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Thermal Convection in Vesta's Core from Experimentally-Based Conductive Heat Flow Estimates

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Electrical resistivity measurements of Fe-5wt%Ni were made in-situ under pressures of 2-5 GPa and temperatures up to 2000 K in a cubic-anvil press. The thermal conductivity was calculated from the measured electrical resistivity data using the Wiedemann–Franz law. Comparison of these data with previous studies on pure Fe and Fe-10wt%Ni shows that a change in the Ni content within the range 0-10wt% Ni has no significant effect on electrical resistivity of Fe alloys.

The thermal conductivity values of Fe-5wt%Ni from this study, was used to calculate the adiabatic heat flux in Vesta's core. Vesta is of interest because the remnant magnetism in eucrites dated at 3.69Ga, reveals it possessed an internally generated dynamo (Fu et al., 2012). Comparing the estimated adiabatic core heat flux of ~331 MW at the top of Vesta's core to the range of estimated heat flux through the CMB of 1.5–78 GW, we infer that the mechanism stirring Vesta's liquid outer core to generate its surface magnetic field tens of millions of years in its early history was thermal convection.