# Analysis of organic biomarkers in single Precambrian oil-bearing fluid inclusions using ToF-SIMS

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Organic biomarkers are valuable sources of information on the biodiversity and environment of early Earth. However, with organic biomarkers, especially in old samples, there are often problems of syngeneity and many of the most ancient biomarkers are suspected of being younger contamination.

A type of sample where biomarkers are better constrained in the rock is oil-bearing fluid inclusions, especially if single inclusions can be analysed. However, most inclusions, including Precambrian oil-bearing fluid inclusions are so small (less than 10 $\mu$m) that analyzing single ones with conventional techniques is not possible. Therefore, we have developed an approach employing time-of-flight secondary ion mass spectrometry (ToF-SIMS) to selectively open individual oil-bearing inclusions by $C_{60}^+$ ion etching, and to subsequently analyse their content. Using this approach steranes and hopanes could be detected in single Ordovician oil-bearing inclusions (15-30 $\mu$m) from the Siljan impact structure in Sweden.

Now the developed approach has been applied on Precambrian samples. Four different oil-bearing fluid inclusions trapped in a 1.43 Ga sandstone from the Roper Superbasin in Australia were opened and analysed with ToF-SIMS. The ToF-SIMS spectra of the oil in the different inclusions were similar to each other indicating that the same oil was trapped in all inclusions. In addition, the ToF-SIMS spectra contained peaks that could be assigned to alkanes, cycloalkanes, aromatic moities, steranes and hopanes.

With further development and if applied on other Precambrain samples this approach could help answering questions regarding early evolution of life on Earth.

# The impact associated to wastewaters treatment plant discharges into a fluvial system (Central Portugal)

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The Ocreza River is an important fluvial system in inner central Portugal, which originates in the Gardunha Chain at 1160 meters high and stretching for about 80 km before flowing into the Tagus river. It has several creeks and tributaries along which there are several communities dedicated mostly to agriculture and livestock activities. The impact of several wastewaters treatment plants discharges on water quality must be characterized, monitored and, mostly controlled as it has a crucial role on local communities' welfare.

This paper focuses on the Alcains and Castelo Branco wastewaters treatment plants which discharges into the Líria River, an Ocreza's tributary. Twenty georeferenced water samples were collected between the wastewaters treatment plants discharges and the Ocreza river confluence. Secondary inflows were identified and sampling performed at approximately equal distances and, were conducted during three different hydrological periods in 2010: rainy winter (January), intermediate conditions (March) and dry season (June). The following chemical parameters were analyzed: biochemical oxygen demand (BOD), dissolved oxygen concentration (DO), dry residue, $P_{total}$, $N_{total}$; pH, temperature and microbiological parameters. The dissolved oxygen concentration (DO), biochemical oxygen demand (BOD) and microbiological parameters were used as indicators to the presence of organic matter in the body of water, and consequentlty as parameters for evaluating the environmental pollution.

The QUAL2kw software was used to construct a water quality model performing a coupled hydrodynamic and water dispersion model to simulate the pollution in the Ocreza River due to sewage effluent. The model's fair calibration is demonstrated by the simulation consistent results with field observations and demonstrate that the model has been correctly calibrated. The model is suitable for evaluating the environmental impact of sewage effluent on Ocreza River from the wastewaters treatment plant inflows, allowing feasibility studies of different treatment schemes and the development of specific monitoring activities.