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Link between geomagnetic field and climate during geologic time

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The main goals of climatology are to reveal the climate change and ascertain the cause of it. The climatic records during the geomagnetic field reversal would be the most suitable to examine the geomagnetic impact on climate, a long-term disputed subject. We report that the climate changes from marine oxygen isotope stage (MIS) 31 to 17 based on the palynological data from the Osaka Bay core. During this period, two geomagnetic polarity reversals occurred during interglacial periods; the Lower Jaramillo (LJ) and the Matuyama-Brunhes (MB) polarity reversals in MISs 31 and 19, respectively. The climate changes well accord with marine oxygen isotope variations which are dominated by the Earth's orbital elements. However, the climates of MISs 31 and 19 have an anomalous cooling event, which cannot be explained by the Milankovitch theory. Both cooling events are almost correlated with the time of low-geomagnetic field intensity (below 20-30% of a normal intensity) just before the main polarity boundaries, and the warming occurred in conjunction with the geomagnetic field intensity recovery. More than 60% of increase in CR flux is estimated for such low field intensity. Such an increase in CR flux would cause cooling by 2-3 deg. C, estimated by the cloud radiative forcing. The same degree of cooling can be estimated by applying the modern analogue technique to palynological data. These lines of evidence demonstrate a link between the Earth's magnetic field and climate.

Keywords: Svensmark effect, Cooling, Geomagnetic polarity reversal, Cosmic ray, Paleoclimate