

2009 HSC Earth and Environmental Science

Sample Answers

This document contains 'sample answers', or, in the case of some questions, 'answer may include'. These are developed by the examination committee for two purposes. The committee does this:

- (a) as part of the development of the examination paper to ensure the questions will effectively assess students' knowledge and skills, and
- (b) in order to provide some advice to the Supervisor of Marking about the nature and scope of the responses expected of students.

The 'sample answers' or similar advice, are not intended to be exemplary or even complete responses. They have been reproduced in their original form as part of the examination committee's 'working document'. While the handwritten notes have been typed for legibility, no further editorial change or addition has occurred.

Section I, Part B

Question 16 (a)

Sample answer:

Transform fault

Question 16 (b) (i)

Sample answer:

Divergent boundary

Question 16 (b) (ii)

Sample answer:

The mountain range is formed through uplifted sea floor resulting from rising convection currents in the mantle. The crust weakens and fractures. Magma rises and intrudes the existing crust creating new crust upon cooling. The plates continue to move apart and magma continually intrudes. The crust is hotter at the ridge, has a lower density and consequently sits higher than the surrounding sea floor.

Question 17 (a)***Sample answer:***

Most of the earthquakes are located at plate boundaries where there is stress due to plate movement.

Question 17 (b)***Sample answer:***

A wire creep meter can be used to predict earthquakes. The length of a wire across a fault is measured as it stretches because of the movement across the fault. The more the wire stretches, the more strain within the rocks and the more likelihood an earthquake will occur.

Question 17 (c)***Sample answer:***

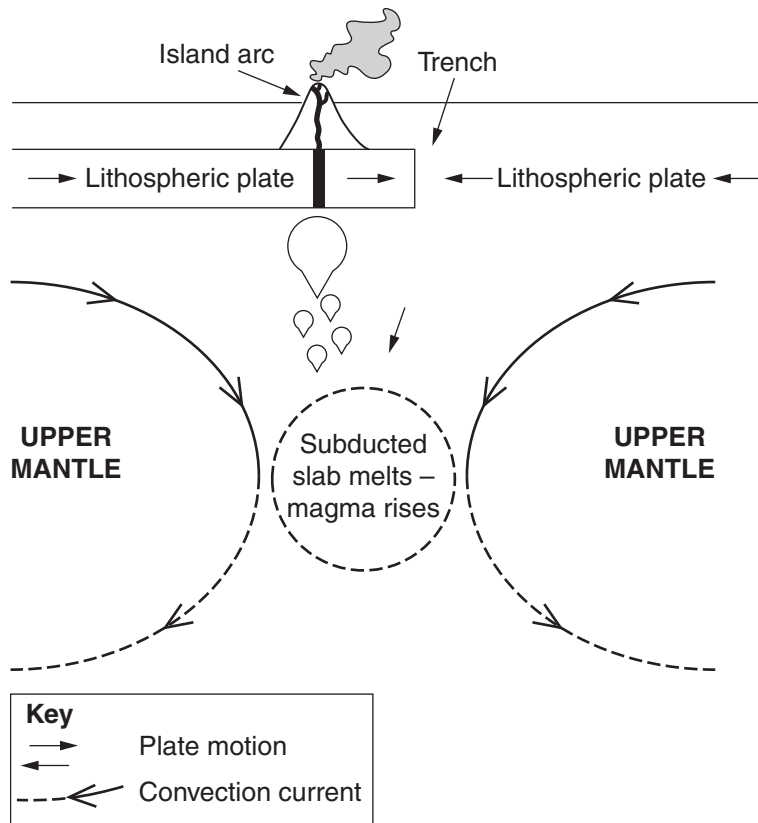
Earthquakes produce surface waves which cause the ground to move. As the ground moves under buildings they shake. If a building vibrates it may resonate with a frequency matching its natural frequency. As a consequence the building may rupture and collapse.

Question 18***Sample answer:***

Subduction produces new crustal material as a result of the melting of subducted plate. From the Cambrian to the Jurassic period, Australia grew from west to east through the process of subduction associated with eastward moving mobile belts. Island arcs formed along the edge of the growing plate and were eventually cratonised. As the position of the mobile belts moved eastward, the process of subduction, island arc formation and cratonisation occurred several times. Weathering and erosion of the 'newly' formed island arcs filled the basins in between the cratons, forming the continents.

