> WHEN IT COMES TO EARTH'S DEEP CARBON CYCLE, THERE ARE MORE QUESTIONS THAN ANSWERS

FROM THE EDITOR'S DESK:

Carbon underworld

2019 is the Society's Year of Carbon. On page 7, Flo Bullough gives an overview of the activities the Society has planned and in a feature on page 16, Matthieu Galvez makes the case for carbon as a key element that defines our planet, in large part due to its central role in the ethical dilemmas faced by humankind.

Indeed, Earth's shallow carbon cycle—the transfer of carbon between the near-subsurface, soils, biosphere, oceans and atmosphere—has come under intense scrutiny as we grapple with issues surrounding human-induced carbon emissions, deforestation and land-use alteration, and climate change. We now know a tremendous amount about the relatively rapid transfer of carbon between surface stores, which is expedited and thrown out of balance by human activity. The deep carbon cycle, however, is much less familiar.

Earth's core, mantle and lithosphere are vast carbon reservoirs. Carbon is cycled between deep and shallow stores very slowly, via metamorphism, volcanism and subduction, over many thousands of years. This natural geological cycle has helped regulate Earth's temperature in the long-term and kept our planet habitable. Thus, to accurately constrain the impacts of human activity and our extreme acceleration of carbon transfer, we need a better grasp of the deep carbon cycle.

In 2009, the Deep Carbon Observatory international collaboration was launched with the aim of better understanding the quantities, movements, forms and origins of carbon in Earth. The discoveries resulting from this project are numerous, but some recent highlights include the ideas that 26 to 30-million-year cycles in atmospheric CO_2 concentrations and ocean anoxia may be linked to tectonic cycles and the ability of new seafloor to store and release carbon (Müller & Dutkiewicz, *Sci. Adv.* 2018); that CO_2 emissions from rifts during continental break up may have triggered some past greenhouse climates (Brune *et al., Nat. Geosci.* 2017); that carpets of methane-munching microbes beneath the seafloor take years to recover from disturbances—whether naturally via mud eruptions, or artificially via trawling or deep-sea mining—potentially affecting methane emissions (Ruff *et al., ISME* 2018); and the idea that barely living 'zombie' bacteria, archaea and eukarya exist to depths of 5 km, creating a subsurface 'Galapagos' that constitutes a mass of carbon up to 385 times greater than that of all humans on the surface (**https://deepcarbon.net/**).

In 2019, the Deep Carbon Observatory team is synthesising the results of this decade-long research programme and exploring ways to continue beyond 2020—there is still so much learn. When it comes to understanding the whole carbon cycle, we're still only just scratching the surface.

In other news, 2019 also marks the centenary of female Fellows at the Society. To celebrate, we're running a competition giving the chance for your designs to feature on the cover of *Geoscientist* (see page 7 for details). And due to high demand, this month also sees the return of the crossword, created by 'Bindweed'. We hope you enjoy it!

Cave of Swallows in Aquismon Mexico

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