the use of magnetic isochrons for the implicit dating of ocean floor remains of primeval importance, the use of magnetic measurements to better understand the fundamental processes of mid-ocean ridge accretion is becoming more and more important. With the increased data density, the higher precision of the observations, both in positioning and sensitivity, as well as the availability of data at different scales and different altitudes relative to the ocean floor, an entire new spectrum of applications of marine magnetic anomalies is opening up. In this contribution, we compare recent observations of Ravilly et al. (JGR, 1998), along the axis of the mid-Atlantic Ridge, with those made many years ago off axis in the Cretaceous magnetic quiet zone (85 - 118 Ma). Ravilly et al. observed that along segments of the mid-Atlantic Ridge, between 20 and 40 N, the axial magnetic anomaly is higher by a factor of about 2 near the segments ends as compared to the segment centres. The preferred explanation is that both variations in the Fe-Ti content resulting from shallow magma fractionation and serpentinisation of shallow mantle rocks near the segment ends are responsible for this variation. One question is then if this signature persists as the crust generating the axial magnetic anomaly becomes older and moves away from the spreading axis by seafloor spreading. The best region to look for such a signature off axis is the Cretaceous magnetic quiet zone, because there the signal is not contaminated by large reversals in the Earth's magnetic field. Collette et al. (1984) observed such an increase in effective magnetization near the ends of segments, which expresses itself as distinctly positive anomalies over the fossil fracture zone valleys, when the magnetic anomalies are reduced to the pole. Hence, we conclude that both observations are consistent and that the processes responsible for the amplitude variations are restricted to the axial region. Hydrothermal processes off axis may be responsible for additional changes in the total magnetic structure of the oceanic crust, but the fundamental 'magnetic' segmentation is preserved.

GP21A-0036 0830h POSTER

Interpretation of the new CHAMP crustal field anomaly maps using a GIS technique

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Reliable global crustal field anomaly maps produced from magnetic data of the first three years of the CHAMP satellite mission now allow for quantitative geological studies of crustal structure and composition. Here, we have developed a GIS based forward modeling technique to infer crustal structure overlain by younger cover. Modeling takes the geologic and tectonic maps of the world as the input and, depending upon the known rock types in each region, an average susceptibility value is computed for every geological unit. Next, the vertically integrated susceptibility (VIS) is generated by multiplying the average susceptibility with the seismic crustal thickness, as given by global models of 3SMAC and CRUST2.1. Starting with this initial VIS model, the vertical field anomaly is computed at an altitude of 400 km and compared with the corresponding CHAMP vertical field anomaly map. Significant geological inferences are made from the agreement and the discrepancies between our initial map and the observed anomaly map. In a subsequent modeling step the poorly known boundaries of buried crustal units are modified until the recomputed map fits the observed magnetic map. By this simple procedure a remarkably good fit to the magnetic anomaly map is be achieved. We conclude that the lateral extent of Archean units in the lower crust can thus be inferred from satellite magnetic anomaly maps.

GP21B MCC: Level 1 Tuesday 0830h

High-Resolution Description of the Earth's Magnetic Field Time Variations Using Paleomagnetism and Archeomagnetism I Posters

Presiding: **Y Gallet,** Institut de Physique du Globe de Paris**; M Korte,** GeoForschungsZentrum Potsdam

GP21B-0037 0830h POSTER

Constraining the geomagnetic field intensity in Western Europe during the 17-19th centuries from French faience shards

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We obtained new archeointensity results for France from the analysis of seven groups of potsherds precisely dated from the beginning of the 17th century to the 19th century. These earthenware shards were found during excavations in Nevers which was an important production center of faience in France during the 17-18th centuries. For our intensity determinations, we used a new variant of the Thellier and Thellier (1959) method. This procedure ("IZZI" method; Tauxe et al., 2003) involves the alternation of pair of heatings in field-zero field ("IZ" steps) and pair of heatings in zero field-in field ("ZI" steps), and was specially designed to detect biased intensity results due to multidomain magnetic grains. The raw intensity values were corrected for TRM anisotropy and cooling rate effects. Our preliminary results do not show strong intensity variations during the 17-19th centuries. In particularly they do not exhibit a rapid intensity decrease during the 17th century as predicted in Western Europe from the global geomagnetic models of Jackson et al. (2000). To constrain their models during the 1590-1840 period, during which directional but no intensity geomagnetic measurements are available, these authors used a backward extrapolation made on the basis of the linear decay of the dipole moment observed since 1840. Our study challenges the validity of this extrapolation and contributes to our knowledge on the recent variation of the dipole moment of the geomagnetic field.

