

Climate cycles

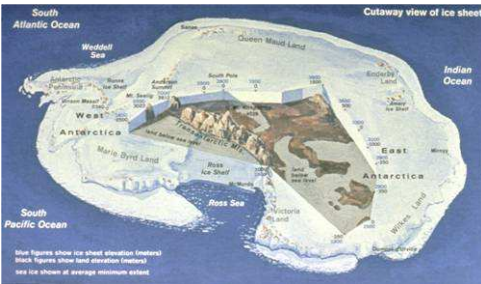
It is important to distinguish between the **weather**, which varies over short periods - from a day to a week, and the **climate** which is described over much longer periods, from thirty up to a million years.

An indirect way of studying past climates is from measurements of snowfalls preserved in polar icecaps: water contains an isotope, O^{18} , in percentages that vary as a function of external temperature.

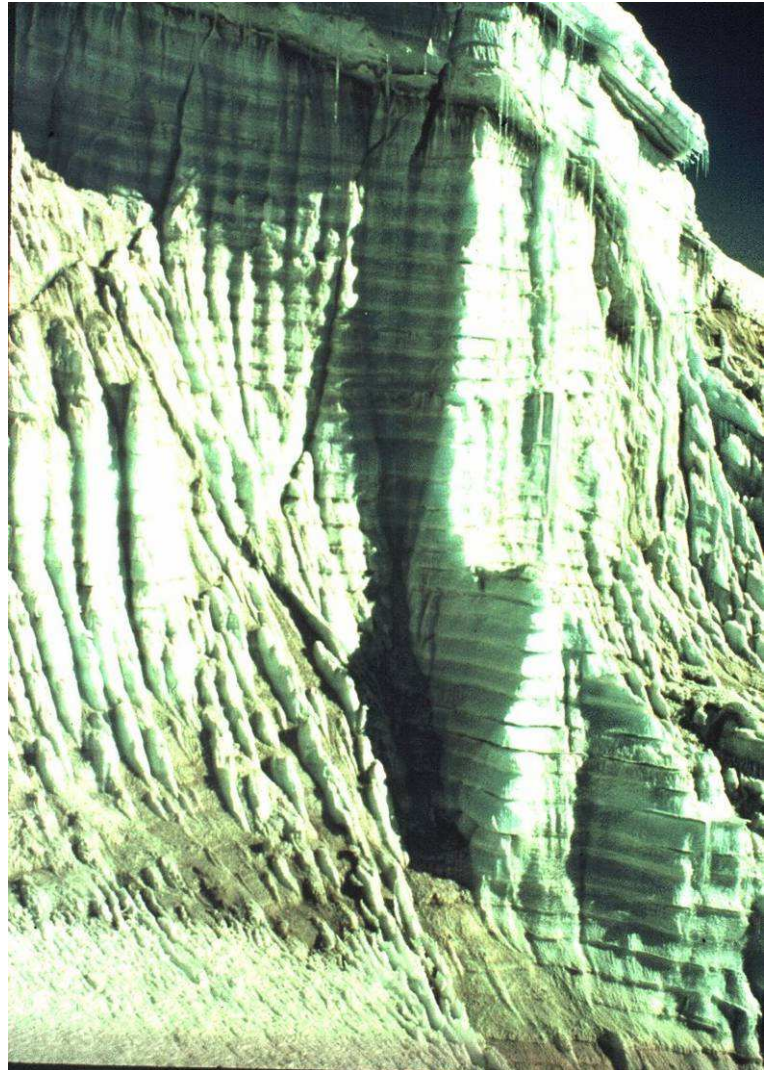
The *Ecole Nationale Supérieure* in Lyon has a website explaining these variations:

<http://www.ens-lyon.fr/Planet-Terre/Infosciences/Histoire/Paleoclimats/Articles/delta-temperature.htm>

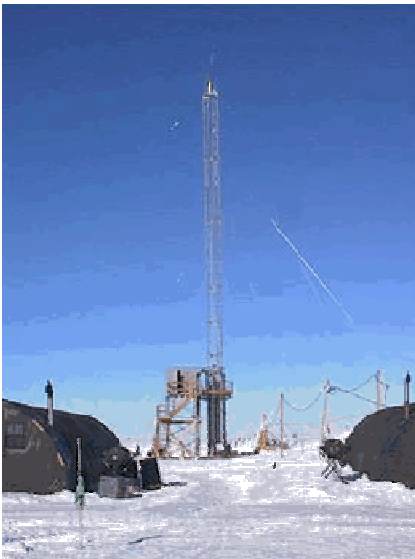
The Antarctic



Snowfalls vary with the seasons, at least at the Poles. The photo on the right shows the different layers of snow that have fallen season by season.



