RÉSUMÉ

Watered down

WATER conservation campaigns in response to the drought in California have certainly been effective; domestic usage in some urban areas has dropped by 28 per cent since 1986. R. A. Berk and colleagues were interested in exactly how this was achieved (*Clim. Change* **24**, 233–248; 1993). Changes in behaviour such as turning off the tap whilst brushing teeth are likely to be short-term, whereas technological fixes, such as low-flow shower heads or a brick in the cistern, should give long-term reductions. The research team approached the task with a healthy grain of scepticism, in which they were justified: of 632 Californians questioned on their conservation practices, 2 per cent claimed to recycle their light bulbs, 14 per cent apparently had an energy-saving television, and at least 10 per cent had heard of fictitious government campaigns to ban wearing fur, cutting Christmas trees or driving during smog alerts.

Inside information

ICEBERGS are not just a hazard for ships — they also cause headaches for those trying to plan oil and natural gas exploration or production in polar regions. The problem is that not much information is available about the movements of icebergs in the past, so it is hard to predict their likely paths in the future. S. Løset (*J. geophys. Res.* **98**, 10001–10012; 1993) now suggests that iceberg paths can be retraced from their internal temperature. He reports profiles of ice temperature versus depth obtained from icebergs in the Barents Sea, and shows that drilling deep enough (12 m into the ice) gives access to temperatures that are characteristic of the region from which the berg originally calved, and are unaffected by the temperature of the water through which it subsequently travelled.

Courses for horses

To test a horse's sporting performance, or see if it is under the weather, it can be more convenient to exercise the animal on a treadmill rather than on a track. The treadmill can be sloped to increase the workload of the running horse. But what angle best reproduces overground conditions when, among other differences, the horse will have a rider? E. Barrey *et al.* tackled this question, taking heart rate as the measured parameter (*Vet. Rec.* **133**, 183–185; 1993). They exercised seven horses at different speeds on a turf track, and compared heart rates for the same horses moving at various speeds on various slopes on a treadmill. From these analyses the optimal angle emerged as 3.5%, a result which was verified by re-runs on the track and on the treadmill with that slope. The 3.5% solution might, then, become a standard.

unlikely that repetitive advance in step with events in the Northern Hemisphere could have been fortuitous. And although damped in comparison to their northern counterparts, the Dansgaard–Oeschger events are apparent in several different ice cores from Antarctica[7].

Wallace Broecker, the acknowledged ringleader of climate change studies, recently commented that what once appeared to be a stately procession of climate oscillations now seems to have been more of a "drunken lurch". Undoubtedly, some of the inebriation he senses was brought on by the mechanical instabilities of ice sheets. But the implication from the Last Interglacial period that the conveyor may have flipped on and off in the absence of icebergs and meltwater helps to narrow the field of suspects. One of the more likely remaining culprits is the hydrological cycle, whose habits are still only poorly known. No doubt there will be heightened interest over the next few years in trying to document the strength and patterns of global vapour transport and their interactions with the conveyor. □

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SEISMOLOGY

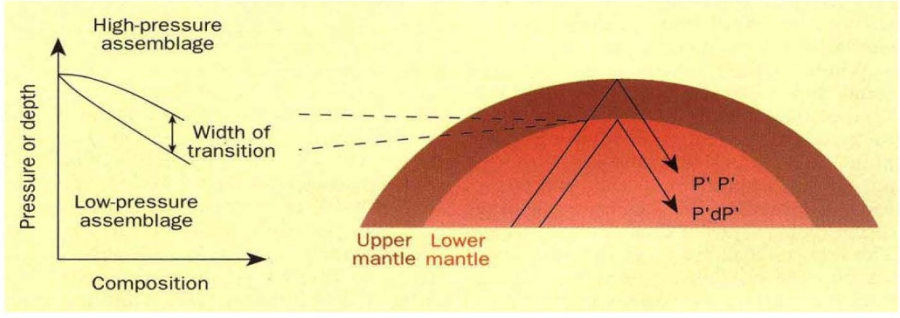
The mantle in sharper focus

Raymond Jeanloz

GLOBAL seismology is moving beyond the classical model of the Earth's onion-like structure, a static picture of the metallic core surrounded by the rocky mantle and crust. The new emphasis is on fine seismological details reflecting the dynamics of the interior; that is, the underlying convective motions driving plate tectonics and the geological processes of the Earth's crust. Such details include the horizontal variations (a few per cent in magnitude) in wave velocities determined from seismic tomography, and the kilometre-sized undulations of the interfaces between layers. New studies of interface reflectivities may also tell us much about the Earth's internal dynamics, as Benz and Vidale show on page 147 of this issue[1].

The traditional interpretation of mantle structure, the subdivision into upper mantle, transition zone and lower mantle, is in terms of equilibrium transformations among mineral phases[2,3]. The discontinuous changes in seismic velocities at 400–410 and 650–670 km depth, defining the top and bottom of the transition zone, are ascribed to the olivine and pyroxene of the upper-mantle rock transforming to high-pressure spinel structures (γ-spinel and β-'spinelloid' phases) at 14 GPa, which then transform to a mineral assemblage dominated by $(Mg,Fe)SiO_3$ perovskite at 23 GPa.

Like the Earth's 'onion' structure, a model based on thermodynamic equilibrium is essentially static in nature, yet has the advantage of making detailed predictions of what should be observed at depth. Consequently, deviations from the phase-equilibrium predictions can provide insight into the dynamics of the mantle (alternatively, such deviations may simply be showing that our models of the interior are wrong). A specific prediction is that phase transitions — and hence the corresponding seismic discontinuities — should occur over a finite depth interval, in general. The width of each transition or discontinuity is given by the pressure interval across the coexistence loop in the equilibrium phase diagram (see figure). Thus, seismic reflections become



The width of the coexistence loop for a high-pressure transformation among mineral phases (left) can be related to the amplitude of seismic reflections from the corresponding transition in the Earth's mantle (right). The magnitude of the impedance (velocity and density) contrast across the transition also determines the reflected amplitudes. P'P' and P'dP' are two different seismic ray paths.