Question 19 (a)

Answers could include:


Question 19 (b)

Sample answer:

The data can be considered accurate because the measuring devices are likely to be well calibrated given the operators are reputable.

The data can be considered reliable because all three measuring devices are operated by reputable organizations and gave very similar data on each occasion.

Question 20 (a)***Sample answer:***

Cyanobacteria

Question 20 (b)***Sample answer:***

Stromatolite numbers have decreased over time and there are now fewer locations where they are found. They have decreased in numbers due to the greater number of predators. Stromatolites have decreased in distribution due to changes in environmental conditions resulting in fewer locations where they can survive.

Question 20 (c)***Sample answer:***

When cyanobacteria photosynthesise one of the products is oxygen. As oxygen levels increased ultraviolet rays in the upper atmosphere split some oxygen molecules. The free oxygen atoms bonded with oxygen molecules forming ozone. As oxygen levels in the atmosphere increased this process continued over time and the ozone layer was formed.

Question 21 (a)***Sample answer:***

Terrestrial plants have a thin coating on their leaves called the cuticle. This waxy layer helps to prevent the desiccation of plants on land. Terrestrial plants have vascular tissue which allows the plant to transport water, minerals and food around the plant to where it is needed.

Question 21 (b)***Sample answer:***

In the terrestrial environment the distribution of free water is limited. Reptiles have eggs with a shell unlike amphibians that have moist jellylike eggs. This prevents the developing reptile young from drying out and dying when the egg is laid on land. Amphibian eggs must remain moist and in water in order to survive. Thus reptiles have colonised a wider geographical area than amphibians.

Question 22 (a)*Sample answer:*

Hard shell

Question 22 (b)*Sample answer:*

Hard shells gave Early Phanerozoic organisms protection against predators. This increased their chance of survival compared to Late Proterozoic organisms which had no such protection.

Question 23*Answers could include:*

Pheromones are specific to particular insect pests and lure them away from a crop. Pesticides kill both target and non-target species and may leave long lasting toxic residue in soil. Pesticides may also bioaccumulate and biomagnify in food webs. A disadvantage of pheromones is that they must be deployed at the right time in the pest's reproductive cycle to have the best effect. Overall, the use of pheromones is a safer way of managing some insect pests than using pesticides.

Question 24 (a)*Sample answer:*

Sedimentation

Question 24 (b) (i)*Sample answer:*

Run effluent through artificial wetlands

Question 24 (b) (ii)*Sample answer:*

Running effluent through artificial wetlands is a suitable process because as the effluent flows through them, the plants in the wetlands remove excess nutrients. When the effluent finally discharges into a river, there will not be a nutrient overload, and therefore algal blooms are less likely to occur.

Question 25***Sample answer:***

A contaminated mine site may have high levels of pollutants in the soil and very little vegetation. Rehabilitation needs to isolate the pollutants and restore vegetation to prevent soil erosion. A suitable method to isolate the pollutants is to cover the site with a compacted layer of clay which will prevent water entering the ground and mobilising the pollutants.

A suitable method for replacing vegetation is to plant shrubs, trees and grasses grown from seed previously collected from the site. This will ensure that the plants will be the ones that are best suited to that region.

Question 26 (a)***Sample answer:***

The more sheep there are per hectare, the lower the amount of soil moisture.

Question 26 (b)***Sample answer:***

One strategy is to maintain a low number of sheep per hectare. Graph A shows that as the number of sheep per hectare increases soil moisture decreases. Graph B shows the erosion rate increases as soil moisture decreases. The most suitable way to reduce erosion is to keep sheep numbers per hectare low. The thinner the soil, the lower the number of sheep per hectare.

Question 27***Sample answer:***

The Australian environment has a number of features that make it vulnerable to imposed change. The climate is arid, with rainfall highly unpredictable. Australian soils are for the most part, highly weathered and of low fertility. This, coupled with the long isolation from other continents has led to the evolution of communities adapted to these harsh conditions.

The arrival of Aboriginal people in Australia, along with their method of hunting and use of fire has been linked to the extinction of the megafauna. The recent fossil record suggests that the use of fire by Aboriginal people did lead to changes in the type of vegetation in Australia, favouring more fire resistant species. Australian megafauna were vulnerable to the Aboriginal people because of their weapons.

The greatest contribution to the recent extinctions in Australia has been the unsustainable use of resources by European settlers. In trying to apply Northern Hemisphere farming methods to Australia, they failed to recognise the fragility of the soils and the limited supply of water.

