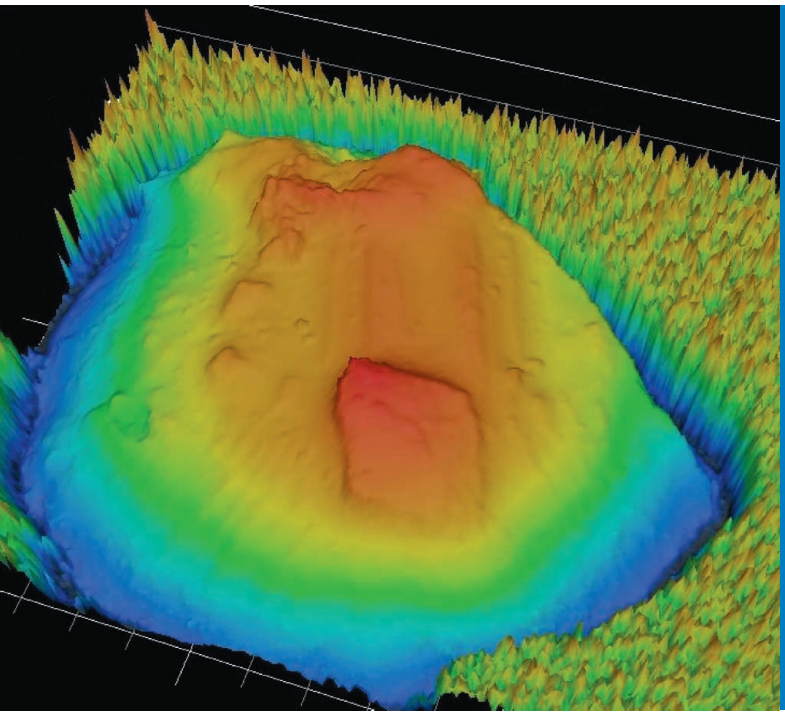


PLANETARY SCIENCE

Organic Delivery Device

Several plausible mechanisms could produce complex organic molecules on the Moon, including synthesis by energetic UV radiation or impact shocks, delivery from meteorites, and even decay of biotic matter. However, Apollo samples have shown surprisingly low levels of carbon. Thomas-Keprta *et al*. have now detected complex organics larger than methane within lunar samples from Shorty Crater. They probed glassy beads tens of micrometers in diameter for fluorescence, revealing some with thin layers of carbonaceous material that were apparently embedded while the silicate surface was still molten. Chemical characterization with micro-Raman spectroscopy indicated the presence of macromolecular matter similar to kerogen, a compound that composes the bulk of stony meteorites. The authors favor a production scenario in which these abiotic organics were delivered via micrometeorites around the time that the volcanic glass beads formed. More substantial meteoritic accretion from cometary and asteroidal fragments also is thought to have occurred on the early Earth. The specific quantity and nature of these organics remain under investigation in the context of possible precursors for life in the solar system. — MMM

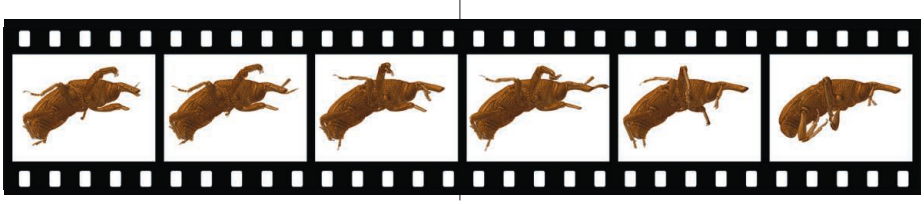
Geochim. Cosmochim. Acta 10.1016/j.gca.2014.02.047 (2014).

BIOPHYSICS

Weevils: Now in 4D

Methods are ever improving for the study of anatomic structures and their associated dynamics as they occur in real time and 3D space. dos Santos Rolo *et al.* developed in vivo x-ray cinetomography for 4D analysis, which allows the visualization of optically opaque tissue in small living organisms. The method combines ultrafast x-ray computed microtomography and motion analysis procedures to examine structures in the micrometer range and with temporal resolution of a few tens of milliseconds. The method was applied to the exoskeletal hip joints of the wheat weevil *Sitophilus granarius* to reconstruct 4D kinematics. Weevil hip joints are fast-moving and display what is termed a screw-and-nut system. The imaging method was able to track the movement of the hip joint and elucidate its structural displacement from the main body by following the geometrical center of the hip and by separating angular velocities. The kinematics of the wheat weevil reveals features of its mobility and can be compared to that of different weevil species or other arthropods. The method may also be applied more widely for morphological dynamics in animals and biomaterials. — BAP

Proc. Natl. Acad. Sci. U.S.A. **111**, 10.1073/pnas.1308650111 (2014).



