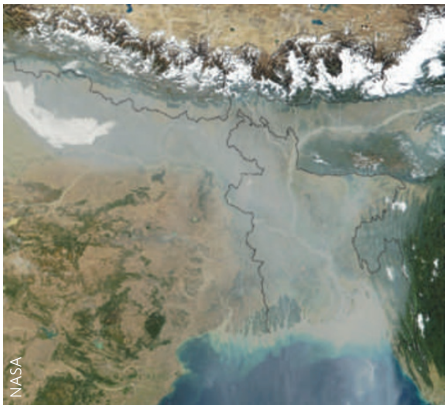
Restricted rains

J. Geophys. Res. **114,** D06213 (2009)



Anthropogenic aerosols originating in western Central India are known to accumulate over the southern Arabian Sea. Model simulations now indicate that these pollutants — collectively known as the Bombay plume — may suppress winter monsoon rainfall in the Bay of Bengal.

Tiruvalam Krishnamurti, of Florida State University, and colleagues used the NASA Goddard Earth Observing System model to examine the effect of the Bombay plume on precipitation. They found additional rainfall over the entire Arabian Sea of up to 3 mm per day during periods of intense pollution. However, the polluting aerosols also heat the atmosphere, resulting in local changes in tropospheric circulation that suppress winter monsoon rainfall over the southeast coast of India.

To validate their results, the authors analysed 23 years of climatological data; they found that winter monsoon rainfall was reduced by approximately 60% over the southeast Indian coast during high pollution events.

Not a lot of plume

J. Volcanol. Geotherm. Res.
doi: 10.1016/j.jvolgeores.2009.01.034 (2009)

An analysis of basalts from the Snake River Plain in the northwestern United States shows that the rocks were generated at shallow depths under moderately high temperatures. This finding implies that the source melts were formed with little contribution from the nearby Yellowstone plume.

William Leeman, from the US National Science Foundation, and colleagues estimated the pressures and temperatures at which the magmas were segregated from the mantle using geochemical and geophysical data. The team used three independent techniques to estimate conditions at the time of formation from these data, which converged on maximum values for temperature and pressure of about 1,430 °C and 2.8 GPa, equivalent to a depth of less than 100 km.

These values are consistent with a melt source in the shallow mantle, but not with a hot, deep source expected from a plume. The researchers suspect that the uppermost mantle in this region may be more susceptible to melting than mantle material in similar settings elsewhere, which would explain the relatively high volume of basalts produced from this unexpected source.

End of a dynamo

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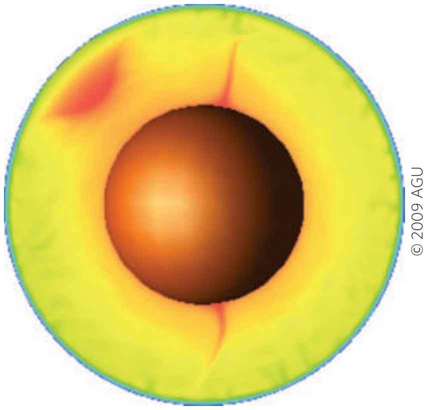
doi: 10.1029/2008JE003287 (2009)



Although there is no global magnetic field on Mars today, magnetized crustal rocks provide evidence that, over four thousand million years ago, a field was once in existence. Recent modelling of Mars' interior indicates that a series of massive impacts may have extinguished this early magnetic field.

James Roberts, of the University of California at Santa Cruz, and colleagues calculated the amount and distribution of heat generated by the largest impacts on early Mars. Based on this information, they modelled thermal convection in the martian mantle and estimated the heat flow at the core–mantle boundary. The model shows that extremely large impacts are capable of heating the underlying mantle through to the core–mantle boundary.

Planetary magnetic fields, which arise from convection in the liquid iron core, are thought to be sustained by heat flow from the core to the mantle. The group suggests that repeated impacts suppressed the core–mantle heat flow, thus inhibiting convection in the core to the point of permanently shutting off the global magnetic field.

Warm pool precursor

Palaeogeogr. Palaeoclimatol. Palaeoecol.
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A precursor to the western Pacific warm pool developed over 11 million years ago, according to reconstructions of ocean temperatures. The modern warm pool — defined by annual average sea surface temperatures above 28 °C — influences global atmospheric circulation patterns and moisture flux.

Stephen Nathan and Mark Leckie of the University of Massachusetts at Amherst used numerous proxies from marine sediments to reconstruct the thermal structure of the western equatorial Pacific Ocean during the Miocene epoch. Their data show two distinct pulses of thermocline warming 11.6 and 10.6 million years ago. The authors suggest that falling sea levels restricted the flow of surface waters from the Pacific Ocean into the Indian Ocean, thus creating the thick lens of warm, relatively fresh water that forms the warm pool.

The emergence of the proto-warm pool, which waned with the rise in sea level about 9 million years ago, coincides with rising productivity in the eastern equatorial Pacific Ocean, and may reflect the development of a La Niña-like pattern 11 million years ago.

Slow squeeze

Earth Planet. Sci. Lett. **281,** 27–35 (2009)

Stowaway mantle rocks indicate that ancient subduction may have deeply buried the continental crust of western Norway for up to 30 million years, far longer than predicted by geodynamic models.

Over 400 million years ago, the crust now found in western Norway was buried during a collision between two continents, where it picked up pieces of mantle rock that were carried to the surface as the crust was exhumed. Dirk Spangler from Kyoto University, Japan and colleagues used the mineralogy and chemical composition of these rocks to estimate the timing and conditions of metamorphism undergone by the buried continent. Their analysis shows that the crust was subducted to almost 200 km in depth, where it was subject to ultrahigh-pressure metamorphism at fairly cool temperatures for almost 30 million years.

Such prolonged burial of continental rocks deep in the mantle has not been seen in other regions, and may be suggestive of a changing regime in interior heat flow as the Earth cools.