The habitat change caused by the unsustainable use of soil and water resources has been exacerbated by the introduction of non-indigenous animals and plants, which have been able to out-compete native organisms for food and other resources.

Section II

Question 28 (a) (i)

Sample answer:

Salvinia

Question 28 (a) (ii)

Sample answer:

Salvinia was introduced to Australia as an ornamental pond plant.

Question 28 (a) (iii)

Sample answer:

Salvinia is a floating aquatic plant that spreads with water movement, moving downstream with winds and currents once it entered streams.

Question 28 (a) (iv)

Sample answer:

A specific weevil can be used as a biological control strategy.

Question 28 (b) (i)

Sample answer:

The poison baits could be ingested by native species.

Question 28 (b) (ii)

Sample answer:

The baiting program was successful as the data shows that the number of fresh feeds and baits taken decreased over the time frame. The data also shows that in the final years of the program, a greater percentage of baits were left indicating there were less foxes.

Question 28 (c) (i)**Sample answer:**

A biological control organism should only be used once rigorous testing has occurred to ensure that no native species could be used; that the life cycle of the introduced organism is consistent with requirements; the introduced organism will not become a pest; and the introduced organism targets the required pest.

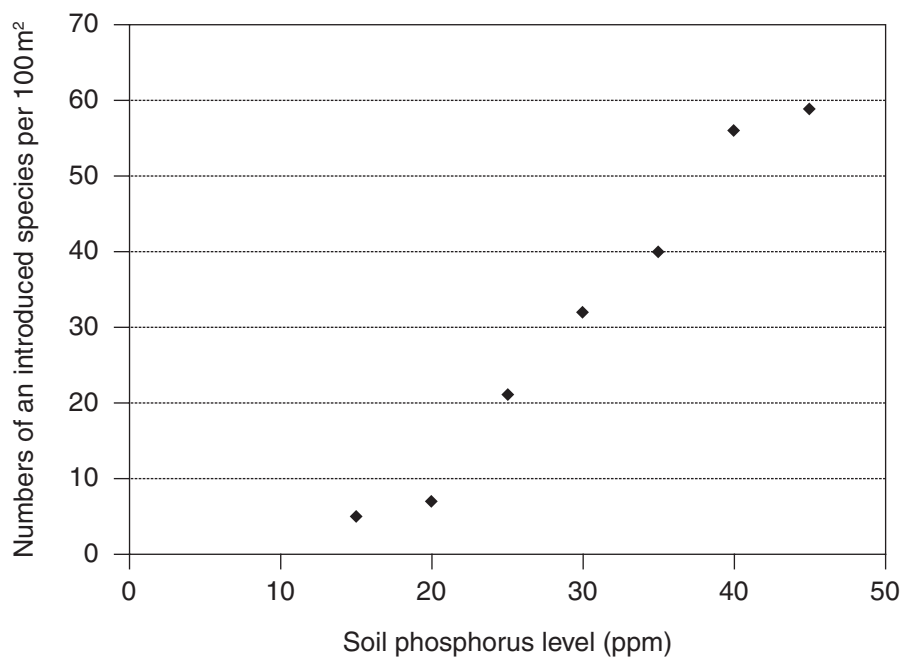
Question 28 (c) (ii)**Sample answer:**

Both bacterial/viral parasites and the release of sterilised males focus on preventing the pest being able to reproduce. Parasites may kill or debilitate the pest while sterilised males prevent the female from being fertilised.

Bacterial/viral parasites act on both the male and female of the species, whereas with sterile male release, only the males have undergone genetic manipulation to prevent reproduction.

Question 28 (d) (i)**Sample answer:**

Soil phosphorus level

Question 28 (d) (ii)**Sample answer:**

Question 28 (e)***Sample answer:***

The percentage of seeds germinating increases from zero at 5°C to a maximum of 18 at 25°C and then decreases to 1 at 45°C. This implies that the optimum temperature for native seed germination is 25°C.

Question 28 (f)***Sample answer:***

Species that have been introduced to Australia have out-competed and/or preyed upon native organisms. For example, the cane toad has out-competed native frog species for food resources and habitat causing or threatening some extinctions, at least at a local level. Plants also can impact on the biotic environment for example wandering jew can dominate moist environments preventing other species from growing in that area.

