That the charge-ordered phase appears to be intimately associated with the CMR transition is consistent with Dagotto's most recent simulations.[5] Weak, charge-ordered correlations are present in the insulating paramagnetic state. As the temperature is reduced toward the transition temperature, the correlations strengthen, creating regions of charge order. "Then, at the transition itself," Dagotto says, "the ferromagnetic state abruptly emerges, as if its lower energy defeats the charge-ordered state's higher entropy."

Support for that picture, which is based on simulating clusters of up to 256 Mn atoms, may come when Tao extends her investigation to other doping values.

Charles Day

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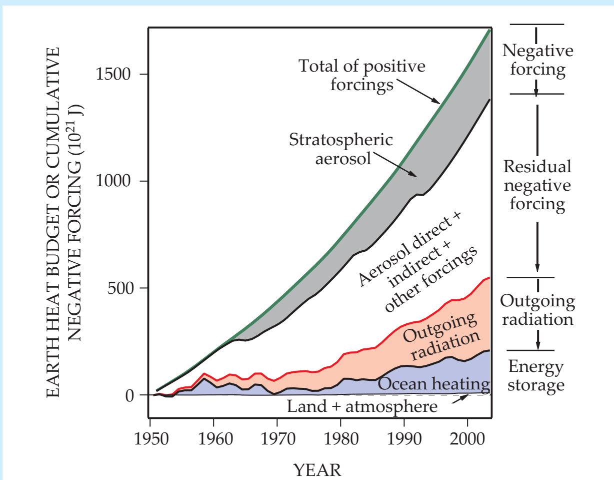
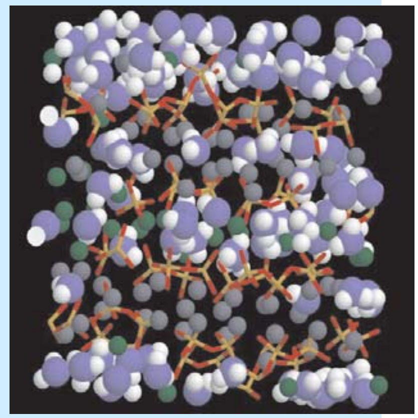


ergy in the form of heat is added to Earth by the Sun's direct radiation and by the well-characterized radiative contributions from greenhouse gases. Those positive contributions (so-called forcings) are balanced, as shown in the figure, by stratospheric aerosols of volcanic origins that reflect incoming sunlight, increased outgoing IR radiation from a warming Earth, long-term heating of Earth—almost entirely of its oceans, which have far higher heat capacities than the atmosphere, land, or ice—and a residual term that mainly represents direct and indirect cooling effects of anthropogenic aerosols throughout the atmosphere. The analysis shows that the anthropogenic aerosols contribute a net cooling of 1.1 Wm^{-2}, in agreement with the 2007 assessment by the Intergovernmental Panel on Climate Change but with tighter error bars. The researchers, led by Daniel Murphy of the National Oceanic and Atmospheric Administration in Boulder, Colorado, say that the agreement gives confidence both in their technique and in the global circulation models used by the IPCC. They also found that the aerosols' effects over time reflected the stabilized amount of atmospheric sulfates that resulted from the adoption of emission controls in North America in the 1970s. (D. M. Murphy et al., *J. Geophys. Res.* **114**, D17107, 2009.) —SGB

Modeling cement hydrates. Concrete is the most prevalent synthetic material on Earth, yet the detailed nature of its primary binding constituent, hydrated cement, is only poorly understood. When cement, a dry powder that consists mostly of calcium oxide and silicate, is mixed with water, the material hardens through the formation of a complex hydrated oxide called calcium-silicate-hydrate. But the microscopic structure of C-S-H is largely unknown—even its stoichiometry, as suggested by convention with hyphens. C-S-H's structure had been thought to be related to that of two naturally occurring calcium silicate minerals, but those minerals can't explain C-S-H's observed properties. Armed with recent measurements of C-S-H's density and its ratio of calcium to silicon atoms, a team of researchers at MIT has proposed a new molecular model for C-S-H based on atom-scale simulations: Layers of calcium ions (gray in the figure) are surrounded by silicon (yellow) and oxygen (red) arranged as short silica chains one, two, and five units long; between those layers are water (oxygen in purple, hydrogen in white) and interlayer calcium ions (green) that ensure overall neutrality. The model's chemical composition, $(CaO)_{1.65}(SiO_2)(H_2O)_{1.75}$, agrees well with results from neutron scattering experiments. In addition to reproducing the known structural properties of the material, the model also suggests that at short length scales C-S-H should be viewed as a glassy phase. With an atom-level model of the C-S-H structure now in hand, the researchers hope to be able to manipulate the macroscopic properties of concrete, such as its strength and temperature resistance. (R. J.-M. Pellenq et al., *Proc. Natl. Acad. Sci. USA* **106**, 16102, 2009.) —RJF



Earth's core catches a wave. A journey to Earth's center would take us through the crust, the mantle, and then two regions of the core. Innermost of those is an iron crystalline solid; surrounding that is a freely flowing, conducting fluid, capped by a thin boundary layer that abuts the rocky mantle. The presence of the fluid core is deduced from seismic studies, and its dynamics can be extracted—with a few assumptions—from time-dependent observations of Earth's surface magnetic field (see PHYSICS TODAY, February 2008, page 31). A new study does just that, by using nearly 150 years' worth of surface magnetic measurements to determine the magnetic flux in the liquid core. Motions there are modeled with a set of 20 nested cylinders coaxial with Earth's rotation axis and the key assumption that fluid waves in the core must balance Lorentz, Coriolis, buoyancy, and pressure forces. Jean Dickey (NASA's Jet Propulsion Laboratory) and Olivier de Viron (Institute of Earth Physics, Paris, and University Paris Diderot) found four robust modes of angular-momentum oscillations corresponding to waves—with periods of 85, 50, 35, and 28 years and diminishing amplitudes—that propagate inward from the core–mantle boundary. There was some previous observational evidence for two of the modes, and theorists had predicted all four modes having similar periods. Now, the strong concurrence of all the results lends credibility to the new modes' existence. (J. O. Dickey, O. de Viron, *Geophys. Res. Lett.* **36**, L15302, 2009.) —SGB ■