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Magnetic guiding through time

Climate change is one of the biggest global worries of our time. In order to understand the processes behind, scientists are trying to reconstruct past climate variations. To correlate findings from around the world, it is important to figure out when climate events happened. It might come as a surprise, but clues to the timing of such events are sometimes found in tiny natural compasses.

Clues to past climates can be found in geological archives such as ice cores and lake sediments. These contain *climate-proxies* that in one way or another provides indirect information about past climates. Pollen and other plant material contained within lake sediments are examples of proxies that can tell us something about for example precipitation and wind conditions at the time of their deposition.

To paleoclimatologists, a sequence of lake sediment is like a natural climate museum. Unfortunately, sediment contain no informational displays saying "*Birch pollen – 11.000 years old"* and it is important to know the time of deposition of the climate proxies in order to establish a climate history. But how do you put a time stamp on sediment? One way is to study natural magnets found within.

Lake sediments often contain tiny grains of magnetic minerals. At the time of deposition they were aligned with Earth's magnetic field, like miniature compasses pointing to magnetic north. The magnetic grains were eventually locked in place by overlying sediment, their orientation preserved for scientist to discover thousands of years later. Their orientation can be used as a dating tool because the magnetic poles move around. A compass today does not point in exactly the same direction as twenty or hundred years ago, and the same is true for magnetic minerals contained in lake sediments.

Historical maps and navigator's diaries provide information about variations in Earth's magnetic field in recent history. Independently dated sediment sequences from around the world provide information that goes much further back. Even rocks contain important information from magnetic minerals that froze in place when the rock crystallized from hot molten magma.

By looking at available data, geophysicists have made complex models that predict past variations. By comparing the variation in the orientation of magnetic minerals in carefully retrieved lake sediments to variations predicted by models, it is therefore possible to successfully date sediment sequences and aid in the reconstruction of the climate history. Who would have thought that tiny compasses could be this useful?

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