EXTRASOLAR PLANETS

A whiff of methane

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Investigations of planets outside our Solar System are becoming ever more sophisticated. The latest development is the discovery of a carbon-containing molecule in the atmosphere of one such extrasolar body.

Methane is a constituent of many of the atmospheres in our Solar System: those of Earth, Mars, Titan and the gas giants Jupiter, Saturn, Uranus and Neptune all contain traces of it. Despite its low abundance, the methane provides telling clues about planetary formation, evolution, weather, photochemistry and — in the case of Earth — life. We have discovered more than 270 planets outside our Solar System, but for most of them we know nothing more than their mass and orbital properties. Owing to their immense distances from us, and their feeble brightness relative to the incandescence of the stars they orbit, observationally inferring anything about their composition is extremely difficult.

That, however, is just what Swain *et al.*¹ have achieved. On page 329 of this issue, they present the first detection of methane, CH₄, on an extrasolar planet. They also confirm a previous detection² of water vapour in the

atmosphere of this planet, called HD 189733b, and provide a more robust estimate of its abundance. The planet is a 'hot Jupiter' that orbits only 0.03 Earth–Sun distances from its star. Blasted by starlight, the planet's atmospheric temperatures reach a searing 1,000 K.

Swain and colleagues' finding is the first detection of any carbon-bearing molecule on a planet outside our Solar System. It was made possible by the fact that HD 189733b is a transiting planet — one whose orbit is fortuitously aligned such that the planet periodically passes in front of its star as viewed from Earth. Such transits are relatively easy to detect, even using small telescopes on Earth³. In the case of HD 189733b, the planetary transit blocks more than 2% of the starlight, allowing a direct estimate of the planet's radius. Much harder to detect are the subtle variations of this absorption with wavelength that yield clues to atmospheric composition. At wavelengths at

which the atmosphere is transparent, starlight passes through the atmosphere unimpeded. At wavelengths that are more opaque, the atmosphere blocks the starlight and the total absorption seen from Earth is greater (Fig. 1). In this way, Swain *et al.*¹ used observations from the NICMOS camera on the Hubble Space Telescope to construct an infrared spectrum of the planet as seen in transmitted starlight; that spectrum shows the tell-tale absorption features of methane and water vapour in the planet's atmosphere.

So what does the measurement tell us about planetary behaviour? The methane abundances on Jupiter, Saturn and both Uranus and Neptune correspond to respective carbon/hydrogen ratios of 3, 7 and ~30–40 times the C/H ratio in the Sun's atmosphere (where carbon resides entirely in atomic form). This provides important clues about planetary formation, because it suggests that these planets not only received carbon from the gas of the solar nebula (which presumably had nearly the solar C/H ratio), but that they also absorbed huge quantities of carbonaceous rocky and icy material as they were forming. For extrasolar planets, one thus expects the C/H ratio (as well as the ratio of other heavy elements to hydrogen) to provide a crucial probe of how much solid material accreted with the gas.

But the story is more complicated for HD 189733b. The observationally inferred

DRUG DISCOVERY

Schistosome treatment

The statistics are grim.

Schistosomiasis — a tropical disease caused by flatworms of the genus *Schistosoma* — kills 280,000 people annually. Moreover, 200 million people are infected with the worm, and a further 800 million or so are at risk. An effective, low-cost drug called praziquantel is available. But it is heavily and regularly prescribed and, as there is currently no vaccine or alternative drug available, the danger of schistosome parasites evolving resistance to the drug is looming. So the discovery by Ahmed Sayed and colleagues, at Illinois State University in Normal and the US National Institutes of Health (NIH) in Bethesda, Maryland, of a drug that may be as effective as praziquantel, if not more so, is good news (A. A. Sayed *et al. Nature Med.* doi:10.1038/nm1737; 2008).

Within their human host, schistosome parasites reside in aerobic environments — skin, blood, lungs and liver. This means they must be able to avoid damage

caused by reactive oxygen species.

The authors therefore took advantage of a valuable resource — the NIH Chemical Genomics Center chemical repository — to screen thousands of compounds for their ability to target the antioxidant pathway in one of the most widespread of schistosome species, *Schistosoma mansoni* (pictured).

The screen led to the identification of two groups of compounds, phosphinic amides and oxadiazole 2-oxides, which inhibit an enzyme known as TGR — a multifunctional agent that is uniquely responsible for the detoxification of reactive oxygen species in schistosome parasites. One oxadiazole called furoxan was particularly noteworthy for being highly potent at low doses.

Furoxan did well in subsequent tests. The authors found that, within 24 hours, drug concentrations of just 10 micromolar killed 100% of adult *S. mansoni* grown in culture, and concentrations of 2 micromolar had the same effect over 5 days.

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Moreover, furoxan was active against two other worm species that also cause schistosomiasis.

Human white blood cells produce nitric oxide, which can kill larval schistosomes. Sayed and colleagues show that, as well as inhibiting TGR activity, furoxan reacts with TGR to produce nitric oxide, increasing the compound's toxic effect on the parasite.

The authors also tested the toxicity of furoxan in mouse cell lines and found that its toxicity is not very different from that of praziquantel. Investigating the efficacy of furoxan in overcoming schistosome infection

in mice revealed that, depending on the stage in the life-cycle of *S. mansoni* at which the drug was administered, the disease burden was reduced by at least 88%. Such efficacy exceeds the criteria set by the World Health Organization for potential lead compounds for the treatment of schistosomiasis. Furoxan is thus a highly promising compound for use as an alternative or supplement to praziquantel — the two drugs function through different mechanisms. Efforts are already under way to generate furoxan derivatives suitable for use in humans. **Sadaf Shadan**