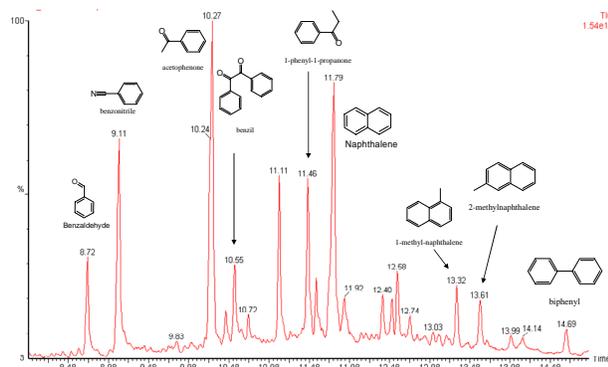


## Generating the aromatic world: Synthesis of aromatic compounds in icy environments

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The aromatic hydrocarbons are recognized as astrophysically important molecules and their presence in interstellar ices may contribute to the materials incorporated into planets, satellites, asteroids and comets. Ultimately, PAHs are recognized as key molecules in the study of the origin of life, due to their photochemical properties that could allow to PAHs to play the role of primitive pigment systems that drive synthesis of amphiphilic compounds; assemblies based on aromatic hydrocarbons were proposed as components of informational polymers, containers and mediators in metabolic pathways (1). The disponibility and stability of such aromatic compounds plus their capacity for self-assembly driven by pi-pi stacking interaction and weak forces made the aromatic hydrocarbons good building blocks for protocellular structures. Indeed, it has been demonstrated that amphiphilic polycyclic aromatic compounds are capable to self-assemble and form bilayer structures (2). We demonstrate that complex mixtures of aromatic compounds could be synthesized in cold systems with water ice and methane as carbon source. Using spark discharges as energy source and generating a "ice reactor" by means of a cycle of freezing-melting we found benzene derivatives as acetophenone, benzaldehyde and benzonitrile and PAHs.



**Figure 1:** SPME-GC/MS chromatogram showing main aromatic compounds obtained in an icy environment.

### References

- [1] Ehrenfreund P., Rasmussen J., Cleaves J., Chen L. (2006) *Astrobiology* **6**, 490-520.
- [2] Chen L., Geiger J., Perlstein J., Whitten D.G. (1999) *J. Phys. Chem. B.* **103**, 9161-9169.

## Dating carbonate rocks with *in situ* produced cosmogenic $^{10}\text{Be}$ : Why it often fails

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*In situ* produced cosmogenic nuclides have proved to be valuable tools for environmental and Earth sciences. Progress in the field of accelerator mass spectrometry (AMS) allows the determination of radionuclide concentrations as low as of  $10^4$ - $10^5$  atoms/(g rock) that makes quantifying Earth's surface processes possible.

However, surface exposure dating of carbonate rocks using the cosmogenic radionuclide  $^{10}\text{Be}$  is still problematic. In order to investigate the reasons for this, we have performed extensive step-wise leaching of calcite-rich samples. Results on different grain size fractions clearly indicate the sources of atmospheric  $^{10}\text{Be}$  being small clay minerals. We demonstrate that partial-leaching procedures that result in moderate pH levels will not release  $^{10}\text{Be}$  (*in-situ* produced or atmospheric) due to the instant re-absorption on grain surfaces. Under strongly acidic conditions all absorbed atmospheric  $^{10}\text{Be}$  is leached from aluminosilicates giving abnormally high  $^{10}\text{Be}$  concentrations and consequently exposure ages that are too old (Merchel *et al.*, submitted).

Now, that we understand the main obstacles in analysing  $^{10}\text{Be}$  from carbonate rocks, the next steps are clear: We need to concentrate on samples that do not contain clay minerals. This might require working on coarser grain size fractions or recrystallized material. Or we need to find a way to physically and/or chemically separate clay minerals from carbonates before dissolving them. This task is most challenging because clay is generally much more resistant to chemicals than carbonate minerals. After testing several analytical methods, i.e. XRD, IR, TEM-SAED, ICP-OES, SEM-EDX, we are still searching for a "simple and fast" method which could quantify clay concentrations in our samples and could help monitoring the efficiency of future separation procedures.

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### References

- Merchel S., Braucher R., Benedetti L., Grauby O., and Bourlès D.L. (2007), submitted to *Quaternary Geochronology*.