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Microwave paleointensities indicate a low paleomagnetic dipole moment at the Permo-Triassic boundary

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A B S T R A C T

The quantity of igneous material comprising the Siberian Traps provides a uniquely excellent opportunity to constrain Earth's paleomagnetic field intensity at the Permo-Triassic boundary. There remains however, a contradiction about the strength of the magnetic field that is exacerbated by the limited number of measurement data. To clarify the geomagnetic field behavior during this time period, for the first time, a microwave paleointensity study has been carried out on the Permo-Triassic flood basalts in order to complement existing datasets obtained using conventional thermal techniques. Samples, which have been dated at ~250 Ma, of the Permo-Triassic trap basalts from the northern extrusive (Maymecha-Kotuy region) and the southeastern intrusive (areas of the Sytikanskaya and Yubileinaya kimberlite pipes) localities on the Siberian platform are investigated. These units have already demonstrated reliable paleomagnetic directions consistent with the retention of a primary remanence. Furthermore, Scanning Electron Microscope analysis confirms the presence of iron oxides likely of primary origin. Microwave Thellier-type paleointensity experiments (IZZI protocol with partial thermoremanent magnetization checks) are performed on 50 samples from 11 sites, of which, 28 samples from 7 sites provide satisfactory paleointensity data. The samples display corresponding distinct directional components, positive pTRM checks and little or no zig-zagging of the Arai or Zijderveld plot, providing evidence to support that the samples are not influenced by lab-induced alteration or multi-domain behavior. The accepted microwave paleointensity results from this study are combined with thermal Thellier-type results from previously published studies to obtain overall estimates for different regions of the Siberian Traps. The mean geomagnetic field intensity obtained from the samples of the northern part is 13.4 ± 12.7 μT (Maymecha-Kotuy region), whereas from the southeastern part is 17.3 ± 16.5 μT (Sytikanskaya kimberlite pipe) and 48.5 ± 7.3 μT (Yubileinaya kimberlite pipe), suggesting that the regional discrepancy is probably due to the insufficient sampling of geomagnetic secular variation, and thus, multiple localities need to be considered to obtain an accurate paleomagnetic dipole moment for this time period. It demonstrates that the overall mean paleointensity of the Siberian Traps is 19.5 ± 13.0 μT which corresponds to a mean virtual dipole moment of $3.2 \pm 1.8 \times 10^{22}$ Am^2. Results indicate that the average magnetic field intensity during Permo-Triassic boundary is significantly lower (by approximately 50%) than the present geomagnetic field intensity, and thus, it implies that the Mesozoic dipole low might extend 50 Myr further back in time than previously recognized.

1. Introduction

The behavior of Earth's magnetic field in the geological past is found to be inconsistent and poorly studied for some epochs. Interpreting the changes in the absolute paleointensity variations presents an opportunity to understand the evolution of Earth's magnetic field and to obtain new information about the geodynamo's behavior. It can inform us how the convection in the lowermost part of the Earth's mantle might be influencing the generation of the magnetic field in the underlying core (Valet, 2003; Tauxe and Yamazaki, 2007; Biggin et al., 2012). Reliable absolute geomagnetic field intensity data over geological time periods are required to solve geoscience problems such as the dynamics of Earth's core, the thermal interaction of the

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