models during periods of rapid climatic change. Most important is the prospect that this core will give the best opportunity so far to determine whether simultaneous changes in the greenhouse gases were involved — first to confirm the somewhat incomplete evidence from the earlier cores that important changes in greenhouse gas composition occurred during these events[4]; and second, taking advantage of the much greater resolution of this core, to determine whether there were significant leads or lags with respect to the temperature changes.

A feature of the GRIP project was the amount of analytical technology taken into the field, allowing a broad spectrum of constituents to be analysed alongside the drilling operation, often at high resolution (in some cases at millimetre-resolution) along the length of the core. Thus continuous profiles including d.c. and a.c. electrical properties (relating to hydrogen ion and total neutral salt contents) and microparticle, ammonium, nitrate and hydrogen peroxide contents are already available and have contributed to the multi-parameter dating strategy. Many of these species are relevant to atmospheric chemistry and should help to elucidate the link between climate and other environmental changes.

One of the first surprises was the discovery of sporadic high-concentration spikes of ammonium together with several organic acids, especially formate. Legrand and others[5] have hypothesized that these events are fingerprints of biomass burning events in the northern high latitudes, which may have been regulated by climatic conditions in the past. Further surprises are likely, and their relation to climate must be studied in the historical perspective, where unlikely events become possible simply because of the passage of time.

Eagerly awaited will be the first data through the last interglacial, when conditions around 126,000 years ago were up to 2 °C warmer than now. This should give us the first detail from the Northern Hemisphere on climate and associated environmental responses during the last period of the Earth's history when conditions were analogous to those predicted for the near future. □

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OZONE DEPLETION

Volcanic aerosols implicated

Guy Brasseur

Is stratospheric ozone vulnerable to volcanic eruptions? Yes, according to reports detailing depletion recorded last year. In *Geophysical Research Letters*[1], Grant *et al.* describe *in situ* balloon measurements and satellite measurements showing that ozone levels were low in the mid-latitudes in the months following the eruption of Mount Pinatubo, Philippines. And on page 283 of this issue[2], Hofmann *et al.* attribute unexpected changes in the ozone hole that appeared over Antarctica last year to aerosols transported from the less well known eruption of Mount Hudson, in Chile.

The effect of volcanoes on ozone has been widely debated[3,4] since evidence was produced[5] that ozone abundance decreased following the eruption in 1982 of El Chichón in Mexico. The argument presented in the early 1980s was that volcanoes release chlorine into the atmosphere (mainly in the form of hydrogen chloride) and that chlorine has the potential to destroy ozone efficiently in the stratosphere. This natural source, however, affects the stratosphere much less than the anthropogenic source provided by industrially manufactured chlorofluorocarbons (CFCs). In fact, hydrogen chloride is rapidly removed from the troposphere by washout processes in clouds, whereas the CFCs are not. Thus, CFCs easily penetrate into the stratosphere where they are photolysed by solar ultraviolet radiation and release reactive chlorine atoms.

The gas-phase reactions involved in the destruction of stratospheric ozone by chlorine account only for a small fraction of the ozone depletion recorded since 1980. In addition, the largest ozone trends (approximately 10–30 per cent per decade), which have been observed between the tropopause and 20 km altitude, are not reproduced by models based on gas-phase chemistry alone. The discrepancy is now commonly attributed to the role of solid particles (such as ice crystals in polar stratospheric clouds) or small liquid droplets (such as the sulphate aerosol particles) observed in the lower stratosphere. As a result of

RÉSUMÉ

Beyond the fringe

Beyond Pluto and Neptune (themselves 4.5 billion kilometres, or 30 astronomical units, away), D. Jewitt and J. Luu believe they have discovered the most distant member of the Solar System yet (*IAU Circ.* No. 5611; 1992). Glorying in the name of 1992 QB1, the object was first spotted from the 2.2-metre telescope at Mauna Kea on 30 August, and was tracked for the next two days. It is so faint that it will now not be seen until the next moonless night. Assuming that its albedo is that typical for comets (4 per cent) the authors reckon from its brightness that 1992 QB1 is a mere 200 km across. They note that it is remarkably red, suggesting that its icy surface is rich in organic materials. The exact orbit will not be clear for several months, but 1992 QB1 seems to be 37–59 astronomical units away. One possibility is that the object is the first-identified occupant of the Kuiper Belt, a much discussed but purely hypothetical reservoir of comets at the edge of the visible Solar System.

Eating in

An unlikely breed of miners is described in the *Mineralogical Society Bulletin* (No. 96, 3–4; 1992) by R. J. Bowell. It seems that elephants are wont to traverse a perilous ledge, worn down by generations, 345 metres up the side of a cliff on Mount Elgon, on the Kenya–Uganda border, to reach a natural cave known as Kitum. Their literal quarry is deposits of zeolites (alumina silicate minerals) precipitated in the mountain's volcanic basalts by hydrothermal activity. These they excavate with their trunks, passing the lumps around the herd to be eaten for the sodium and calcium salts they contain. Like all gourmets, the elephants are particular about their zeolites; the choicest morsels are those that have been seasoned by reaction with bats' guano.

Cosmic undoing

Texture, one of the obscure palliatives devised by cosmologists to account for the present structure of the Universe, is called into question in papers by M. Kamionkowski and J. March-Russell, and R. Holman *et al.* (*Phys. Rev. Lett.* **69**, 1485–1488, 1489–1492; 1992). Like magnetic monopoles or cosmic strings, textures are topological defects embedded in space. Unlike them, textures unwind as different regions of space come into contact; this is how they created the seeds of cosmological structure shortly after the Big Bang. But the new work shows that textures are unlikely to last long enough to do the job. To be cosmologically useful, texture is so delicately balanced that gravitational effects, even those due to primordial Planck-mass (20 μg) black holes, will prevent it from forming.