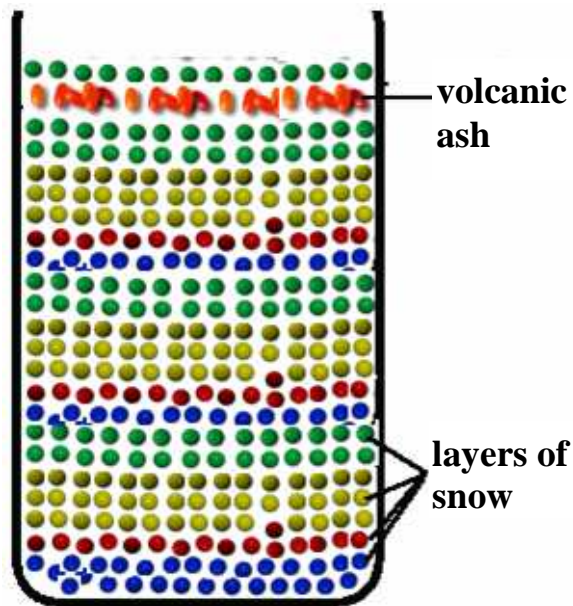
Extracting an ice core



Very simple equipment can serve to help students understand these successive snowfalls and the resulting packing phenomenon, in fact nothing more than marshmallows of different colours, Smarties and a glass jar.

The marshmallows simulate the different layers of snow whereas the Smarties replicate an exceptional event such as a volcanic eruption.

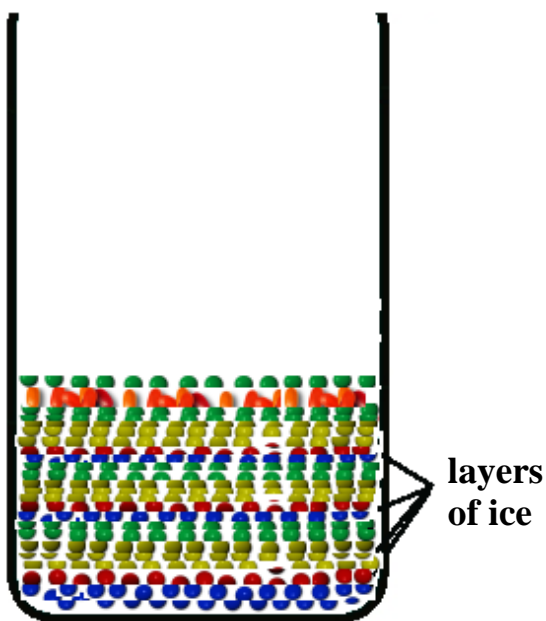




The students fill their jars successively with spring snow (e.g. green), summer snow (e.g. yellow), autumn snow (e.g. pink) followed by winter snow (e.g. white) before starting over again with spring, summer, autumn and winter for several years.

The 'volcanic eruptions manager' (using Smarties to represent ash, for instance) can intervene at will (after all, this is a random phenomenon!).

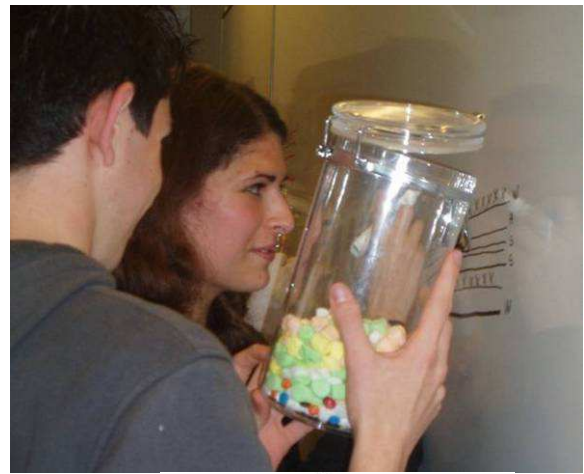
To simulate packing, the layers need to be squeezed together to produce layers of ice.



