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Evidence of a global magma ocean in Io's interior

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Io is the most volcanic planetary body in the solar system. It is well known that Io derives most of its internal energy from the time-varying solid body tides raised in its interior by Jupiter. The extremely high temperature of the lava erupting on its surface and the prodigious thermal emissions provide hints of an extremely hot interior with large fraction of magma in its interior.

Using Jupiter's rotating magnetic field as a sounding signal, researchers have previously discovered and explored the properties of liquid water oceans in the icy moons of Jupiter. Using the same electromagnetic induction technique on the magnetometer data collected by Galileo near Io, we report evidence for large amounts of rock-melts in the asthenosphere of Io. This work shows that the induction response from a completely solid mantle model is inadequate to explain the magnetometer observations. We find that a layer of asthenosphere > 50 km in thickness with a rock melt fraction $\sim$ 20% is required to model the observed magnetic field. This work also places a stronger upper limit of 107 nT-RIo^3 on the permanent dipole field that could be generated by a dynamo inside Io.