

Supercellular carbon dioxide flows

One approach to mitigate anthropogenic climate change is carbon capture and storage (see the article by David Kramer, *PHYSICS TODAY*, January 2020, page 44). The carbon dioxide from burning fossil fuels is either harvested from the air or gathered from the source. Among the suitably long-term reservoirs for the captured CO_2 are geologic formations of porous rock. This two-dimensional top-down view of a recent large-scale 3D numerical simulation of an injection site shows CO_2 flow structures. The flows formed cells of about 50 cm for a typical 50-m-deep underground reservoir with pore sizes of 50–400 μm . The red-to-yellow color gradient indicates the variation in CO_2 concentration. Carbon dioxide exists as a supercritical fluid at the reservoir's temperature and pressure. Driven by the density difference between CO_2 and the liquid brine found in some permeable rocks, the solution exhibits what's known as Rayleigh–Darcy convection.

Marco De Paoli and his colleagues at TU Wien in Vienna, Sapienza University of Rome, and the University of Udine examined the flow structures closer to the boundaries of the reservoir. They saw that the smallest cells aggregate into larger supercells, bounded by the thick black lines in the picture. The supercells, whose size depends on the local value of the Rayleigh number, range in diameter from 3 m to 10 m for typical reservoirs and act as columnar forms that control the convective transport of CO_2 in the flow. Because of their shape and dynamics, the supercells resemble the granules caused by convective currents on the surface of the Sun. (S. Pirozzoli et al., *J. Fluid Mech.* **911**, R4, 2021; image courtesy of Marco De Paoli.) —AL

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