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# How do early diagenetic processes affect the molecular composition of the sedimentary organic matter?

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## Introduction

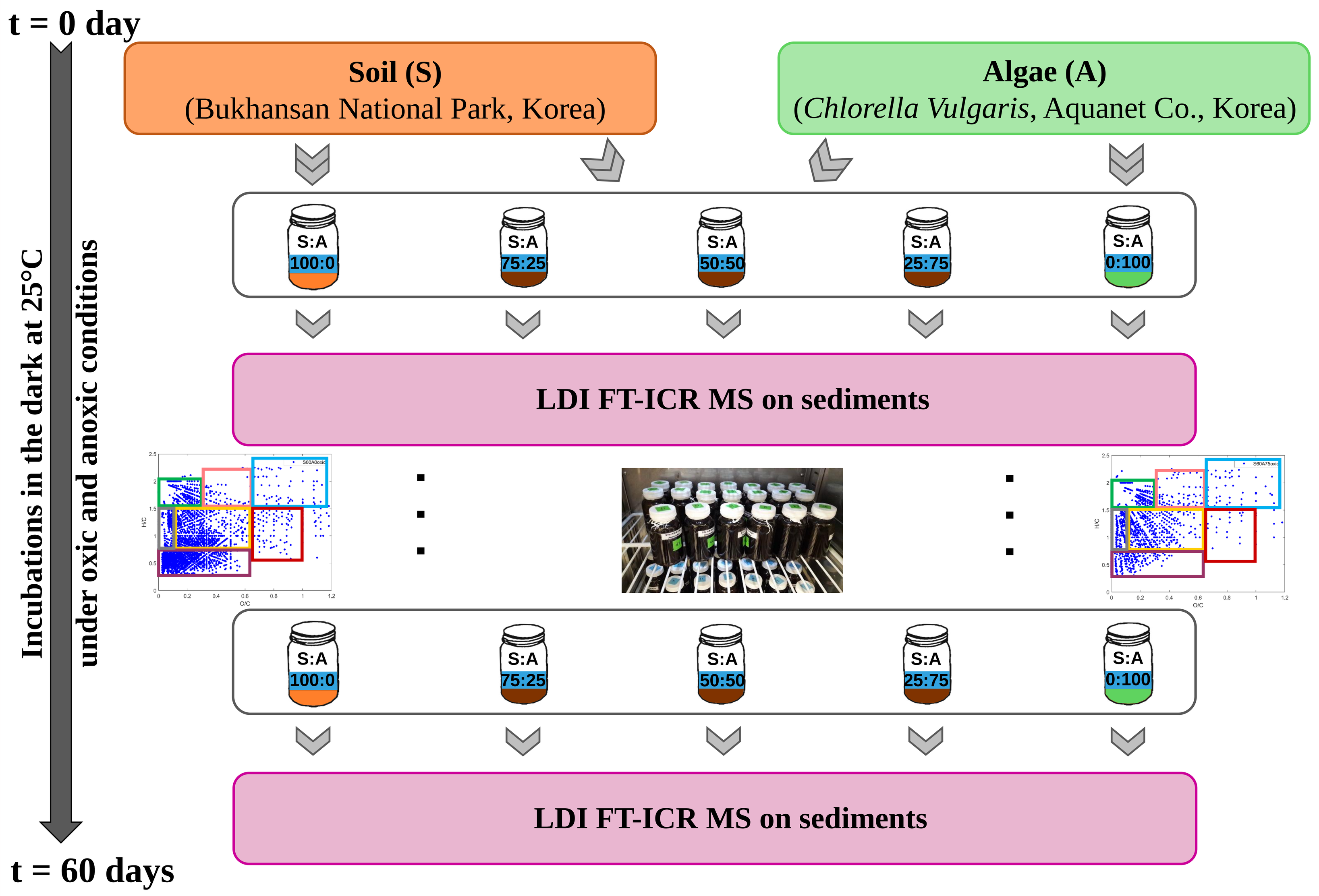
Sediments represent a large reservoir of nutrients and natural organic matter (NOM) from diverse inputs in various proportions. Indeed, sedimentary OM is derived from bacteria or plankton formed in situ, but also receives allochthonous OM from the upstream catchment. Soil OM is a representative allochthonous OM source and it is easily transported into the rivers and ends up in sediments through hydrological processes (van der Meij et al., 2018). Sediments are also a reactive compartment where diagenetic processes occur inducing changes. The processes may be physical, chemical, and/or biological in nature and may occur at any time subsequent to the arrival of a particle at the sediment-water interface (Henrichs, 1992; Milliken, 2003). Among the early diagenetic processes, biodegradation plays a key role as it is one of the main processes causing changes in amount, composition and properties of OM in sediment (Arndt et al., 2013; Guenet et al., 2014).
Investigating the processes that control the composition of sedimentary OM is crucial for a thorough understanding of OM dynamics and its role in the carbon cycle at a local and global scale (Gordon and Goni, 2003; Pedrosa-Pàmies et al., 2015).

