DEVELOPMENTAL BIOLOGY

Red-eye redirected

In most mammals, the cornea — the transparent part of the eye over the lens — has no blood vessels. This trait is obviously essential for optimal vision, but it also means the cornea is a useful experimental system for studying the factors that promote or inhibit the formation of blood vessels (angiogenesis). But why the cornea remains avascular despite the presence of the potent angiogenic factor VEGF-A and the proximity of other highly vascular tissues has remained unclear.

In this issue, B. K. Ambati *et al.* (*Nature* **443**, 993–997; 2006) show that in the cornea a soluble receptor, called sflt-1, traps VEGF-A, stopping it from directing the formation of blood vessels. When the authors blocked expression of sflt-1 using a variety of approaches, they saw an increase in free VEGF-A and in corneal vascularization, demonstrating that sflt-1 maintains corneal avascularity.

Blood vessels form spontaneously in the corneas of certain mutant mouse strains, as well as in those of people who suffer from a condition known as aniridia as a result of a similar mutation. Ambati and colleagues show that in all these cases, corneal vascularization is accompanied by a deficiency in the expression of sflt-1. In the mice, injections of sflt-1 reduced the corneal vascularization.

The authors surveyed different mammalian species to see whether the close relationship between the presence of sflt-1 and an avascular cornea is evolutionarily conserved. Manatees (pictured) are the only known organism with uniformly vascularized corneas. They compensate for their impaired vision with highly developed sensory bristles that enable them to navigate and locate food. Manatees live primarily in turbid freshwater areas, and corneal vascularization may result from or protect against this environment. Interestingly, no sflt-1 expression was detected in manatee corneas, whereas those of dugongs (which belong to the order Sirenia, like manatees) and of elephants — the manatee's closest terrestrial relatives — all produced sflt-1.

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Nernst–Einstein relation, which shows how electrical conductivity changes with the diffusion rate and concentration of charged species. Intriguingly, the *a* axis of olivine (the direction of potentially high conductivity) aligns parallel to the flow during viscous creep in the mantle. Because olivine deforms more easily along some crystallographic axes than along others, the alignment of olivine crystals can be observed using various seismic techniques. In regions of the oceanic mantle for which seismic and geochemical measurements have provided independent constraints on the alignment of olivine and on the water content, the Nernst–Einstein relation provides a good fit to both the magnitude and anisotropy of electrical conductivity. It also explains rapid changes in conductivity that occur in regions where water content is predicted to decrease[9]. Yet despite the apparent success of this approach, the idea that water affects conductivity met with scepticism owing to the lack of experimental verification.

Yoshino *et al.*[1] and Wang *et al.*[2] both report a huge increase in the conductivity of olivine with increased hydrogen content. But important differences in the results lead the authors to varying conclusions. Yoshino and colleagues' measurements[1], which were conducted on olivine single crystals, show an anisotropy of conductivity similar to that predicted by the hydrogen diffusion measurements. But the measured temperature dependence of conductivity for crystals oriented parallel to the *a* axis is significantly smaller than that of other directions. Thus, at face value the extrapolation of these data to conditions inside Earth (from the maximum experimental temperature of 723 °C to around 1,400 °C) indicates that the hydrogen effect is too small to explain the high conductivity of the mantle. The experiments were conducted at low temperatures to inhibit hydrogen loss from the sample by diffusion.

Wang and colleagues' experiments[2] were conducted on aggregates of fine-grained olivine at higher temperatures, and show a somewhat greater effect of hydrogen on conductivity, as well as a slightly greater temperature dependence. Extrapolating their data to mantle conditions provides excellent agreement with the observed conductivity. Based on these initial experiments, the influence of hydrogen concentration on conductivity is lower than that predicted by Karato's original hypothesis[7], although Wang *et al.* note[2] that the limited range of hydrogen content in their samples prevents a determination of the precise extent of this difference. Thus, these authors argue that only a fraction of dissolved hydrogen contributes to the conductivity during experiments — a conclusion drawn from similar measurements on wadsleyite, which is a form of olivine found at high pressures[10].

More work is required to resolve the differences between these studies. Variables such as grain size, other mantle mineral phases, aggregate anisotropy and the presence of small amounts of hydrous melt all need to be explored. But it is promising to note how well Karato's application of the Nernst–Einstein relation agrees with Wang and colleagues' data over the temperature range of the hydrogen diffusion experiments (800–1,000 °C; Fig. 2a on page 978). This agreement is even stronger if new constraints on the solubility of hydrogen in olivine are taken into account[11]: the technique that both Yoshino *et al.* and Wang *et al.* used to measure hydrogen content may underestimate the hydrogen concentration by a factor of three (meaning that the dashed lines in Wang and colleagues' Figure 2a are plotted a factor of three too low).

The discrepancy between the Nernst–Einstein relation and the data at lower temperature might then be explained by a fundamental difference between the conductivity and diffusion studies, as Wang and colleagues note in the supplementary information to their paper. During diffusion experiments, which measure the rate of hydration of olivine, hydrogen defects must first be created and then migrate. Activation energy must be supplied for both these processes. In the conductivity experiments, by contrast, the samples are 'doped' with hydrogen before the experiment, and activation energy is required only to get the hydrogen moving. As a result, the temperature dependence of the conductivity experiments is lower than that of the diffusion experiments. ■

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Correction

In the News & Views article "Greenland's ice on the scales" by Tavi Murray (*Nature* **443**, 277–278; 2006), the figures given in mass units for Greenland's ice loss are 1,000 times too small. The correct statement is that the Greenland ice sheet lost between 192 billion and 258 billion — not million — tonnes each year between April 2002 and April 2006. The equivalent volume figures given in the article — 212–284 km^3 — are correct. Our thanks to Mary Whitfield and her students at the Edmonds Community College, Lynnwood, Washington state, for pointing this error out.