GP21B-0038 0830h POSTER

Archaeomagnetism of some pre-Columbian mural paintings in Central Mexico

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This work investigates the magnetic remanence associated with the mural paintings at three archeological sites in Central Mexico dated between 200 AD and 1450 AD (Cholula, Cacaxtla and Templo Mayor). The remanence of the murals is shown, using X-ray analyses and rock-magnetic measurements, to be carried by both magnetite and hematite. In most specimens, a characteristic magnetization is successfully isolated by alternating field demagnetization. The mean site directions are consistent with the available master curve for Mesoamerica. This work shows that murals from Central Mexico can retain their remanent magnetization for centuries and demonstrates the viability in principle of pictorial remanence as an archeomagnetic tool.

GP21B-0039 0830h POSTER

Absoulte Paleointensities From 21-84 ka Ontake Volcanic Rocks, Japan - Evidence For Excursion At 80 ka

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Tanaka and Kobayashi (2003) reported a paleosecular variation in directions from 21-84 ka volcanic rocks of the Ontake Volcano, Japan. They found two low latitude VGPs from 48 ka (41.9N, 196.2E) and 80 ka (15.9N, 183.3E) lavas, indicating existence of excursions in Japan during the latest Pleistocene. Following this study, we have tried absolute paleointensity measurements on the Ontake volcanic rocks including samples with these two low latitude VGPs. From various rock magnetic experiments, main remanence carrier was judged to be titanomagnetite with minor Ti content. Hysteresis properties suggested that most of the paleomagnetic cores had PSD characteristics, though ratios of Hcr/Hc were beyond the value of PSD-MD threshold (Hcr/Hc=4) for some cores. These evidences indicated that the present samples had ordinary rock magnetic properties for absolute paleointensity measurements. Therefore, we have performed two different methods of the measurements; Coe's version of the Thellier method (Coe, 1967), and double heating technique of the Shaw method combined with low temperature demagnetization (LTD-DHT Shaw method; Tsunakawa et al., 1997; Yamamoto et al., 2003). Until now, the former method has been applied to 71 specimens while the latter to 126 specimens. Each method gave 30 and 54 successful results. Especially, the latter method seemed to be effective for the MD-pronounced specimens. These results ranged from about 10 to 60 ZAm2 in VADM except one site at 84 ka (110 ZAm2). Striking point in these results is that samples from the 80 ka lava with low latitude VGP yielded consistent low paleointensities for both methods; 4.9+/-0.4 uT for the Thellier method (N=4); 5.9+/-0.2 uT for the LTD-DHT Shaw method (N=3). These samples were collected from two outcrops which are 20 m apart across a gully. Since corresponding VDM and VADM is about 12% of the present value, typical for the geomagnetic excursions, the existence of 80 ka excursion is confirmed not only from the paleodirectional evidence but also from the absolute paleointensity data.

GP21C MCC: Level 1 Tuesday 0830h

Extraterrestrial Paleomagnetism: Role of Impact Related Shock I Posters *(joint with P)*

Presiding: **B Lin,** University of California, Berkeley**; D Mitchell,** University of California, Berkeley**; M Fuller,** HIGP-SOEST, University of Hawaii

GP21C-0040 0830h POSTER

Pyrrhotite in Extraterrestrial Materials: Paleomagnetic Implications of its High-Pressure Transition

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In mineralogical and rock magnetic studies of meteorites, pyrrhotite has been somewhat underscored due to misidentification with troilite and to the poor knowledge of its magnetic properties until the nineties. In the common case of pyrrhotite-magnetite (or metal) mixtures, remanence may be mainly carried by pyrrhotite while thermomagnetic curves points toward metal or magnetite. We have now studied 20 (among a total of 28) independent martian meteorites (SNCs) and found that among the 18 strongly magnetic ones (Mrs more than 10 A/m), 9 have their magnetic remanence carried by pyrrhotite. Among the chondrites, rumurutites (R) contain only pyrrhotite, while a number

of carbonaceaous chondrites (including Allende) contain mixture with metal or magnetite. Low unblocking temperatures combined with high AF resistance of NRM may point toward pyrrhotite (or other sulfides) as the main NRM carrier in various published studies. A high-pressure transition to non-magnetic state has been pinpointed to 2.8 GPa (Rochette et al., 2003; GRL doi:10.1029/ 2003GL017359). Remanence measurements on well characterized nearly SD pyrrhotite confirm full demagnetization at this pressure, and 3/4 at 2 GPa. As the majority of meteorites (including all SNCs) has been shocked much above this pressure this implies that the pyrrhotite NRM is post-shock even in meteorites considered to be considered to be "unshocked". Indeed the threshold for petrographic shock evidence is 4-5 GPa. This shock demagnetization may also explain the lack of magnetization at several crater radii from the large impact basins on Mars (Hood et al., 2003; GRL doi10.1029/2002GL016657).

