New study shows for first time that carboxyl groups can enhance organic carbon preservation

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In the super clean environment of the experimental hutch at Diamond, Majid Kazemian trains Lisa Curti to load her samples onto the beamline. Credit: Prof. Caroline Peacock, University of Leeds

A study by Ph.D. student Lisa Curti explored the preservation of organic carbon in the natural environment because of its importance in the global carbon cycle, which controls Earth's climate. Called "Carboxyl-richness controls organic carbon preservation during coprecipitation with iron (oxyhydr)oxides in the natural environment," published in *Communications Earth & Environment*, the paper shows for the first time that carboxyl groups can enhance carbon preservation by strongly sticking to iron mineral surfaces and once linked together carbon can be locked away from the atmosphere for hundreds to thousands of years.

Caroline Peacock, Lisa's co-supervisor and professor of biogeochemistry at University of Leeds, says, "Lisa's work shows how carbon chemistry plays a key role in how well it sticks to iron minerals in soils and sediments, and provides a platform for us to understand the interplay between carbon chemistry and minerals in carbon sequestration and climate. We could not have achieved this fantastic result without access to a world leading large scale science facility like Diamond."

Curti explains that despite many years of research, the exact mechanisms that adhere carbon and minerals are far from understood because of the chemical and physical processes involved and the variety of organic molecules and functionalities that can be found in nature. This work shows for the first time that carbon that is rich in carboxyl groups sticks more strongly to iron minerals in soils and sediments, and is subsequently stabilized against degradation.

Curti says, "Carboxyl richness could provide an important control on organic carbon preservation in the natural environment. This is really exciting because carbon preservation over very long timescales in sediments effects Earth's long-term climate, but carbon preservation over shorter decadal to centennial timescales in soils plays an important role in Earth's short-term climate, and finding new ways to increase the storage of carbon in soils might help offset current climate change."

Lisa is currently finishing her Ph.D., and has been working on Diamond beamline I08, with her co-supervisor at Diamond Burkhard Kaulich, and support from Majid Kazemian. Both are co-authors on the paper.

Commenting on her joint Ph.D. between Diamond and University of Leeds, Curti says, "It has been a great opportunity for me to work at Diamond and complement my research with cutting-edge synchrotron techniques. I really enjoyed my time spent at Diamond, despite the need for me to wear a full protective suit complete with a scientific shower cap in the experiments cabin, whilst my supervisors and colleagues looked on with amusement. I hope to have the chance to work at Diamond again in the future and to look even further into carbon-mineral associations."

More information: Lisa Curti et al, Carboxyl-richness controls organic carbon preservation during coprecipitation with iron (oxyhydr)oxides in the natural environment, *Communications Earth & Environment* (2021). DOI: 10.1038/s43247-021-00301-9

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