

From lab to large infrastructures, from statistical data treatment to AI: insights into the latest state-of-the-art tools for probing reactive nanoparticles in complex natural media

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Highly divided particles—whether amorphous, crystalline, or in the form of nanoparticles—play a crucial role in various biogeochemical cycles and processes. Because of their extremely high surface-to-core atom ratio, they exhibit unique properties. However, studying these particles and the mechanisms they are involved in remains a challenge, largely due to the difficulty of accurately characterizing them. This is especially true since they often participate in rapid chemical reactions.

Significant progress has been made in our understanding of these particles, thanks to advances in scientific instruments and innovative experimental techniques, particularly those incorporating microfluidics. At the same time, artificial intelligence has become a valuable tool for handling vast amounts of data.

This talk will highlight the latest breakthroughs in cutting-edge instruments and experimental platforms that integrate microfluidics and data analysis. Through specific examples, we will see how these technologies enhance our ability to study and better understand nanoparticles in bio-geochemical contexts.

A special focus will be placed on tools that utilize X-rays, both in synchrotrons and in laboratory settings, with concrete examples drawn from large-scale distributed infrastructures, such as the IMAGINE2 platform— (national platform for IMaging and Analysis to Guide INnovation addressing the Environmental and Energy transition).

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