## Aims of the study

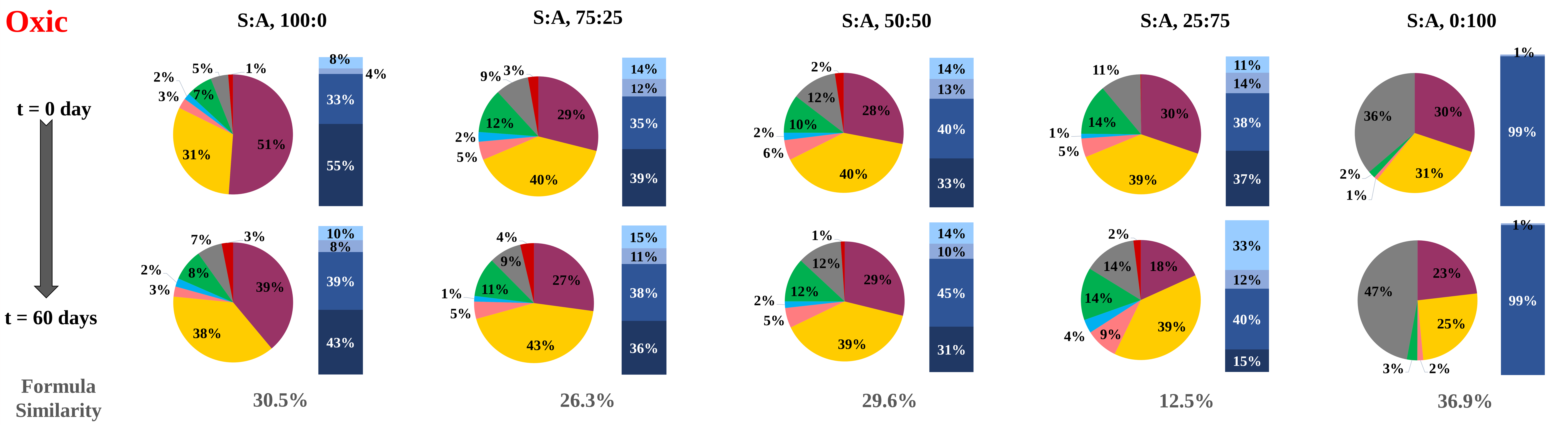
(i) to **identify which molecules** or groups of molecules are the **most affected** by the **biodegradation processes,**
(ii) to **examine the potential effect** of the **absence** and/or **occurrence** of **oxygen**, and
(iii) to **examine the potential effect** of the **OM source**s on the **molecular composition** during **biodegradation**.