APPLIED PHYSICS

More Memory Please

The storage density of digital media has soared by many orders of magnitude over the past several decades, but still there is demand to store even more on an even smaller scale. Doing so, however, has its bounds, as engineering capabilities or fundamental physical limitations may hinder further size reduction. Phase-change memory materials provide a platform to store digital information in the form of bits, the state of the bit being distinguished by the different reflective properties of the amorphous and crystalline state. The state of the bit typically is set by optical, electrical, or thermal pulses that change the phase of the materials. Instead of shrinking the size of the bit, Wang *et al*. show that such a phase-change memory bit can access several levels. Using a series of ultrafast laser pulses to the control the amount of energy pumped into the bit, they show that a ladder (or gray scale) of stable states can be accessed. Such a multilevel approach could be useful for enhancing effective storage density without the need to shrink the device size. "What I know can be written on the back of a postage stamp" may actually turn out to be a rather showy feat of memory recall, and not a self-deprecating claim of modest knowledge as intended. — ISO

Appl. Phys. Lett. 104, 121105 (2014).

ECONOMICS

Problematic Permitting

When faced with environmental regulations and the costs they impose, companies may relocate to a less-regulated jurisdiction, taking with them jobs and contributing to "leakage" in which targets of regulation, such as carbon emissions, are not reduced, just redistributed. To retain companies, jurisdictions often include exemptions and other incentives in their regulations. Yet these incentives may be seen as taxpayer-funded "handouts" to industry, threatening political support. Thus, the balance is critical. Martin *et al.* studied the European Union (EU) Emissions Trading Scheme (ETS), which offered emissions permits for free, rather than auctioning them, to many companies deemed at risk of relocating. They interviewed managers of 761 manufacturing

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firms across six EU countries, and combined this with economic performance data and official ETS carbon emissions data. They found that reductions in the risk of relocation under the ETS permit allocation rules could have been achieved with far fewer free permits. The mismatch was especially problematic in terms of reducing the risk of job loss. Although their initial analyses drew on information gleaned from interviews with companies, the authors developed permit allocation schemes that drew on more easily accessible information, such as firm-level employment and carbon emissions, that were still more effective in terms of minimizing leakage and job loss. Such optimization is critical as ETS considers revising its permitting process, and more emissions trading markets worldwide adopt similar exemption rules. — BW

Am. Econ. Rev., http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2033683 (2014).

PSYCHOLOGY

A Personal Connection

Telephone companies have long used recorded voices, usually female, and many services companies have chosen to confront callers with voice-based menus of options. Personalized assistance became available by means of Siri for iPhone users, and Waytz *et al.* have now begun to explore the psychological consequences of endowing autonomous vehicles, one of the latest technological innovations to come to market, with a voice. They monitored drivers' physiological status while in a driving simulator operated either by themselves or by an

CREDIT: ANGELA PIAZZA/ZUMA PRESS/NEWSCOM

autonomous entity, referred to as Iris, that spoke to the human drivers. Not surprisingly, audio communication increased the sense of liking and of anthropomorphization; it also enhanced feelings of trust—which was measured both by self-reported ratings and by fluctuations in heart rate—under normal driving conditions. Furthermore, in the aftermath of a collision with another car, programmed so as to be unavoidable, drivers were more likely to absolve Iris of blame in comparison to a similar, nonverbal autonomous vehicle. These effects fit neatly into a framework of greater humanization as being reflective of an entity's capacities to carry out actions (agency) and to embody feelings. — GJC

J. Exp. Soc. Psychol. **52**, 113 (2014).

ENGINEERING

Bacterial Diagnosis

You've read about the enormous community of microbes that live in the guts of humans and other animals. But what if we could train some of them to perform non-invasive but reliable diagnostic procedures deep inside the body? Kotula *et al*. report experiments showing that such a strategy is not at all farfetched. Bacteria were engineered to contain a stable genetic switch that would record exposure to a chemical while the bacteria were living in the gut of a mouse. The switch was then rigged to be activated if the bacteria were exposed to a certain chemical, low concentrations of which regulated a repressor element built into the trigger mechanism for the sensor. The modified bacteria could then be fed to mice. When the bacteria were later collected from fecal samples, they accurately "remembered' whether or not the host animal had been exposed to the chemical more than a week earlier. Given these results, one can imagine similar programming of bacteria that would report the presence of diagnostically sensitive chemicals indicative of cancer, inflammation, or other conditions within the gut of the host animal. — LBR

Proc. Natl. Acad. Sci. U.S.A. **111**, 10.1073/pnas.1321321111 (2014).

VIROLOGY

A Mouse Model for MERS

Coronavirus (CoV) infections acquired from wild and domesticated animals pose a threat of causing severe and often fatal human pneumonias, as witnessed by the severe acute respiratory syndrome (SARS) CoV, originating in edible wildlife, and more recently by the Middle East respiratory syndrome (MERS) CoV, possibly from camels. The pathogenesis of MERS is poorly understood, and animal models have been restricted to macaques until now. Zhao *et al.* have developed a way of rapidly producing models by transducing mice with a non-replicating adenovirus vector carrying the human MERS virus cellular receptor dipeptidyl peptidase 4 (hDPP4). The receptor was expressed on the surface of mouse lung alveolar epithelial cells. Receptor-bearing mice were susceptible to MERS, showed pathology, and had immune responses similar to those seen in humans and thus can be used to test vaccines and antiviral drug candidates. — CA

Proc. Natl. Acad. Sci. U.S.A. **111**, 4970 (2014).

Published by AAAS

A Mouse Model for MERS

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Science **344** (6180), 131.
DOI: 10.1126/science.344.6180.131-c