Fragmented slab

Earth Planet. Sci. Lett. **311,** 124–135 (2011)

The Yellowstone region of the United States is part of an elongated volcanic track that is commonly regarded as the surface expression of a deep mantle plume. Seismic images of the mantle beneath this region suggest that the volcanism could instead result from hot mantle upwelling around the edge of an ancient fragment of subducted oceanic plate.

David James at the Carnegie Institution of Washington and colleagues used seismic wave data to obtain images of the mantle beneath the western United States. Their measurements reveal a remnant of oceanic plate that has broken off from the currently subducting Juan de Fuca plate. It now lies almost horizontally in the upper mantle transition zone at a depth of 500–600 km. The shape and orientation of the plate fragment shows a remarkable match to that of the surface volcanism associated with the Yellowstone hotspot track.

The researchers argue that the fragment separated from the remainder of the subducting plate around 17 million years ago — coincident with the onset of large-volume volcanism in the Pacific Northwest — allowing hot mantle material to upwell around its edges. Yellowstone's volcanic activity may therefore not require a deep mantle plume. *AW*

Precession control

Quat. Sci. Rev. **30,** 3716–3727 (2011)

Marine sediment analyses suggest that over the past 400,000 years, the hydrological cycle over the Western Pacific warm pool was controlled by local incoming solar radiation.

Kazuyo Tachikawa and colleagues at Aix-Marseille University, France, determined the geochemistry of marine sediments and associated fossils in a core collected from the northern coast of Papua New Guinea. Using the abundance of elements typically found in the rocks of the island, they reconstructed river run-off, and hence precipitation, over the past four glacial–interglacial cycles. Somewhat surprisingly, precipitation intensity was seemingly unrelated to the glacial cycles. Instead, changes in rainfall were closely linked with the precession of the Earth's orbit, which strongly influences insolation in the tropics on a 23,000-year cycle.

Records in other parts of the warm pool that do show glacial–interglacial shifts in precipitation could reflect the effects of glacial reduction of sea level, which eliminated the shallow seas that serve as a moisture source to the neighbouring islands. *AN*

Magnetic asymmetry

Phys. Earth Planet. Inter. http://dx.doi.org/10.1016/j.pepi.2011.10.005 (2011)

Earth's magnetic field is generated by flows within the fluid outer core and is broadly symmetrical about the axis of rotation. Numerical modelling shows that thermal anomalies above the boundary between the core and mantle could cause the magnetic field to deviate from this symmetry.

Hagay Amit and Gaël Choblet at the Université de Nantes, France, numerically simulated the effect of narrow ridges of hot material in the lower mantle on flow within the outer core. Such ridges have been identified beneath central Asia and the Indian Ocean and below the American Pacific coast. Some of the relatively hot ridges seem to act as barriers to the overall westward flow of material at low latitudes in the core, causing it to upwell into elongated zones. The upwelling material causes the overall geomagnetic field to become heterogeneous and asymmetrical.

The researchers suggest that the hot ridges could have caused localized patches of intense geomagnetic flux to the west, below east Asia and the Americas, that should be apparent when averaged over time. *AW*

Ice and algae

Geophys. Res. Lett. http://dx.doi.org/10.1029/2011GL049712 (2011)

The organic compound dimethylsulphide is generated by marine algae in the surface ocean and escapes to the atmosphere, where it influences clouds and climate. An analysis of Antarctic sea ice suggests that algae embedded in the brines also generate a significant amount of dimethylsulphide.

Elizabeth Asher of the University of British Columbia and colleagues measured the concentration of dimethylsulphide and two precursor compounds in brines at various locations in the Antarctic sea-ice zone during the austral summer of 2010–11. The sea-ice brines contained large quantities of dimethylsulphide, with concentrations exceeding 200 nmol in some cases, together with significant quantities of microbial biomass. Using a multi-tracer approach to measure the turnover rates, the researchers show that dimethylsulphide is rapidly recycled. In many cases, the reduction of one of the precursor compounds — dimethylsulphoxide — dominates the production of dimethylsulphide in sea ice.

The findings suggest that microbial activity in sea ice leads to the accumulation of large quantities of dimethylsulphide, and could represent a significant source of this compound in marine systems. *AA*

Variability matters

J. Clim. http://dx.doi.org/10.1175/2011JCLI4115.1 (2011)

Weather-dependent processes, such as disease outbreaks and terrestrial productivity, are sensitive to the variability as well as the mean state of climate parameters. Satellite data show that the variability of two such factors — solar radiation and precipitation — was correlated in recent years.

David Medvigy and Claudie Beaulieu of Princeton University examined variations in surface-level solar radiation and daily precipitation across the globe between 1984 and 2007. They found significant shifts in solar variability over 35% of the globe; shifts in precipitation variability were evident over 40% of the globe, with an increase apparent over tropical Africa and southeast Asia. Variations in solar radiation were positively correlated with variations in precipitation and the abundance of deep convective clouds in tropical regions.

Whether or not a causal link exists between solar variability, precipitation and cloud abundance, however, remains unclear. *AA*

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