Stable Isotopes – Oxygen Isotope Palaeothermometers

Oxygen Isotopes

The most common form of oxygen has an atomic mass of 16 (^{16}O). A heavier oxygen isotope with a mass of 18 is also stable (^{18}O). The distribution of these isotopes in the environment changes as a result of changing temperature.

Isotope distribution in COLD (glacial) periods

The concentration of heavy oxygen **(^{18}O) increases in the ocean** because cold air does not have enough energy to hold up heavy water molecules. The lighter oxygen isotopes (^{16}O) evaporate more easily, falling as snow and becoming trapped in ice on land.

Because there is relatively more ^{18}O in the oceans during cold periods, this isotope is more frequently incorporated into the calcium carbonate ($CaCO_3$) that makes up shells of marine organisms and limestone. The concentration of ^{18}O in shells and sea water is the same. **Thus, ice cores from cold times have relatively lower ^{18}O and marine sediments have relatively higher ^{18}O.**

Isotope distribution in WARM (interglacial) periods

The concentration of heavy oxygen **(^{18}O) decreases in the ocean** because warm air has more energy to evaporate and retain heavy water molecules. The ^{18}O isotopes are more common in precipitation that falls as snow on the poles and is trapped in ice on land.

Because there is relatively less ^{18}O in the oceans during warm periods, this isotope is less frequently incorporated into the calcium carbonate ($CaCO_3$) that makes up shells of marine organisms and limestone. **Thus, ice cores from warm times have relatively higher ^{18}O and marine sediments have relatively lower ^{18}O.**

Summary

Climate	Relative concentration of ^{18}O	
	Ocean and marine sediments	Ice cores
Cold	Higher	Lower
Warm	Lower	Higher