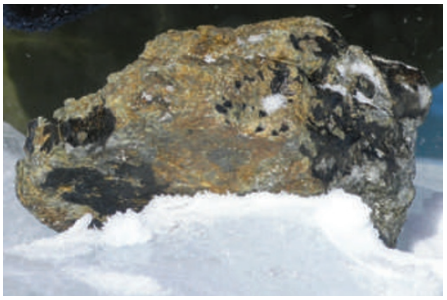
## Crusty asteroids

*Nature* **457,** 179–182 (2009)



ANTARCTIC SEARCH FOR METEORITES

Two recently recovered meteorites, thought to come from the outermost layers of an asteroid, have a chemical composition closer to the Earth's continental crust than any other known extra-terrestrial material. In addition they show a much greater complexity of early-formed materials in the Solar System than previously recognized.

James Day of the University of Maryland and colleagues used petrological and geochemical techniques to characterize the chemical composition of the two meteorites, which are at least 4.5 thousand million years old and classified as achondrites. The team found that the meteorites more closely resembled the bulk composition of Earth's continental crust, compared with previously examined achondrite-type meteorites, which show greater similarity to the rocks that form oceanic crust.

Earth's continental crust formed after the planet had already separated into the core and mantle. The asteroid parent body of the meteorites, however, generated complex material without such differentiation, suggesting that these rock types can form by processes unlike those in operation on Earth.

## History of Heinrichs

*Paleoceanography* **23,** PA4218 (2008)

Heinrich events — periods of increased delivery of ice-rafted debris from North America to the North Atlantic Ocean, which commonly occur at the end of ice ages — have been documented over the past 140,000 years. Now an analysis of marine sediments shows that Heinrich events sourced from the Hudson Strait first appear in the sedimentary record 640,000 years ago.

David Hodell of the University of Florida at Gainesville and colleagues analysed the chemical composition of marine sediments from the North Atlantic Ocean, spanning the past 1.4 million years. Although peaks in ice-rafted debris occurred throughout the time series, Hudson Strait events only appeared after the mid-Pleistocene transition from 40,000-year glacial cycles to100,000-year cycles.

The group suggests that the increasing volume of ice in North America may have caused ice sheet instability in the strait region, leading to the periodic heavy discharge of icebergs. Although, it could also indicate that this was the first time climate conditions allowed icebergs from the strait to survive transport to mid-latitudes.

## Modelling Monsoons

*J. Clim.* **21,** 6119–6140 (2008)

High-frequency variations in sea surface temperature drive the variations in rainfall that occur in an Indian monsoon season, according to a new climate simulation. The annual development of the Indian summer monsoon is one of the most consistent and stable features of the global climate system, yet intraseasonal variability has been unpredictable.

Nicholas Klingaman of the University of Reading and colleagues forced the Hadley Centre Atmospheric Model with daily- and monthly-mean observations of sea surface temperature derived from satellites. Simulations based on daily variations showed much greater variability in monsoon rainfall across much of the monsoon domain, compared with those based on monthly means. In addition, the strength, speed and organization of intraseasonal variations matched observed events only in the daily forced-model. The results indicate that sea surface temperature anomalies may amplify and help organize variability in intraseasonal monsoon rainfall.

The authors conclude that atmospheric models, once thought unable to capture intraseasonal variations in the Indian summer monsoon, can be improved with more realistic estimates of sea surface temperature.

## Triggering eruptions

*Earth Planet. Sci. Lett.* **277,** 399–407 (2008)

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Eruption rates of subduction-related volcanoes in Chile increased for about a year following two large magnitude earthquakes that occurred offshore in the Pacific Ocean. This concurrence hints at the possibility that earthquakes can trigger eruptions with a greater delay than is usually considered.

Sebastian Watt from the University of Oxford and colleagues analysed historic records for potential temporal relationships between earthquakes greater than magnitude 8 that occurred along the Chilean subduction zone and eruptions of Chilean volcanoes. They found a marked rise in eruption rates during the year following the great earthquakes in 1906 and 1960. The researchers conclude that this concurrence is not coincidental, and that these particular earthquakes were the triggers for increased volcanic activity.

Other great earthquakes in the historic record that they analysed, however, are not correlated with greater eruption rates, precluding any simple relationship between earthquakes and eruptions.

## Cold start for Mars

*Geophys. Res. Lett.* doi:10.1029/2008GL036513 (2008)

According to new model results, extreme ultraviolet solar radiation probably inhibited build- up of carbon dioxide in the early martian atmosphere for at least several hundred million years. Carbon dioxide, a greenhouse gas, is one key feature in the establishment of a warm climate.

Feng Tian of the Massachusetts Institute of Technology and colleagues developed a sophisticated numerical model to study the effect of extreme ultraviolet radiation on the stability of carbon dioxide in Mars's upper atmosphere. Their results show that this radiation on early Mars was intense enough to have allowed carbon to escape to space, thereby preventing a dense atmosphere from forming. They found that far more carbon was lost from the early atmosphere than could have been added by volcanic eruptions. As the intensity of the radiation decreased, carbon dioxide began to build-up, leading to a brief period of warmer climate.

Without an insulating atmosphere like that of the early Earth, Mars was most probably a cold and dry place early in its history, with conditions unfavourable for the existence of liquid water.