GP21C-0041 0830h POSTER

Shock and Anisotropy Related Magnetization in a Freshly Fallen LL Ordinary Chondrite

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We conducted a rock magnetic, magnetic anisotropy and paleomagnetic study of the brecciated LL6 bensour meteorite a few months after its fall on Earth. Magnetic properties, in particular hysteresis loops before and after heating, as well as high field anisotropy indicate that tetrataenite is the major magnetic mineral. A very strong coherent susceptibility and remanence anisotropy is evidenced and interpreted as due to the last large impact responsible for the post-metamorphic and post-brecciation compaction of this material. Demagnetization of mutually oriented sub-samples evidences three components of magnetization. Medium and high coercivity components carried by tetrataenite are randomly distributed down to a scale of 0.1 cc. They represent the magnetization acquired by tetrataenite during its formation by low-temperature atomic ordering of taenite, but the link with the original magnetization of taenite and kamacite grains, acquired during cooling of the parent body after metamorphism, is unknown. Alternatively this randomness may be due to a post-metamorphic thermoremanent magnetization subsequently randomized by brecciation. A non random low-coercivity component is also evidenced. We show that it clearly predates the fall of the meteorite on Earth and postdates the last major impact on the meteorite parent body. The coercivity spectrum of this component as well as the close relation with the impact-related petrofabric indicate that the low coercivity component is likely related to this major impact, possibly in quasi-absence of ambient magnetic field.

GP21C-0042 0830h POSTER

The Crustal Magnetic Signature of Hellas Planitia

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The Electron Reflectometer (ER) onboard Mars Global Surveyor (MGS) detected a plasma boundary between the ionosphere and the solar wind as the latter is diverted around and past the planet [Mitchell et al., GRL, 27, 1871, 2000; Mitchell et al., JGR, 106, 23419, 2001]. Above this boundary the 10-1000 eV electron population is dominated by solar wind electrons, while below the boundary it is dominated by ionospheric photoelectrons. This "photoelectron boundary", or PEB, is sensitive to pressure variations and moves vertically in response to changes in the ionospheric pressure from below and the solar wind pressure from above. The PEB is also sensitive to crustal magnetic fields, which locally increase the total ionospheric pressure and positively bias the PEB altitude. We have empirically modeled and removed systematic variations in the PEB altitude associated with the solar wind interaction, thus isolating perturbations caused by crustal magnetic fields. A map of the PEB altitude perturbations closely resembles maps of the horizontal component of the crustal magnetic field measured at 400 km by the MGS Magnetometer (MAG). We find a PEB altitude bias over the Hellas basin that is consistent with a horizontal magnetic field with an intensity of several nanotesla at 400 km altitude. This is compatible with upper limits to the horizontal crustal field strength set by MGS MAG measurements from the 400-km-altitude mapping orbit. If there are crustal sources within Hellas that give rise to a several-nanotesla horizontal field at 400 km altitude, then these same sources should give rise to crustal fields of at least several tens of nanotesla at 100 to 200 km aerobraking altitudes. Although low-altitude MAG measurements over Hellas are sparse [Acuna et al., Science, 284, 790, 1999], there was no evidence for crustal sources of this predicted field strength. Furthermore, electron reflection data (with more complete sampling) detected only a few isolated sources within Hellas [Lee et al., EGS-AGU-EUG Joint Assembly, Abstract EAE03-A-07938, 2003], which are far too weak to account for the observed PEB bias. We explore two possibilities for the observed PEB bias over Hellas: 1) horizontal fields over Hellas arise from magnetic sources around the basin perimeter, and 2) the solar wind flow is perturbed by crustal sources in the southern hemisphere such that the effective solar wind pressure over Hellas is systematically reduced. No detectable PEB or magnetic signature is observed over the younger Argyre and Isidis Basins.

