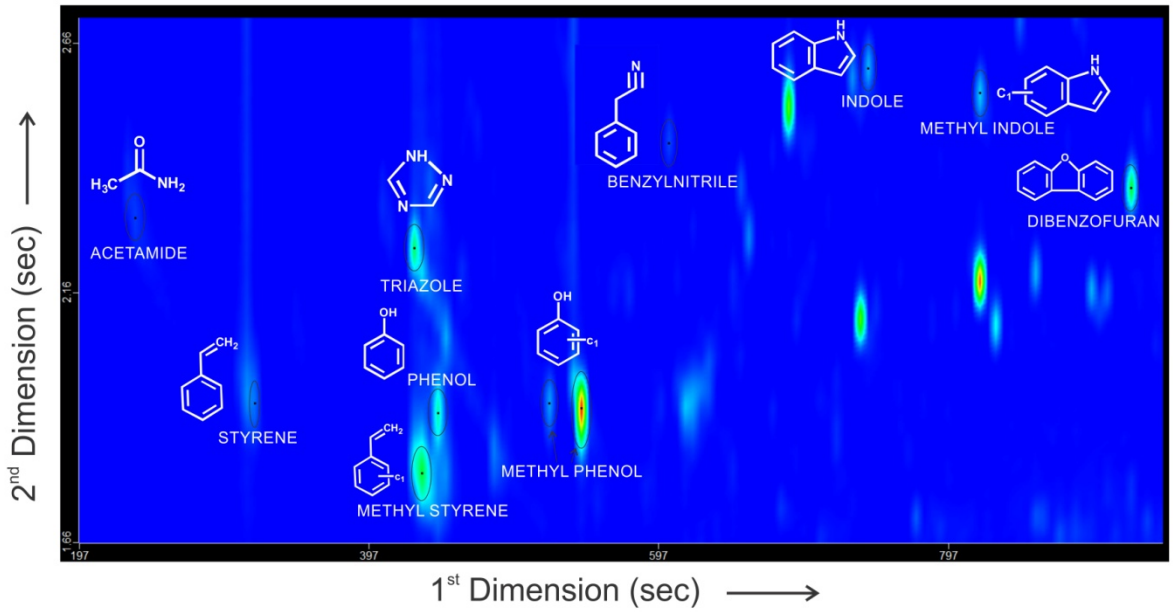


*Figure 1. Selected ion chromatogram (m/z 59+69+94+107+130+154) resulting from pyrolysis-GC×GC-TOFMS of preserved organic matter in early Cambrian eggs from the Kuanchuanpu Formation, Shaanxi Province, China.*

## References

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