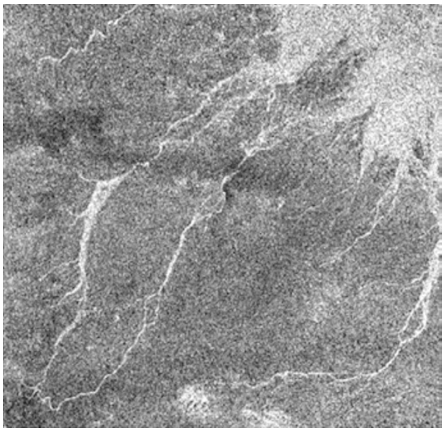
PLANETARY SCIENCE

Landscapes on Titan

Geol. Soc. Am. Bull. http://doi.org/jzf (2012)



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A decade ago, the Cassini–Huygens mission revealed that the surface of Saturn's moon, Titan, seemed to have been sculpted by flowing liquids, primarily methane. Further imaging of Titan's diverse fluvial landscapes shows that the sedimentary and hydraulic processes that occur on Titan's surface are often similar to those that occur on Earth.

Devon Burr at the University of Tennessee-Knoxville and colleagues analysed the morphology of fluvial features as observed in ten years of Cassini–Huygens data. They combined the spacecraft radar imagery with insights from process mechanics and terrestrial analogues. In the valley networks near the Huygens probe landing site, the morphology is consistent with mechanical erosion of sediment by overland channelled flows, probably fuelled by alkane rains. Sediment deposition occurs in braided river channels, extant and former lake basins and along some plains. However, it isn't immediately clear how or where these sediments were created.

Precipitation and run-off during seasonal storms on Titan, spurring flows capable of moving many different sizes of sediment, can explain many of the surface features. The area of Titan's surface affected by this fluvial dissection is around an order of magnitude greater than that inferred from visible fluvial networks alone. *TG*

DEEP EARTH

Core light elements

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The Earth's outer core should be composed largely of molten iron and nickel, but density estimates indicate the presence of at least one lighter element. High-pressure experiments suggest that early in Earth's history, silicon and oxygen could have dissolved into the metallic liquid that formed the outer core from an overlying silicate layer.

Kyusei Tsuno and colleagues at the University of Bayreuth, Germany, performed laboratory experiments at temperatures and pressures similar to those expected at depth in the early Earth. They assessed the partitioning of silicon and oxygen between molten silicate and a molten iron alloy, representative of Earth's mantle and core respectively. In the experiments — which reached up to 25 GPa and 3,080 K — both silicon and oxygen partitioned into the iron pool in similar amounts. Using thermodynamic modelling to extrapolate the results to higher temperatures and pressures, the researchers showed that temperatures of 3,300 to 3,500 K are required for silicon and oxygen to partition into molten iron at levels that can explain the observed density of Earth's outer core.

The release of silicon and oxygen from the outer core as it cools could result in iron oxide and silica enrichments at the base of the mantle. *AN*

TECTONICS

Accretionary surge

Geology http://doi.org/jzj (2012)

During subduction, sediment is scraped off the down-going oceanic plate and accreted to the overriding plate; changes in the rate of accretion are commonly thought to arise from variations in tectonic motions at the plate boundary. An analysis of the sediment attached to the North American Plate identified a batch of material that was suddenly accreted during a tectonic event within the continent.

Trevor Dumitru at Stanford University, USA, and colleagues use U-Pb dating to assess the timing of sediment accretion at the Franciscan subduction zone, located in the northwestern US, as well as the source of the sediments. They find that the subduction zone received a sudden surge of sediments about 53 to 49 million years ago. The sediments originally came from Idaho, several hundred kilometres away from the subduction zone, and were delivered to the Pacific Ocean and the subducting plate by rivers draining the continent. The timing of the accretionary surge coincides with a period of tectonic extension, uplift and erosion in Idaho.

The researchers therefore suggest that the increase in sediment accreted to the edge of the North American Plate about 50 million years ago was caused by tectonic activity inside the interior of the continent, far away from the plate boundary. *AW*

BIOGEOCHEMISTRY

Toxic sediments

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The Yangtze River, which traverses some of the most populous and developed regions in China, delivers large quantities of sediments and pollutants to the East China Sea. An analysis of estuarine sediments suggests that significant quantities of polycyclic aromatic hydrocarbons — a widespread carcinogenic organic pollutant — are deposited at the mouth of the river.

Tian Lin of Fudan University, Shanghai, and colleagues measured the polycyclic aromatic hydrocarbon content of surface sediments in the mud belt that stretches from the mouth of the Yangtze River to the inner shelf of the East China Sea. According to their analysis, 152 tons of these toxic hydrocarbons are deposited on the estuarine inner shelf each year. This is equivalent to around 38% of the total annual input of these hydrocarbons into the East China Sea, and makes the inner shelf of the Yangtze estuary one of the largest terrestrial repositories of polycyclic aromatic hydrocarbons globally. The predominance of hydrocarbon compounds with low molecular weight suggests that a significant fraction is sourced from oil.

Re-suspension of the polycyclic aromatic hydrocarbons in the water column, for example by strong currents induced by monsoon winds, could constitute a significant secondary source of toxins to the East China Sea. *AA*

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