OCEANOGRAPHY

Ice loss and ocean life

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Sea ice cover in the Arctic Ocean has declined significantly in the past three decades. Model simulations suggest that the biological draw-down of surface-water CO_2 to depth has increased as a result.

Manfredi Manizza of the Scripps Institution of Oceanography, USA, and colleagues assessed temporal changes in Arctic Ocean carbon uptake between 1996 and 2007, using a regional physical–biogeochemical model forced with reanalysis data. According to their simulations, the Arctic Ocean took up an additional 1.4 Tg of carbon per year over this period. A rise in phytoplankton productivity in the surface waters of the Laptev, East Siberian, Chukchi and Beaufort seas was responsible for the increase in carbon uptake. In contrast, net carbon uptake declined in the Barents Sea, where a warming-induced outgassing of surface-water CO_2 countered the rise in primary production.

The findings suggest that the continued decline of Arctic sea ice cover could be accompanied by a rise in the oceanic uptake of carbon dioxide, although uncertainties in the response of physical, chemical and biological processes to sea ice loss hinder reliable predictions at this stage. *AA*

PALAEOCEANOGRAPHY

Southern upwelling

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At the end of the last glacial period about 20,000 years ago, atmospheric CO_2 concentrations rose in several steps. Radiocarbon measurements from a marine sediment core suggest that the upwelling of carbon-rich waters in the Southern Ocean contributed to the CO_2 rise.

Giuseppe Siani of IDES-CNRS-Université de Paris-Sud, France, and colleagues measured the radiocarbon ages of surface and sea-floor-dwelling foraminifera from a marine sediment core in the Southern Ocean, with the idea that a smaller age difference indicates more mixing between the surface and the waters below. They found three periods of enhanced mixing during the deglaciation. Using independently dated layers of volcanic ash within the core, they compared their records with reconstructions of atmospheric CO_2 concentrations from Antarctic ice cores. They found that the two younger periods of enhanced mixing coincided with a steep increase in atmospheric CO_2 levels, and the oldest with a small, temporary rise.

The team concluded that enhanced vertical mixing in these intervals brought CO_2-rich waters from the deep ocean to the surface, allowing CO_2 to escape from these upwelled waters to the atmosphere. *AN*

TECTONICS

Sunken islands

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Ocean islands, such as Hawaii, are typically created by voluminous volcanic activity caused by thermal or compositional anomalies in the underlying mantle. Seismic analyses of oceanic lithosphere in the Atlantic and Southwest Indian oceans, however, reveal chains of ancient ocean islands generated by tectonic processes, rather than volcanism.

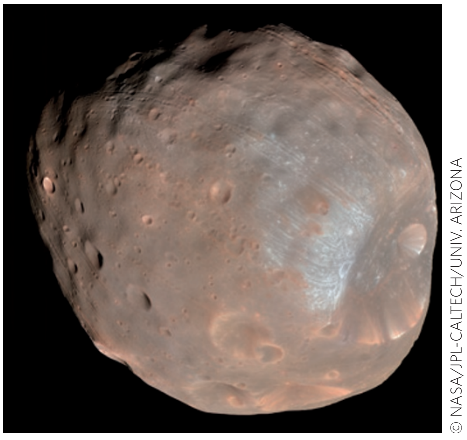
Camilla Palmiotto at the University of Bologna, Italy, and colleagues used seismic reflection data to image the structure of the crust in the equatorial Atlantic Ocean and the southwest Indian Ocean. In both locations, the images reveal ridges of oceanic rocks that had been extensively eroded flat before caps of carbonate rocks were deposited on top. Although now located about 500 to 1,000 metres beneath the ocean surface, the erosion must have taken place at sea level by the action of waves, implying that the ridges once formed chains of ocean islands. Strontium-isotopic dating of the carbonate rocks, which formed on top of the islands after they sunk back below sea level, show that the ridges must have been above sea level between 12 to 2 million years ago.

The ridges are bounded by large faults, so the researchers suggest that the islands were uplifted by tectonic movements, rather than anomalous volcanic activity. *AW*

PLANETARY SCIENCE

Weighing Phobos

Icarus http://doi.org/p26 (2013)



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Little is known about the origin and internal make-up of the moon Phobos and its relationship with its host planet Mars. A reanalysis of observations from the Mars Express spacecraft's 2008 flyby of Phobos, along with observations from a closer approach in 2010, suggests a porous and unhomogeneous moon that accreted close to Mars.

Martin Pätzold at the Universität zu Köln, Germany, and colleagues used the 2010 flyby data to further refine estimates of the mass and density of Phobos. The calculated density is too low for Phobos to be composed of solid rock. The density can, however, be explained by the presence of a loosely consolidated interior, consistent with models that suggest a porous jumble of rock and ice. Such a high porosity is inconsistent with the hypothesis that Phobos is an asteroid that was captured by the gravitational pull of Mars.

Instead, Phobos, like the Earth's Moon, may be a second-generation Solar System object that accreted from material orbiting in a disk around its primary planet. *TG*

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