Aliphatic hydrocarbons on Ceres' surface found to have short lifetimes

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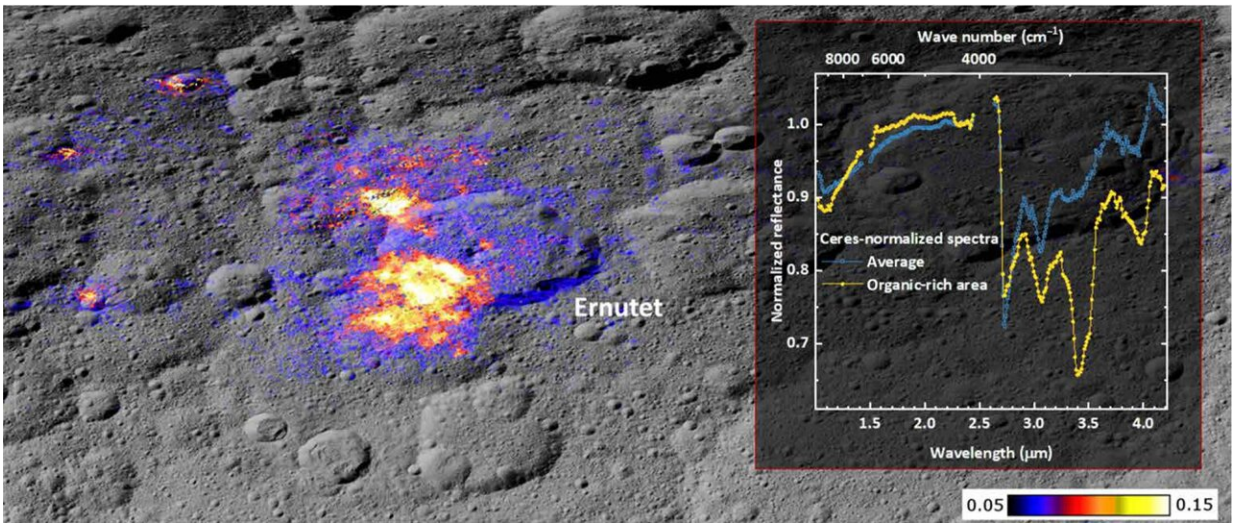

Map of the distribution of the aliphatic organics. Map of the AOs on Ceres, using as a proxy the 3.4-μm band depth (scale bar) derived by the Dawn VIR data, superimposed to a context map of the Ernutet region. The inset shows an example of a spectrum of aliphatic-rich pixels compared with an average spectrum of the Ernutet region taken by the VIR spectrometer. Credit: *Science Advances* (2024). DOI: 10.1126/sciadv.adp3664

A team of astrophysicists from several institutions in Italy, working with a colleague in the U.S., has found that aliphatic hydrocarbons observed on Ceres' surface have short lifetimes, suggesting they likely appeared there within the last 10 million years.

In their paper published in the journal *Science Advances*, the group describes how they conducted experiments in their lab designed to mimic conditions on Ceres.

Ceres is the largest body in the middle of the main asteroid belt that lies between the orbits of Jupiter and Mars. It was initially classified as an asteroid but more recently has been upgraded to dwarf planet.

Prior study of Ceres, much of which came from NASA's Dawn space mission, has shown there is organic material on its surface. In this new effort, the researchers investigated the history of aliphatic organics (AOs) on the surface.

AOs are a hydrocarbon class that includes alkenes, alkanes and alkynes—some of them have been observed on Ceres's surface circling a large crater. The team wanted to know how long the AOs have been there. To find out, they created a batch of material meant to mimic the AO material on Ceres as closely as possible.

They then fired ultraviolet radiation and other ions at the sample as an attempt to mimic the conditions faced on Ceres. Prior research has shown that such space-weathering can break down organic compounds.

After the bombardment, the researchers studied the sample, looking for signs of degradation. They found evidence showing that such a breakdown would occur relatively quickly. Doing the math showed that it would break down considerably over the course of just 10 million years. This, they note, suggests that the AOs spotted on Ceres could not have been there any longer than that.

Prior research has shown that the organic materials on the surface of Ceres likely formed deep inside the dwarf planet. The new findings suggest that such mixing occurred relatively recently. The researchers

theorize that the AOs on the surface were likely produced by Ceres's internal ocean.

More information: Maria Cristina De Sanctis et al, Recent replenishment of aliphatic organics on Ceres from a large subsurface reservoir, *Science Advances* (2024). DOI: 10.1126/sciadv.adp3664