When exploiting the results, the students can see that it is impossible to assess the quantity of snow fallen per season or per year. The packing of the different layers varies and the snowfall itself is uneven from place to place.

It is possible, however, to count the number of cycles (the different colours corresponding to the different seasons) and the layers of ash provide information for dating. This is because geological studies can identify the layers of ash found at other sites.

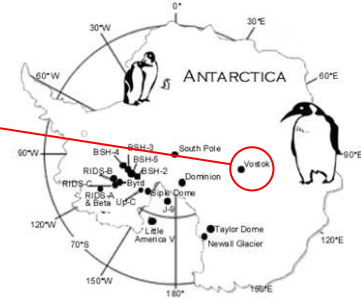
This simple experiment introduces the concept of relative and absolute markers for fixing the dates of the various layers.



Students can then investigate the cycles that are apparent in the data from ice-cores extracted at Vostok.

These data can be found on the first website mentioned above.

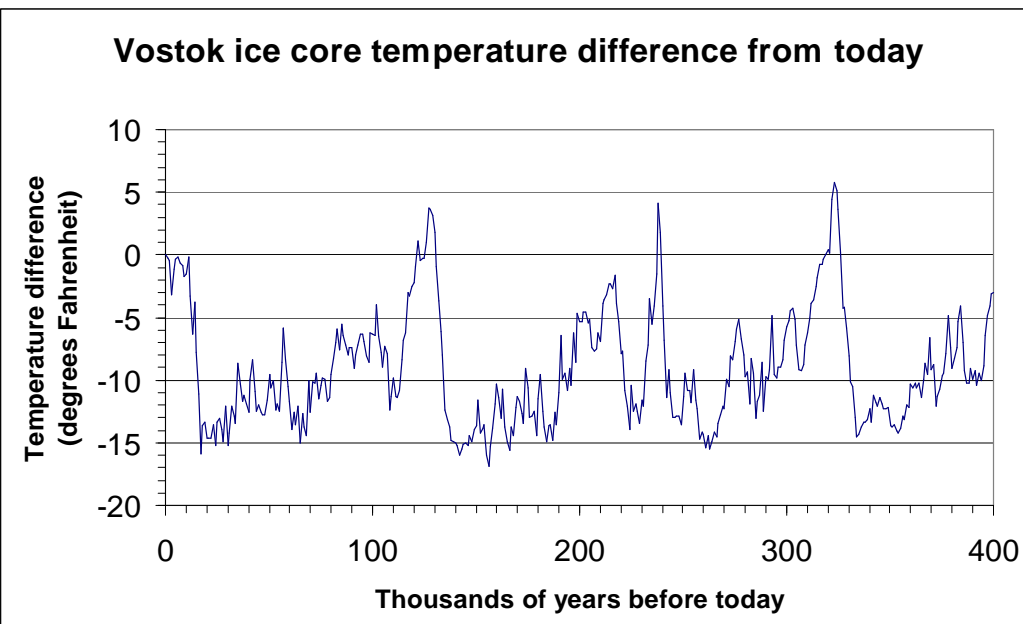
One way that the students might exploit them would be to identify the cycles and delete the most recent ones (for the last 100,000 years, for example).



Explanations of these cycles can be found at:

<http://planet-terre.ens-lyon.fr/planetterre/XML/db/planetterre/metadata/LOM-milankovitch-2005-09-27.xml>

Ice-cores



<http://deschutes.gso.uri.edu/~rutherford/milankovitch.html>

<http://www.ngdc.noaa.gov/paleo/milankovitch.html>

http://www.museum.state.il.us/exhibits/ice_ages/

<http://www.secretsoftheice.org/icecore/cores.html>

<http://niel.usgs.gov/>

<http://www.arm.gov/docs/education/globwarm/icexpert.html>

<http://www.ngdc.noaa.gov/paleo/paleo.html>