S. MORGAN/KATZ

Figure 1 **Indonesia ablaze, 1998. These widespread fires released massive amounts of carbon into the atmosphere — maybe an echo of events 55 million years ago.**

Kurtz *et al.* is based on an isotope mass-balance modelling approach, and on the use of two geochemical indicators, the carbon-isotope and sulphur-isotope records. The carbon-isotope record serves as a proxy indicator of the burial history of organic carbon through time, and the sulphur-isotope record provides information on the main storage sites of organic carbon. Organic matter formed in the biosphere is strongly depleted in the heavy isotope ^{13}C. If this organic carbon were buried at increased rates in marine or terrestrial deposits, ^{13}C would have become enriched in the marine carbon reservoir. Such changes in the oceanic carbon pool would be recorded in the carbon-isotope compositions of biologically generated calcium carbonate ($CaCO_3$) precipitated from sea water, and this isotope signature would be fossilized in marine limestone.

Similarly, the sulphur-isotope signature in marine barium sulphate ($BaSO_4$) provides a record of the oceanic sulphate pool. At a time of high burial rates of marine organic carbon, the marine sulphate pool should shift to isotopically heavier values due to the increased activity of sulphate-reducing bacteria. Sulphate reduction would lead to an increased burial of ^{34}S-depleted sulphur in the form of pyrite (FeS_2). If the sulphur- and carbon-isotope curves are decoupled, the implication is that organic carbon was preferentially buried on continents, with only limited burial of biologically generated sulphur because of the limited supply of sulphate in freshwater environments.

Kurtz and colleagues[2] base their mass-balance models on the available sulphur-isotope[4] and carbon-isotope[5] records. They first trace carbon burial through the Palaeocene, between about 65 million and 55 million years ago, when the carbon-isotope curve is marked by the Palaeocene carbon-isotope maximum, a time of elevated values. Like earlier authors, Kurtz *et al.* take these data as evidence for increased burial of organic carbon. Yet marine Palaeocene sediments are not rich in organic matter. So, many investigators have proposed that the Palaeocene was a time of widespread organic-matter sedimentation on continents. Kurtz *et al.* test this hypothesis by using the sulphur-isotope record as an additional source of information. The lack of change in sulphur-isotope values indicates a decoupling of the sulphur and carbon cycles during the time of increased burial of organic carbon, supporting the idea that organic carbon was stored in peatlands.

Kurtz *et al.* integrate these findings into their new scheme of events. They argue that under increasingly dry conditions, and at the time of decreasing peat formation, wildfires may have raged through peatlands for up to thousands of years. Terrestrial organic carbon would have been rapidly oxidized and isotopically light carbon dioxide would have been transferred to the atmosphere and oceans, causing a sudden warming. The negative spike in the carbon isotope curve would then have originated from terrestrial organic carbon.

Can this new hypothesis be further tested? Available wildfire records are poor and only future investigations will show whether the Palaeocene–Eocene thermal maximum was characterized by increased charcoal deposition, or whether there are traces of fire in the remaining Palaeocene coal deposits. Perhaps it was not only surface wildfires, but also extensive subsurface burning of organic matter derived from abundant lake sediments, as recently documented from Mali[6], that contributed to the perturbation of the

NATURE

100 YEARS AGO

All the experimental evidence so far obtained is now in agreement with the view that the γ rays are an extremely penetrating type of Röntgen rays which have their source in the atom of the radio-active substance at the moment of the expulsion of the β or kathodic particle. For example, I have found that the γ rays from radium always accompany the β rays, and are always proportional in amount to them. In radium the β and γ rays appear only in the third change occurring in the radio-active matter which causes "excited activity," *i.e.* in the fourth of the chain of radio-active products which result from the disintegration of the radium atom… The γ rays arise from the disintegrated atom, and are not secondary rays set up by the bombardment of the radium as a whole by the β rays. **E. Rutherford**

From *Nature* 10 March 1904.

50 YEARS AGO

During the past year, evidence has gradually accumulated for the existence of a new type of nuclear excitation which appears to be due to the presence, within a nucleus, of a neutral hyperon, now designated Λ^0. It is believed that this particle can be bound to the other nucleons of a nucleus to form a relatively stable structure as measured on a nuclear time-scale, and that the eventual disintegration of such a nucleus is due to the decay of the Λ^0-particle. The existence of the Λ^0-particle, which until recently was referred to as the 'heavy neutral *V*-particle', was established by experiments on the cosmic radiation with Wilson chambers. It was shown to be the more common of the neutral particles which produce the 'neutral *V*-events' discovered by Rochester and Butler in 1947… These considerations suggest that the Λ^0-particle is an excited nucleon in a different sense from that suggested by familiar analogies. We are entering a new field where basically new concepts remain to be established; but it seems reasonable to conjecture that the nucleon is transformed into an excited nucleon as a result of changes in its internal constitution. If so, we are beginning to make a new penetration into what Maxwell called "the strange strata of the material world", a penetration into the world of the nucleon. It seems that matter is inexhaustible. **C. F. Powell**

From *Nature* 13 March 1954.