GP43A CC: 519 B Thursday 1330h

Long- and Short-Term Variations of Geomagnetic Field Strength I *(joint with OS, T, PP)*

Presiding: **A Gogichaishvili,** National University of Mexico**; C Carvallo,** University of Toronto at Mississauga

GP43A-01 1330h

What We Really Know About the Long-Term Variation of Absolute Geomagnetic Paleointensity?

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Three different trends of the long-term paleointensity variation were recently analyzed. Trend 1 suggests the low paleointensity during almost whole Mesozoic time. Trend 2, which is mainly based on submarine basaltic glass data , supports the relatively high paleointensity since about 0.3 Ma with lower paleointensities prior to that including the entire Cretaceous Normal Superchron (CNS). In contrast, trend 3 suggest that the paleointensity was higher during CNS. In order to estimate the true features of geomagnetic field intensity we re-analyzed almost all paleointensity determinations obtained since early sixties. The variable quality of published paleointensity estimates makes global compilations difficult and extreme care must be taken not to interpret problematic data in terms of geodynamic features.

GP43A-02 1345h INVITED

Long term trends in paleointensity: Are there any?

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After more than nearly five decades of effort, there is still considerable controversy over the long term intensity behavior of Earth's magnetic field. Was there a period of unusually low intensity in the Mesozoic? Was there a period of unusually high intensity during the Cretaceous Normal Superchron? Is there a relationship between reversal frequency and average field strength? Is the present field intensity unusually strong, or about average? The reasons why these fundamental questions are still under debate are that paleointensity data are rare and the acquisition of them is fraught with difficulties. The idea of normalizing one readily measured remanence with another is deceptively simple. Much of the discussion about intensity behavior therefore revolves around approaches to data selection. It is clear that the "best" experimental material would have a remanence carried by tiny (single-domain) magnetic grains that resist alteration during the experiment and whose rate of remanence acquisition can be approximated in the laboratory. Yet a natural material that closely satisfies these requirements, submarine basaltic glass (SBG), is rejected out of hand in several recent compilations. I will discuss the case for paleointensity data derived from SBG and summarize the current state of the paleointensity data set as a whole, including new data from ODP glasses and new experimental designs. I will also examine the case for the CNS intensity high, the Mesozoic dipole low, and the relationship between reversal frequency and average field strength.

GP43A-03 1405h INVITED

400,000 YEARS OF GEOMAGNETIC FIELD INTENSITY AT HAWAII FROM THE LONG BASALTIC CORES

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We present a compilation of paleointensity results from the Hawaiian long basaltic cores HSDP1 (Mauna Loa and Mauna Kea volcanos), SOH-4 and SOH-1 (Kilauea Volcano) and the first results from the aerial part of the new core HSDP2 (Mauna Loa and Mauna Kea volcanos). The results are selected using a set of paleointensity selection criteria (PICRIT-03) we recently proposed for Thellier-Thellier experiments which has been further improved. Case studies relevant to these selection rules will be presented and discussed. Previous results from SOH-4 (0-98 kyr) and HSDP1 (100-420 kyr) have already been re-examined using these criteria, and the results are in press. Here published results from SOH-1 (0-45 kyr) are re-examined and new results from HSDP2 (100-420 kyr) are selected using these newly proposed criteria for the Thellier experiments. Over the time intervals on which the records overlap (0-45 kyr for SOH-1 and SOH-4 and 100-420 kyr for HSDP 1 and HSDP 2) the paleointensity results yield very consistent results. This allows to construct a spliced record of geomagnetic field intensity at Hawaii for the last 420 kyr which we believe to be accurate within +/-15%.