GP21C-0043 0830h POSTER

Paleomagnetic and Rock-Magnetic Study of the Yaxcopoil-1 Impact Breccia Sequence, Chicxulub Impact Crater (Mexico)

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Results of a detailed paleomagnetic and rock-magnetic study of samples of the impact breccia sequence cored in the Yaxcopoil-1 borehole between about 800 m and 896 m are presented. The Yaxcopoil-1 breccia sequence occurs from 794.63 m to 894.94 m and consists of relatively complex melt-rich suevites. The low-field susceptibility ranges from -0.3 to 4018 10-5 SI. The NRM intensity ranges from 0.02 mA/m up to 37510 mA/m. In general, NRM intensity and magnetic susceptibility present wide ranges and their values are positively correlated, pointing to varying magnetic mineral contents and textures of the melt-rich breccia sequence. The vectorial composition and magnetic stability of NRM were investigated by both stepwise alternating field and thermal demagnetization. In most cases characteristic magnetizations with linear components going through the origin of vector plot are observed. Both upward and downward inclinations are observed in the breccia samples. We interpret the reverse magnetization as the primary component. The multivectorial composition of remanence may be explained by the heterogeneous nature of the breccias and effects of hydrothermal activity. Clasts and matrix forming the breccia appear to have been subjected to a wide range of temperature/pressure conditions and show distinct rock-magnetic properties. High temperature/pressure conditions during cratering resulted in melting, formation of metamorphic minerals, generation of shock features in quartz and plagioclases, crustal uplift, widespread fracturing and deformation and generation of a thermal anomaly. An extended interval of remanence acquisition and secondary partial or total remagnetization may explain the paleomagnetic results.

GP21C-0044 0830h POSTER

Evidence for Terrestrial Magnetic Contamination of the Chondritic Meteorites

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Ordinary chondrites represent primitive material of the Solar System. They provide essential information about the conditions in the early solar nebula. Part of this information can be extracted by analyzing the magnetic properties of meteorites. However, the magnetic record and associated rock magnetic properties are sensitive to the meteorite's numerous post-formation processes including various metamorphic events during planet formation period or terrestrial residence following the meteorite's fall. As shown by the Moravka (H 5-6) and Zebrak (H 5) samples, some ordinary chondrites do not carry stable magnetic remanent record. The loss of primary magnetic remanence (if any) can be associated with metamorphic events that may have taken place before the encounter with the Earth. The soft magnetic component may indicate a viscous terrestrial magnetic contamination. Another (EL 6) meteorite is an example o f a fresh fall. The magnetic material of this chondrite seems to be sensitive to low temperature (< 350 K) ambient magnetic field contamination. The meteorite (H 4) (from the El Baharya "strewn field" of the Libya desert) carries visible traces of terrestrial oxidation and weathering. The magnetic mineral assembly contains products of terrestrial oxidation and the magnetic record present was probably strongly influenced by terrestrial remagnetization. Therefore, numerous space and terrestrial processes reduce the chance of observing a primary magnetic record in ordinary chondrites.

URL: http://www.volny.cz/tomkohout/meteo/

GP21D MCC: 2000 Tuesday 1020h

Magnetic Interpretation: Continental to Planetary Scales II *(joint with OS, P)*

Presiding: **M E Purucker,** Raytheon ITSS at Geodynamics Branch**; J D Phillips,** U.S. Geological Survey

GP21D-01 1020h

Toward the World Digital Magnetic Anomaly Map (WDMAM)

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During the 2003 IUGG meeting in Sapporo, Japan, the IAGA working group on Geomagnetic Modeling rekindled the World Digital Magnetic Anomaly Map (WDMAM) project. Even though preparation of such a map may appear a daunting task, the bulk of it could be accomplished within a few years, taking advantage of many existing national to continent-scale and oceanic magnetic anomaly compilations. In addition, Project Magnet high altitude aeromagnetic surveys could be utilized where available and necessary to fill gaps. Similarly, the CHAMP satellite-derived magnetic anomaly field could be downward continued to provide wavelengths greater than 500 km in this magnetic anomaly map. There are a large number of data handling and processing issues that need to be addressed during the preparation of this map and we discuss some of them here: What should the data spacing be? Should the spacing be uneven according to the data availability? At what elevation should the fields be displayed? How to treat the areas of complete lack of near-surface (marine and airborne) magnetic field coverage? How should one treat the long-wavelength anomaly limitations of