Throughout Earth’s history, the north and south poles of the planet’s geomagnetic field have reversed aperiodically (Fig. 1). During intervals known as superchrons, the magnetic field undergoes few or no reversals for tens of millions of years. These stable periods contrast with the frequent reversals that have occurred during the past five million years, and, together, demonstrate the end-member conditions of geomagnetic field behaviour. Superchrons are often attributed to a long-term pattern of mantle convection and core/mantle boundary conditions. But the exact conditions governing superchrons are ambiguous: both an increase and a decrease in active convection of liquid iron in the outer core could explain this pattern of magnetic field generation. Writing in Nature Geoscience, Granot et al. add to this complexity by suggesting that the activity of the dynamo was highly variable during the Cretaceous Normal Superchron.

Earth’s magnetic field has alternated between episodes of normal polarity, when the direction of the field is the same as it is today, and reversed polarity, when the poles are switched. Where oceanic lithosphere forms at a mid-ocean ridge, the cooling magma preserves a record of the polarity of Earth’s magnetic field at that time. As the sea floor spreads away on either side of the ocean ridge, a distinctive pattern of magnetic stripes, alternating between normal and reversed polarity, form parallel to the ridge. The striped pattern of magnetic anomalies on the sea floor can be measured using magnetometers towed by ships at the sea surface. Independent, typically land-based measures can provide absolute ages for some magnetic reversals, allowing us to estimate the age of virtually the entire oceanic crust.

However, this becomes difficult in periods without frequent reversals. The Cretaceous Normal Superchron, between about 121 and 83 million years ago, is the most recent ultra-long interval of constant magnetic field polarity. Oceanic lithosphere formed during this time lacks the readily detectable magnetic anomalies that characterize more typical periods (Fig. 1). Plate tectonic reconstructions indicate that significant changes in plate motions may have occurred during the mid-Cretaceous, but without a clear-cut way to estimate the...
Arctic freshwater

The Arctic Ocean has become less saline, perhaps in response to climate change. Satellite and in situ observations reveal changes in the regional wind patterns that have re-routed freshwater and prevented it from leaving the Arctic Ocean in the past decades.

Cecilie Mauritzen

The hydrological cycle, which transports freshwater to almost every corner of the world, is an endless loop. It encompasses the atmosphere, mountain tops and glaciers, river valleys and lakes, groundwater and the ocean itself. In the ocean, the freshwater cycle leaves its signature in the distribution of salinity: surface salinity is high in regions where evaporation dominates rainfall, typically in the subtropics. On the other hand, low surface salinity characterizes regions where precipitation exceeds evaporation, such as the tropics and the subpolar and polar regions. In a changing climate, both evaporation and precipitation are projected to intensify. Indeed, over the past decades a decline in salinity has been observed in the — already relatively fresh — western Arctic Ocean. Two studies, published in Nature and Nature Geoscience, explore where the freshwater came from, and how it was captured in the Canadian section of the Arctic Ocean.

As the Earth’s climate changes and the atmosphere becomes warmer, the air is also likely to become moister. In fact, for every 1 °C warming the atmosphere can hold another 7% of water vapour. Therefore it is commonly thought that the hydrological cycle will strengthen in a warming climate. So far, the most convincing evidence for this effect is found in the ocean, where the regions that are typically saline have become even more so, and vice versa. This suggests that both evaporation and precipitation have increased. In the absence of direct measurements of these processes over most of the world’s ocean, these observations of ocean salinity are our clearest evidence.

The Arctic Ocean, where precipitation dominates evaporation, is expected to

of numerous oceanic plateaux (Fig. 1), most notably the giant Ontong Java Plateau. These extreme volcanic outpourings are often linked to mantle plumes, and it is thought that plumes can be responsible for significant heat transfer across the core/mantle boundary.

The time markers and geomagnetic field variability reported by Granot et al. should be recognizable in deep-tow records from elsewhere in the Atlantic and other ocean basins. If confirmed, this would force us to revisit the question of what core and mantle conditions lead to superchrons.

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References