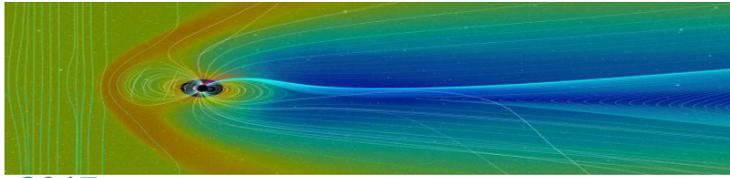




# GEOMAGNETIC SCIENCE NEWS



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## Earth's magnetic field is fluctuating, not diminishing

**Ancient jars found in Judea reveal Earth's magnetic field is fluctuating, not diminishing**

Albert Einstein considered the origin of Earth's magnetic field one of the five most important unsolved problems in physics. The weakening of the geomagnetic field, which extends from the planet's core into outer space and was first recorded 180 years ago, has raised concern by some for the welfare of the biosphere.

But a new study published in *PNAS* from Tel Aviv University, Hebrew University of Jerusalem, and University of California San Diego researchers finds there is no reason for alarm: Earth's geomagnetic field has been undulating for thousands of years. Data obtained from the analysis of well-dated Judean jar handles provide information on changes in the strength of the geomagnetic field between the 8<sup>th</sup> and 2<sup>nd</sup> centuries BCE, indicating a fluctuating field that peaked during the 8<sup>th</sup> century BCE.

The field strength of the 8<sup>th</sup> century BCE corroborates previous observations of our group, first published in 2009, of an unusually strong field in the early Iron Age. We call it the 'Iron Age Spike,' and it is the strongest field recorded in the last 100,000 years, says Dr. Erez Ben-Yosef, the study's lead investigator. This new finding puts the recent decline in the field's strength into context. Apparently, this is not a unique phenomenon -- the field has often weakened and recovered over the last millennia.

### Delving into the inner structure of the planet

We can gain a clearer picture of the planet and its inner structure by better understanding proxies like the magnetic field, which reaches more than 1,800 miles deep into the liquid part of Earth's outer core, Ben-Yosef observes.

The new research is based on a set of 67 ancient, heat-impacted Judean ceramic storage jar handles, which bear royal stamp impressions from the 8<sup>th</sup> to 2<sup>nd</sup> century BCE, providing accurate age estimates.

The period spanned by the jars allowed us to procure data on Earth's magnetic field during that time -- the Iron Age through the Hellenistic Period in Judea, says Ben-Yosef. The typology of the stamp impressions, which correspond to changes in the political entities ruling this area, provides excellent age estimates for the firing of these artifacts.

To accurately measure the geomagnetic intensity, the researchers conducted experiments at the Paleomagnetic Laboratory of Scripps Institution of Oceanography (SIO), University of California San Diego, using laboratory-built paleomagnetic ovens and a superconducting magnetometer.

Ceramics, baked clay, burned mud bricks, copper slag -- almost anything that was heated and then cooled can become a recorder of the components of the magnetic field at the time of the event, said Ben-Yosef. Ceramics have tiny minerals -- magnetic 'recorders' -- that save information about the magnetic field of the time the clay was in the kiln. The behavior of the magnetic field in the past can be studied by examining archaeological artifacts or geological material that were heated then cooled, such as lava.

### Advanced dating method

Observed changes in the geomagnetic field can, in turn, be used as an advanced dating method complementary to the radiocarbon dating, according to Ben-Yosef. The improved Levantine archaeomagnetic record can be used to date pottery and other heat-impacted archaeological materials whose date is unknown.

Both archaeologists and Earth scientists benefit from this. The new data can improve geophysical models -- core-mantle interactions, cosmogenic processes and more -- as well as provide an excellent, accurate dating reference for archaeological artefacts, says Ben-Yosef.

The researchers are currently working on enhancing the archaeomagnetic database for the Levant, one of the most archaeologically-rich regions on the planet, to better understand the geomagnetic field and establish a robust dating reference.

**Journal Reference:** Erez Ben-Yosef, Michael Millman, Ron Shaar, Lisa Tauxe, Oded Lipschits. **Six centuries of geomagnetic intensity variations recorded by royal Judean stamped jar handles.** *Proceedings of the National Academy of Sciences*, 2017; 201615797 DOI: 10.1073/pnas.1615797114