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Geomagnetic field intensity and inclination records from Hawaii and the Réunion Island: geomagnetic implications.

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We report on new paleointensity and inclination records obtained in Hawaii considered together with published results from the Réunion Island in the Indian Ocean, all belonging in age to the Brunhes chron.
In Hawaii, we have obtained new paleointensity (Thellier and Thellier) and inclination determinations from the analysis of 370 samples from 130 flows in the subaerial part of the HSDP2 long basaltic core drilled near Hilo. These new results are combined with previous results obtained from the other long basaltic cores in Hawaii (HSDP1, SOH4 and SOH1) all selected using a set of stringent paleointensity selection criteria (PICRIT-03). This results in a unique and accurate lava record of absolute geomagnetic field intensity and inclination at Hawaii for the last 420 kyr based on at least two independent records over almost this entire time interval. The VADM undergoes large oscillations between about 3 and 16 1022 Am2 with an average value of about 8 1022 Am2. When the values corresponding to recognized excursional periods are omitted, the inclination is on the average 29.6°, i.e. about 6° shallower than the GAD value.
In the Réunion Island, published results by Chauvin et al (1991) and Rais et al (1996) relate to 3 sections, the Rivière des Remparts (80-100 kyr), the Remparts de Bellecombe (5-12 kyr) and Piton des Neiges (70-130 kyr). Values of the virtual dipole moment (VDM) from 7.5 to 9.9x1022 A m2 have been obtained from 23 flows among the 30 sampled from the youngest section, while the Rivière des Remparts yields values for the VDMs from 4.1 to 8.8x1022A m2. Average inclination values from these two sections are -43.2° and -50.9° respectively which thus appear some 15.6° and 7.9° steeper than the GAD value at the site (35.3°).
The results from the Piton des Neiges section indicate that the VDM has varied between 4.1 and 11.7 1022 Am2 during the 70-130 kyr interval, with an average value slightly higher than the present value at the site. When the transitional data are ignored, the average inclination is –43.9°, about 8.6° steeper than the GAD value.
These results are compared with predictions of dynamo solutions that incorporate lateral variations in core-mantle boundary heat-flow derived from seismic tomography. We find that model intensities are too high for both Hawaii and Reunion Island, but decrease as the amplitude of thermal boundary anomalies increase. With strong boundary heat-flow, the model inclination anomaly at Hawaii differs from the observed value by only 0.3 degrees. At Réunion model inclination anomalies have the wrong sign; we attribute this to the use of a low Rayleigh number, which promotes fields with strong dipole symmetry, and prominent lateral variations, which promote non-axisymmetric field components. We conclude that strong boundary heat-flow anomalies give the best fit to the data and that future improvements will be obtained by proportionally increasing both the Rayleigh number and the amplitude of heat-flow variations.