posited as a single turbidite layer (B. F. Bohor, US Geological Survey)? Or are the beds a sequence of turbidites caused by storm waves at a sea-level lowstand, and unrelated to the impact[6]? Tsunami deposition of the entire complex would take only a few days, the alternative mechanism tens of thousands of years.

A pre-meeting field trip offered the chance to settle the issue. There, several sedimentologists assessed the K/T sandstone deposits as highly unusual, something they had never seen before (R. H. Dott, Univ. of Wisconsin; E. Clifton, Conoco, Texas; D. Lowe, Stanford Univ.; A. Ekdale, Univ. of Utah). The sands themselves had been transported by powerful currents which ran in several directions, and had been deposited rapidly.

If a significant amount of time had passed between deposition of individual sand layers, burrowing organisms should have colonized the surfaces, and there would have been traces of burrows. None are present with the exception of the topmost surface of the sandstone layers, demonstrably colonized after its deposition. The field-trip participants concluded that, although they could not definitely exclude deposition in thousands of years, nothing indicated that these sandstones had been laid down over a prolonged period of time.

Some reports stressed that in the Gulf coast area, the iridium maximum taken to mark the K/T boundary is in a mudstone between 5 (el Mulato) and 30 cm (Brazos River), well above the sandstone layer (D. Beeson, Chevron, New Orleans). This would imply that the sandstones date from before the impact. But this mudstone, which tops the sandstone and contains several iridium peaks, gradually decreases in grain size upwards (Smit). Most probably the mudstone represents the slower settling of the muds and silt stirred up by the tsunami waves. The fine, cosmic, iridium-rich dust settled together with these muds.

The widely accepted story that the missing cores drilled from the Chicxulub crater in the 1960s were lost in a warehouse fire has now been unveiled as a myth (V. L. Sharpton, Lunar and Planetary Institute, Texas). Most are still available in Mexico. The Ticul-1 well cores from just outside the crater rings (see figure on previous page) contain a polymict breccia more than 1 km thick. This is a suevite breccia with altered meltclasts, similar to the breccias drilled within the crater (Yuc-6). Other cores outside the crater contain the same suevite breccia. The breccia components seem compatible with the Yucatan basement: they include gneisses, schists, granite and red sandstone and shale fragments. Many of these fragments contain quartz and feldspar crystals with uncontested shock deformation lamellae (Sharpton; A. R. Hildebrand, Geological Survey of Canada).

Overall, evidence from these cores supports the impact theory rather than, say, a volcanic origin for the Chicxulub structure. But as the cores are not continuous, important information about basement, meltsheet and the first sediment infilling of the crater is still lacking.

A Mexican consortium started drilling in the Chicxulub structure in February (L. E. Marín, personal communication). Their goal is to drill one deep hole just outside the central ring structure, penetrating the melt sheet to reach fractured, uplifted basement, and to drill several shallow holes in the outer rings. It is expected that cores will shortly become available to the scientific community. □

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SOIL SCIENCE

Californian acid rock

CALIFORNIA abounds in thick forests and barren deserts, but they are not usually found side-by-side as in this photograph from the northern Californian Klamath mountains. The fact that swathes of healthy coniferous forest in this region are interrupted by bare patches of ground with unusually acidic soil has caused no little perplexity amongst soil scientists and ecologists. Now it seems that the rocks themselves may be the culprits.

According to Randy Dahlgren (page 838 of this issue) the bedrock in these mountains contains large amounts of nitrogen, bound up as ammonium cations. In the forested areas, weathering has gradually removed much of this ammonium from the upper soil layers. But Dahlgren's theory is that for some parts of the forest, a contained disturbance (for example a small forest fire) stripped away the trees and exposed the soil to the elements. Rapid erosion would have followed, bringing to the surface relatively fresh, nitrogen-rich geological material. This would then have been oxidized, giving large amounts of nitric acid. The soil acidity would have caused intense leaching of nutrient cations needed for soil fertility. It would also have mobilized potentially toxic levels of aluminium. All in all, the environment would become rather unfriendly to aspiring saplings, and this, says Dahlgren, can explain the lack of vegetative regrowth.

By contrast, in the healthy forest organic acids bind up any rogue aluminium, and the litter layer replenishes any nutrient cations lost to the soil. But for these mechanisms to come to the rescue of the barren areas, new trees would need to grow; it seems that the initial loss of vegetation traps the soil in a vicious and unremittingly barren cycle. Dahlgren points out that geological nitrogen is found in many rocks around the world, and wonders if it could be having a similar effect elsewhere. He also points out that regions such as this one could prove to be useful analogues for the damage that can be done to ecosystems from anthropogenic nitrogen, deposited not from below, but from above.

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