Helium from the depths

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The source of helium in ocean island basalts has been a subject of debate, with both deep- and shallow-mantle contributions commonly invoked. New geochemical analyses point to deep-mantle origins of helium for islands in the Pacific Ocean.

Doshik Hahm from the Scripps Institution of Oceanography and colleagues compared the geochemistry of basalts from the East Pacific Rise — a mid-ocean ridge that is fed by melting in the shallow mantle — with basalts from seamounts near the ridge and basalts from ocean islands. Although all three types of basalt showed similar isotopic compositions of strontium, neodymium and lead, the seamount and mid-ocean ridge basalts had far lower $^3He/^4He$ ratios than the ocean island basalts. The authors therefore conclude that the shallow mantle is unlikely to be the source of the ocean island basalts.

Instead, the helium ratios of the ocean island basalts probably reflect deep-mantle helium that was tapped by plumes of material originating deeper in the mantle than the source of the mid-ocean ridge and seamount basalts.

Cyanobacterial surprise

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High solar irradiation, temperatures below freezing and some of the lowest precipitation rates on the planet make the Bolivian Andes an incredibly inhospitable environment. A survey of the cyanobacteria in the high-elevation lake systems, however, reveals a thriving and diverse ecology.

Erich Fleming and Leslie Prufert-Bebout of NASA Ames Research Center, USA examined the composition, diversity and evolutionary relationship of cyanobacterial communities of microbial mats in three lake systems in the Altiplano of the Peruvian Andes, reaching up to 5,970 m in elevation. They isolated 78 cyanobacterial cultures. Using microscopic, cultivation and genetic-sequencing techniques, they showed that the communities contained large numbers of nitrogen-fixing cyanobacteria. Surprisingly, 37% of the taxa studied were newly identified species, and 11% of the previously known species were only distantly related to other known cyanobacteria.

The cyanobacterial assemblage bears little resemblance to those in the nearby Atacama Desert, and it remains to be seen whether the newly discovered species share any physiological similarities with cyanobacteria in neighbouring lake systems.

Weathering hotspots

Glob. Planet. Change.
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About half of the atmospheric carbon dioxide taken up by chemical weathering is consumed by rocks covering less than 9% of the Earth's land surface, according to numerical modelling. Chemical weathering is an important long-term sink for carbon dioxide, but it has been difficult to identify the primary mechanisms and regions of carbon dioxide uptake.

Jens Hartmann of Hamburg University, Germany and colleagues estimated the global consumption of carbon dioxide during chemical weathering with a numerical model. The advanced model incorporated 15 rock types at a high spatial resolution, and was calibrated with field studies in Japan. Analyses of the model results indicate that silicate rocks consume about 63% of the 237 million tons of carbon that is taken up by chemical weathering annually, a higher estimate than previous studies.

Moreover, mountainous regions with high levels of precipitation showed disproportionately high rates of weathering and uptake of carbon dioxide. The team identified consumption hotspots in Southeast Asia, the Andes and southern Europe.

Chilean eddies

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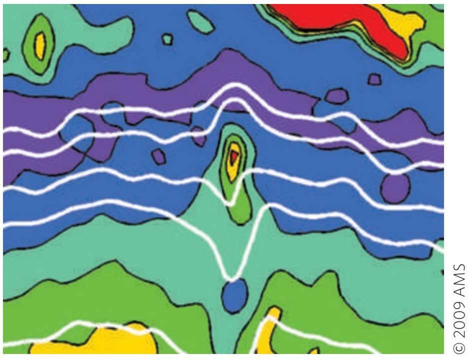

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Data from Argo floats reveal the origin and persistence of numerous subsurface eddies spawned from the Peru–Chile undercurrent. The undercurrent carries relatively salty and nutrient-rich water southward, from Peru to central Chile, along the continental slope and shelf.

Gregory Johnson and Kristene McTaggart of the National Oceanic and Atmospheric Administration, USA mapped the occurrence and migration of lenses of salty water in the eastern subtropics of the South Pacific Ocean using temperature and salinity profiles obtained from Argo floats deployed in the region. The lenses of warm salty water were interpreted as subsurface eddies with an anticyclonic rotation. The eddies seemed to have formed near the Chilean coast — thus entraining tropical waters from the Peru–Chile undercurrent — before they migrated westward into the South Pacific subtropical gyre.

The tropical waters entrained in the eddies are richer in nutrients than the surrounding gyre waters, suggesting that nutrients transported by eddies could feed offshore productivity.

Drier times

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Lush forests and wet environments are thought to have dominated low-lying tropical areas during the Late Carboniferous period (~290–320 million years ago). Plant fossils from the Midwestern US now suggest periods of, at least intermittently, dry climate.

Howard Falcon-Lang of the University of London, Royal Holloway, and colleagues collected fossilized plant material from sediments at the base of Late Carboniferous stream channels in southeastern Illinois. The plant fossils were derived from local sources but, unlike the rainforest assemblages commonly occurring in sediments from this period, the fossils represented coniferous plants that tend to grow in drier conditions. The authors infer that the channels were formed during glacial maximum conditions that marked the end of the Carboniferous period, and that the dry environments were associated with glacial cooling.

Aridity and arid plant assemblages could have been common in the Late Carboniferous tropics, suggest the authors, but because the fossil-preservation potential of wet environments is much higher, arid assemblages are less likely to have survived until today.