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From Deep Earth to Deep Space: Synchrotron infrared spectroscopy measurements on geological and extraterrestrial samples

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We measured carbonaceous material from B-type asteroid (101955) Bennu, returned as part of the OSIRIS-REx mission[1,2], using synchrotron infrared techniques to reveal the heterogeneity of the organic and mineralogical material. The analyses were performed at the Advanced Light Source (ALS) at Lawrence Berkeley National Lab, a U.S. Department of Energy User Facility that provides spectrally broad and bright x-ray and infrared light for chemical analysis and imaging of natural and engineered materials. Diffraction and the long wavelengths of infrared light have traditionally limited the spatial resolution of far-field infrared techniques to the micron scale. However, near-field techniques, such as synchrotron infrared nano-spectroscopy (SINS), enable infrared spectroscopy at a spatial resolution <25 nm [3]. Prior to analyzing the asteroid samples, we demonstrated the capabilities of SINS to measure nanoscale mineralogical and organic heterogeneity in terrestrial shale samples and meteorites [4, 5]. Applying the same technique to Bennu samples reveals N-rich organic material with amide bonds, expanding the known inventory of prebiotic precursor materials in Bennu [6].

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