different secondary symbionts, to adult wasps. Two of the secondary symbiont types killed 25 to 41% of the developing parasitoid larvae a few days after oviposition. These aphids continued to reproduce and transmit the protective symbionts to their daughters, hence maintaining the symbiont population. But it’s not a perfect partnership, as there seems to be a cost borne from pathogenic effects of the symbionts that ultimately compromises aphid fecundity and longevity. — CA

**MINERAL PHYSICS**

**Creepy Mantle**

Periclase (MgO) is a minor component of Earth’s lower mantle, yet it may be essential for understanding the rheological and chemical characteristics of solid-state creep (mantle convection) because of its elastic anisotropy and ionic conductivity. Van Orman et al. measured lattice and grain boundary diffusion of $^{25}$Mg and $^{18}$O in isotopically marked, synthetic periclase at 2273 kelvin and 25 gigapascals in a multianvil device, and then extrapolated to conditions (~4500 kelvin and 140 gigapascals) at the core-mantle boundary (CMB). A transition from dislocation creep to diffusion creep is predicted to occur near the CMB for grains smaller than 1 mm and shear stresses of 1 to 10 megapascals. Substantial chemical exchange near the CMB is allowed by the relatively fast rate of diffusion in periclase. In particular, grain boundary diffusion is very efficient, and over the 4.5 billion years of Earth’s history, a mixed layer of 100 kilometers in thickness could have formed. Thus, the rheological and chemical properties of the mantle are consistent with the seismically observed D$^\prime\prime$ layer at the CMB. — LR

**CHEMISTRY**

**The Strain of Fusing**

One way to generate an “anti-aromatic” system, in which the overall $\pi$-bonding network is destabilizing, is to add two electrons to an aromatic network. Aprahamian et al. have done that in two strained pyrene systems; a large ring bridges the ends of pyrene and bends the $\pi$-bonded network out of a single plane without disrupting aromaticity. Nuclear magnetic resonance spectroscopy revealed that adding two electrons did not yield an anti-aromatic molecule. Instead, a new $\sigma$ bond formed across one of the six-membered rings, creating fused cyclopropyl and cyclopentyl rings. This alternative not only diminishes the induced ring strain in the pyrene network, but it also allows the two added electrons to localize and distance themselves. Thus, although strain does not reduce aromaticity in these pyrenes, it does affect their reactivity. — PDS

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