Introduced species have a negative impact on the abiotic environment by altering nutrient levels of soil or water, increasing erosion rates of soil and altering temperatures due to reduced light levels. Examples include the European carp which stirs up creek and river beds causing an increase in the turbidity and reducing light levels in the water bodies. Privet can block sunlight from lower levels of the bushland floor disadvantaging other species, often resulting in a reduction in the biodiversity of that location.

Question 29 (a) (i)*Sample answer:*

Hunter Valley

Question 29 (a) (ii)*Sample answer:*

Carbon

Question 29 (a) (iii)*Sample answer:*

Boiling point

Question 29 (a) (iv)*Sample answer:*

Particulates

Question 29 (b) (i)*Sample answer:*

The cost of oil will be very high because of its reduced supply

Question 29 (b) (ii)*Sample answer:*

Solar energy can provide electrical energy from photovoltaic cells. This electricity can be substituted for electricity produced from fossil fuels, thus meeting some of the world's energy needs for electricity. It also reduces pollution.

Question 29 (c) (i)**Sample answer:**

Catalytic cracking breaks large hydrocarbon molecules into smaller molecules

Question 29 (c) (ii)**Sample answer:**

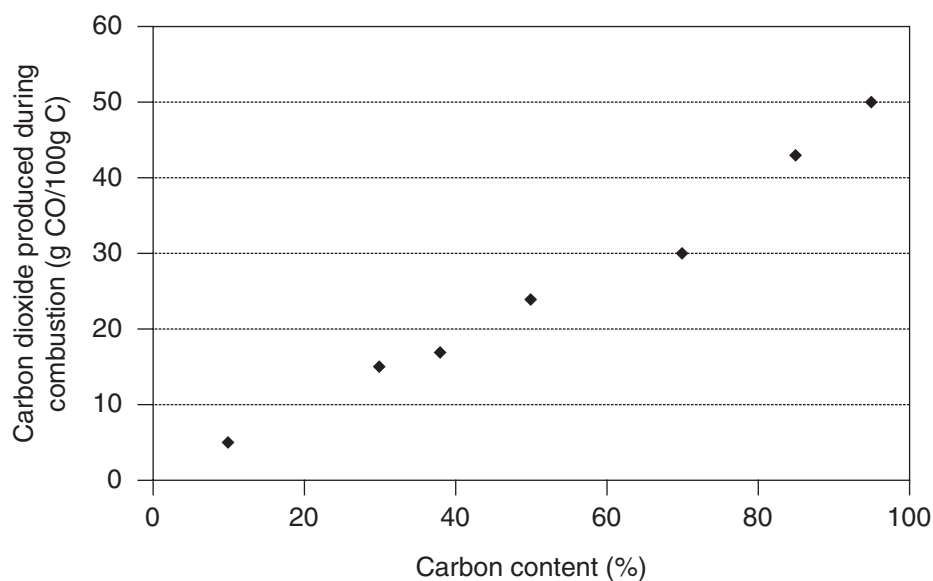
Diagenesis occurs near the surface at low pressure and temperature and changes sediments into sedimentary rock. The production of kerogen (organic matter) and bitumen starts.

Catagenesis occurs at greater depths at higher temperature and pressure. Water is lost and kerogen breaks down to form hydrocarbons.

Metagenesis, is the break down of hydrocarbons at much higher temperature and pressure.

Question 29 (d) (i)**Sample answer:**

Carbon in fuel

Question 29 (d) (ii)**Sample answer:**

Question 29 (e)***Sample answer:***

From 30–87m depth the density remains relatively constant at 2.55g/cc. Between 90–102m depth density decreases sharply from 1.3→1.4 g/cc and then to about 2.7 g/cc below 110m. This implies that between 90 to 102m depth there is a layer of a lower density rock possibly coal.

Question 29 (f)***Sample answer:***

Coal deposits and petroleum accumulations are found in sedimentary basins. Oil/petroleum accumulations will migrate through sedimentary rocks to where the water, liquid and gas are trapped by a capping rock in structural or stratigraphic traps such as anticlines, faults, salt domes. The capping rock and the reservoir rock are mapped using seismic methods. Seismic methods detect boundaries between rocks with different densities thus revealing the stratigraphy and structure. The best locations for test drilling will be decided using the seismic maps.

