請詳譯下列各段文字：

1. (30%) The addition of iron to high-nutrient, low-chlorophyll regions induces phytoplankton blooms that take up carbon. Carbon export from the surface layer and, in particular, the ability of the ocean and sediments to sequester carbon for many years remains, however, poorly quantified. Here we report data from the CROZEX experiment in the Southern Ocean, which was conducted to test the hypothesis that the observed north-south gradient in phytoplankton concentrations in the vicinity of the Crozet Islands is induced by natural iron fertilization that results in enhanced organic carbon flux to the deep ocean. We report annual particulate carbon fluxes out of the surface layer, at three kilometers below the ocean surface and to the ocean floor. We find that carbon fluxes from a highly productive, naturally iron-fertilized region of the sub-Antarctic Southern Ocean are two to three times larger than the carbon fluxes from an adjacent high-nutrient, low-chlorophyll area not fertilized by iron. Our findings support the hypothesis that increased iron supply to the glacial sub-Antarctic may have directly enhanced carbon export to the deep ocean. The CROZEX sequestration efficiency (the amount of carbon sequestered below the depth of winter mixing for a given iron supply) of 8,600 mol mol^{-1} was 18 times greater than that of a phytoplankton bloom induced artificially by adding iron, but 77 times smaller than that of another bloom initiated, like CROZEX, by a natural supply of iron. Large losses of purposefully added iron can explain the lower efficiency of the induced bloom. The discrepancy between the blooms naturally supplied with iron may result in part from an underestimate of horizontal iron supply.

   – Excerpted from Pollard et al., "Southern Ocean deep-water carbon export enhanced by natural iron fertilization," Nature, 457, p. 256-260,2009

2. (30%) An enduring mystery in geophysics is why the periodic stresses of tides do not commonly trigger earthquakes. If earthquakes simply represent reaching some threshold for the failure of rock, tidal forces should often trigger faults near failure by pushing them over the threshold. However, many studies show that this is not the case, except in special situations. Now, Rubinstein et al. report that a seismic activity called nonvolcanic tremor is indeed triggered by lunar-solar tides and, in some cases by distant earthquakes. Discovering how dynamic stresses trigger fault failure may provide important clues about the onset of earthquake rupture.

   Earth tremor episodes involve quasi-continuous emissions of low-frequency seismic energy that last longer than ordinary earthquakes. Tremor is well known in volcanic settings, where it is associated with magma movement and fluid-cavity resonance. The recent discovery of tremor in nonvolcanic settings has inspired multiple groundbreaking studies. An emerging question is how nonvolcanic tremor relates to aseismic (that is, radiating no measurable seismic energy) fault slip; they occur simultaneously and in predictable, periodic episodes in at least two locations where they have been studied extensively. The association of nonvolcanic tremor with fault slip suggests the tantalizing

見背面

possibility that tremor could be used in earthquake forecasting, as it is in predicting volcano eruption.

– Excerpted from Eliza Richardson and Chris Marone, "What Triggers Tremor?" Science, 319 (5860), pp. 166-167, 2008

3. (20%) The thermohaline circulation is that part of the ocean circulation which is driven by fluxes of heat and freshwater across the sea surface and subsequent interior mixing of heat and salt. The term thus refers to a driving mechanism. Important features of the thermohaline circulation are deep water formation, spreading of deep waters partly through deep boundary currents, upwelling and near-surface currents, together leading to a large-scale deep overturning motion of the oceans. The large heat transport of the thermohaline circulation makes it important for climate, and its non-linear and potentially abrupt response to forcing have been invoked to explain abrupt glacial climate changes. Anthropogenic climate change is likely to weaken the thermohaline circulation in future, with some risk of triggering abrupt and/or irreversible changes.

– Excerpted from Rahmstorf, "Thermohaline Ocean Circulation," in Encyclopedia of Quaternary Sciences, 2006

4. (20%) Ocean acoustic tomography is a new technique using underwater sound to measure the ocean's sound speeds and currents. It is analogous to medical computer aided tomography (CAT) scans. An object, the ocean in this case, the body in the medical case, is probed remotely from a series of locations around its periphery, and its interior structure is deduced by inverting the measured data. In medicine, X-ray and radio wave attenuation are the most common observables. In oceanography, the usual observable has been the travel time of acoustic signals, although other parameters such as Doppler shift, amplitude, and phase also have been considered. As currently practiced, ocean acoustic tomography consists of measuring the travel time of acoustic pulse transmitted between sources and receivers, and interpreting them in terms of the interior sound speed and current fields. Because sound speed increases by 4.8 m/sec per centigrade degree, measurements of travel time change can also be interpreted in terms of temperature change.

– Excerpted from Medwin, Sounds in the Sea: From Ocean Acoustics to Acoustical Oceanography

試題隨卷繳回