GP43A-04 1425h INVITED

Paleomagnetic and Paleointensity Results from ∼2.45 Ga Matachewan Dikes (Ontario, Canada): Implications for the Early Geodynamo

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Paleomagnetic and paleointensity studies of Proterozoic-Archean rocks have great potential for providing insight into processes of the early Earth's dynamo. We sampled 20 dikes of the Matachewan swarm emplaced in the Early Proterozoic (∼2.45 Ga). Sampling site locations were chosen so that the dikes contained clear plagioclase crystals according to the classification of Halls and Zhang (1998). Magnetic hysteresis, thermomagnetic, and low-temperature magnetic analyses suggest that PSD to MD magnetite is a dominant magnetic carrier in whole rock dike samples. Paleomagnetic analysis showed the presence of a stable high-temperature (HT) (>500^{o}C) component of natural remanent magnetization (NRM) in the majority of the samples. This component was interpreted to be a primary thermal remanent magnetization (TRM), acquired during dike emplacement. The paleomagnetic directions determined from the HT component are consistent with those reported in previous studies (e.g. Bates and Halls, 1991). After correcting for local tectonic rotations, the between-dike directional variation is consistent with the range of secular variation seen in rocks formed during the last 200 m.y., and hence onset of the geodynamo before the Early Proterozoic. To determine paleointensity we applied the single plagioclase crystal technique, which aims to obtain data less affected by geological and laboratory alteration. Small 1-2 mm size crystals were chosen for analysis (larger, altered plagioclase phenocrysts were avoided). Only ∼3% of plagioclase crystals separated from the dikes were magnetically strong enough (> $5{\cdot}10^{-11}$ Am^2) to be used in paleointensity determinations. Seven successful paleointensity determinations from one dike result in a mean field value of 26.8±2.5 μT, which corresponds to a VDM of $6.8{\pm}0.6{\times}10^{22}$ Am^2.

GP43A-05 1445h

Preliminary Directional and Paleointensity Studies of South African Proterozoic/Archean Minerals Using a CO_2 Laser System

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Many Archean rocks are characterized by multiple components of magnetizations which may reflect a long history of overprinting when exposed to temperatures between 300 and 400 ^{o}C. In addition, many plutonic rocks available for study contain mineral grains with magnetic carriers having drastically different magnetic domain states (multidomain to single domain). As a result, paleomagnetic measurements of whole rock Archean samples can be expected to reflect a highly complex averaging process, potentially taking us very far from the original field direction and intensity. To address this issue, we report preliminary data using a CO_2 laser system under development at the University of Rochester. Using a Princeton Measurements Corporation Alternating Gradient Force Magnetometer, we are able to identify mineral carriers with optimal (single domain-like) behavior. Using the CO_2 laser system we have been able to isolate both directions and paleointensities from such minerals (e.g. feldspars and quartz from 3-3.5 Ga plutonic rocks of Barberton, South Africa). Further developments and data will be discussed, as well as rock magnetic data on other mineral carriers, including zircons.

GP44A CC: 519 B Thursday 1530h

Long- and Short-Term Variations of Geomagnetic Field Strength II *(joint with OS, T, GC, PP)*

Presiding: **A Gogichaishvili,** National University of Mexico**; C Carvallo,** University of Toronto at Mississauga

GP44A-01 1530h

Has the Next Geomagnetic Field Reversal Already Started?

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Although in the past some speculations about an occurring geomagnetic field reversal were already formulated, only recently this has emerged as a really constructive hypothesis to be better investigated. From Information Content analysis of global models of the geomagnetic field and geodynamo simulations, it results that within 1000-1500 years the geomagnetic field will likely change its polarity. In this work we will present some considerations that support this possibility together with their geophysical implications.

GP44A-02 1545h

Paleomagnetism and Paleointensity of the Michoacan-Guanajuato Volcanic Field, Mexico

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We report detailed paleodirectional and paleointensity study from 24 volcanic units (Late Pliocene to Present) from the Michoacan-Guanjuato volcanic field (MGVF). The MGVF belongs to Transmexican volcanic belt and contains over 1000 late Quaternary volcanic centers. Almost 90 percent of them are cinder cones. Single component, linear demagnetization plots were observed in most cases. Seven sites yield reverse polarity magnetization while fifteen volcanoes are normally magnetized. Sixteen samples, from three volcanoes, yield reliable paleointensity estimates with the site-mean virtual dipole moments (VDM) ranging from 7.3 to 12.2 x 1022 Am2. Mean VDM obtained in this study is 9.2 ± 0.8 x 1022 Am2 which is slightly higher than present day geomagnetic field strength.

GP44A-03 1600h

Paleointensity Experiments with pTRM and Tail Checks for Multidomain and PSD Magnetites

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