Coals seams are generally much shallower than oil reservoirs. Thus outcrops in a coal-bearing basin can be mapped and from this information drilling sites selected. Geophysical techniques such as seismic surveys or drill holes can be used to locate faults or folds which influence mining. It is important to determine accurately the depth of a coal seam that is to be mined.

Question 30 (a) (i)*Sample answer:*

Mabo

Question 30 (a) (ii)*Sample answer:*

The Mabo decision led to the delay of the start up of the Century Zinc Mine.

Question 30 (a) (iii)*Sample answer:*

Copper

Question 30 (a) (iv)*Sample answer:*

Water

Question 30 (b) (i)*Sample answer:*

Titanium

Question 30 (b) (ii)*Sample answer:*

For the Ordovician porphyry copper/gold province of NSW, the mineralisation is thought to have been formed by hydrothermal activity. Metal-rich hydrothermal fluids from a subvolcanic intrusion fractured the solidifying magma and surrounding rocks. As the fluids cooled the ore mineral crystallised along the fracture becoming concentrated there.

Question 30 (c) (i)**Sample answer:**

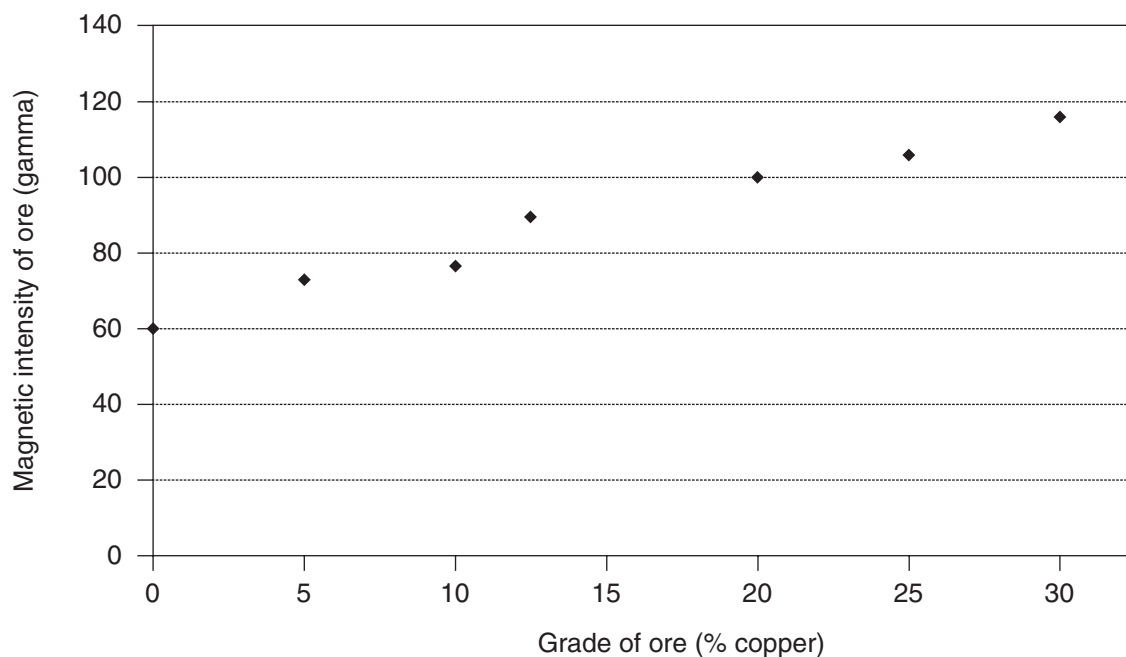
For the Cadia Hill copper/gold deposit soil geochemistry was used to identify where copper and gold levels were above average.

Question 30 (c) (ii)**Sample answer:**

The Cadia Hill orebody is close to the inland city of Orange, so much of the infrastructure was already in place. This included housing for the work force, and a transport network of roads and rail. While electricity and water infrastructure was present in the area, they had to be upgraded to handle the high demand. However this cost was minor compared to the overall value of the ore, which was very high due to the size of deposit. The provision of infrastructure had little impact on the feasibility of mining the deposit because of the size and the value of the deposit.

Question 30 (d) (i)**Sample answer:**

Grade of ore

Question 30 (d) (ii)**Sample answer:**

Question 30 (e)***Sample answer:***

The ore grade is close to zero at shallow depths but increases at 70m. It increases rapidly to 11% at 94m and remains between 11 and 11.4% down to 110m. This implies that a high grade ore body is present at this depth.