## Material & methods

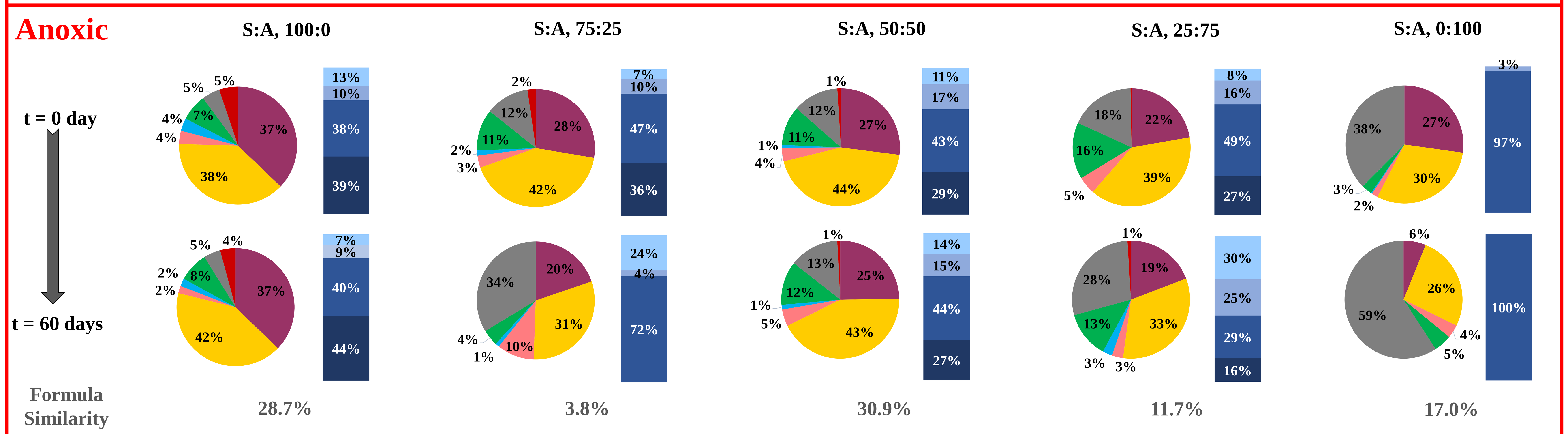
We designed a controlled degradation experiment at laboratory scale using organic-rich sediments artificially composed of two contrasting OM end-members (i.e., soil and algae) at known mixing ratios (Derrien et al., 2019). The incubations were performed under oxic and anoxic conditions in the dark at 25°C for 60 days. The sediment samples were collected on day 0 (e.g., the day where the samples were inoculated) and day 60 and were directly analyzed by laser desorption/ionization Fourier transform ion cyclotron resonance mass spectrometry (LDI FT-ICR MS) avoiding any sample pre-treatment step and consequently limits the inherent problems related to the extraction.




## LDI FT-ICR MS results




Condensed aromatic structures | Lignins | Proteins | Carbohydrates & aminosugars | Lipids | Unsaturated hydrocarbons | Tannins | CHO | CHON | CHOS | CHONS




## Conclusion

In this study, the molecular changes under early diagenesis on sedimentary OM was examined. Through this main goal, we aimed to evaluate the role of the oxygen and the source of OM in these conditions.
Based on the results, the following conclusions can be drawn:
- Molecular changes and compound distribution are observed after 60 days of incubation suggesting an important reactivity of the material for a short time of diagenesis.
- Distributions in compounds and formulas do not seem to be affected by the presence/absence of oxygen during biodegradation. This suggests that oxygen may make a limited contribution to altering the intramolecular mechanisms induced by biodegradation.
- The changes in compound distribution do not reflect ideal mixture behaviors with no linear trend with an increasing proportion of one end member in the mixtures.
- Important changes in compound and formula distributions were observed for specific mixing ( i.e., S:A, 75:25 and .S:A, 25:75) irrespective to the oxygen conditions. These observations suggest the occurrence of priming effects (Guenet et al., 2014).

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