Question 30 (f)***Sample answer:***

The mining of resources has a major though localised environmental impact. Landscapes are altered, river flows diverted, vegetation removed and local habitat eliminated. However, a mine is a temporary use of land, and current environmental laws require rehabilitation of mined land back to a state where it can be of some productive use. Such rehabilitation can include return to agriculture, forests or as habitat for native flora and fauna. From this aspect mined land can be returned to some sustainable use and therefore mining can be considered to be sustainable.

However, when you consider that ultimately geologically resources are finite, there will come a time when all the accessible resources have been extracted. Because such resources take millions of years to form in the Earth, once they have been mined, there will be no more to mine, at least by currently known, economically feasible methods. Therefore from this point of view, mining must be considered as being unsustainable in the long term.

Question 31 (a) (i)***Sample answer:***

3-4%

Answers could include:

- 30-40g of salt per litre of water
- 30 to 40%
- 30,000 to 40,000 ppm

Question 31 (a) (ii)***Sample answer:***

Solution of minerals by weathering and accumulation in oceans

Question 31 (a) (iii)***Sample answer:***

Volcanic outgassing and precipitation

Question 31 (a) (iv)***Sample answer:***

Mid-ocean ridges

Question 31 (b)***Sample answer/Answers could include:***

Warm currents move westward along Northern Australia. If sewage were discharged in this region, it could be transported to the Indian Ocean and then around the globe by these and the other currents.

Question 31 (c)***Sample answer/Answers could include:***

Fish are currently resourced close to continental margins. As our understanding of deeper ocean habitats has increased different fish species can be accessed from more remote areas.

Question 31 (d) (i)
Sample answer:

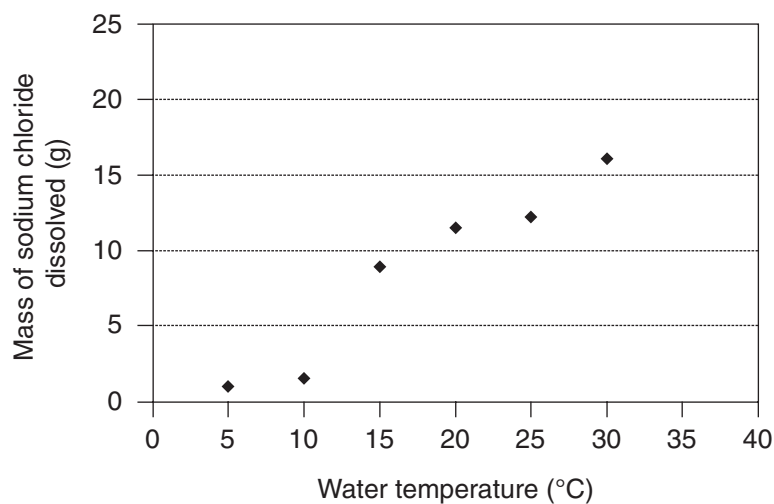
Bathythermographs are dropped from a ship and measure the temperature as they fall through the water. By plotting temperature as a function of depth, the scientists can get a picture of the temperature profile of the water.

Question 31 (d) (ii)
Sample answer:

New technologies provide additional information or improved data about the oceans. Using this information we can develop new or improved models.

Question 31 (e) (i)
Sample answer:

Water temperature

Question 31 (e) (ii)
Sample answer:


Question 31 (f)***Sample answer:***

In the first ten metres the temperature is relatively constant between 20°C and 22°C. Between 10m and 20m the temperature drops 5°C and continues to decrease to 11°C at 60m. This implies that only the top 10m of water are heated by the sun's energy

Question 31 (g)***Answers could include:***

Light is necessary for phytoplankton and these organisms are the basis of pelagic communities. The amount of light and nutrients determines the amount of food produced and therefore the populations of organisms in the surface layers. Water temperature also changes with depth as does salt concentration in some parts of the oceans. The distribution of zooplankton that feed on the phytoplankton changes. When it is light during the day, the zooplankton move deeper and then return to the surface when it is dark. The productivity surface layers are related to sediment distribution because it is the sinking skeletons of phytoplankton that comprise many ocean floor sediments. In areas where ocean productivity is low, red clay sediments form.

Bottom-dwelling communities must either be close to the surface to photosynthesise or rely on other sources of energy. For example, deep vent communities survive without light because they can chemosynthesise.