

GP62A-06 1510h

Magnetic record of Lake Baikal sediments (Baikal Drilling Project 1998)

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Magnetic remanence vectors from 1500 samples taken from a 600 m core through Lake Baikal sediments are reported along with a complete magnetic susceptibility profile obtained from a pass-through system. Matching the stable remanence directions to the standard geomagnetic polarity timescale (GPTS) provides a robust chronology from the present back to 6.7 Ma and yields a remarkably constant sediment accumulation rate of 3.9 cm/ka. For earlier times - represented by depths below 270 m - correlation to the GPTS is more problematic. Susceptibility fluctuations reflect climatic changes that can be matched to the marine oxygen isotope pattern for the last 6.7 Ma. Spectral analysis of the resulting susceptibility time series then indicates that, for the most part, the Milankovitch obliquity signal dominates. However, when the temporal evolution of the frequency content is investigated by analysing sequences of time windows, a complex picture emerges in which eccentricity and precession power appears during some intervals. Furthermore, there is persistent evidence for significant power in a "non-Milankovitch" band between 28 and 35 ka.

GP62A-07 1525h INVITED

Comparison of Paleomagnetic Records with Different Mean Sedimentation Rates From the Rockall Plateau (ODP Sites 980-982)

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North Atlantic high-sedimentation-rate marine "drift" deposits with mean sedimentation rates of about 10 cm/kyr, or greater, often exhibit rather constant sedimentation rates on scales of 0.1-1 Myr. On scales less than 100 kyr, however, sedimentation rates vary by a factor of at least 5 in cases where detailed oxygen isotope data offer precise age control. Guyodo and Channell (2002) have modeled the influence on geomagnetic paleointensity records of variable quality age control for a range of mean sedimentation rates. The simulations illustrate that high-quality age control and mean sedimentation rates in excess of a few cm/kyr are necessary to resolve wavelengths shorter than 25 kyr in stacked u-channel paleointensity records. The numerical simulations are compared with u-channel data from three ODP sites (Sites 980/981 and 982) drilled on the Rockall Plateau and off its eastern edge. The site located on the plateau (Site 982) has a magnetic record extending into the Gauss Chron and a mean sedimentation rate of 2 cm/kyr. One of the sites located at the edge of the plateau (Site 980) has a mean sedimentation rate to the Cobb Mountain Subchron (1.2 Ma) of about 10 cm/kyr. The other site at the edge of the plateau (Site 981) reaches the base of the Reunion Subchron with a mean Matuyama sedimentation rate of 5.6 cm/kyr. The age models were

derived by matching the benthic oxygen isotope data to an orbitally-tuned target curve. The boundaries of the Jaramillo, Cobb Mountain, Olduvai and Reunion subchronozones occur consistently in the expected marine isotope stages but appear consistently older at Site 982 by about 10 kyr. This implies an effective lock-in depth of several tens of centimeters, at least at Site 982 where the lock-in depth represents more time due to the lower sedimentation rate. Normalized remanence data can be correlated to paleointensity records from ODP Sites 983/984 (700 km to the NW from Site 980-982) and with paleointensity data from the Pacific Ocean, although large chronological offsets are apparent for Pacific records with imprecise age control.

GP62A-08 1540h

The Use of Extraterrestrial ³He as Constant Flux Proxy in Paleooceanography

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A fundamental need in interpreting sedimentary records with respect to climatic aspects is the accurate knowledge of sediment mass accumulation rates. In this context, the development of constant flux proxies (CFP) has created an important asset and has led to reinterpretation of previously published paleoceanographic results with dramatic consequences.

Traditionally, mass accumulation rates are determined from stratigraphic methods (i.e. ¹⁸O) and are often biased by sediment redistribution processes. Constant flux proxies represent an alternative approach to reconstruct fluxes of sedimentary constituents by exploiting the fact that the supply rate of the CFP is known to within well-defined limits. CFPs offer two fundamental advantages compared to normal stratigraphic methods. (i) Traditional stratigraphic methods are unable to evaluate the net gain or loss of sediment by lateral transport (focusing and winnowing by deep-sea currents). Fluxes derived using a CFP are insensitive to lateral redistribution of sediments. (ii) Fluxes can be constructed with higher temporal resolution. Whereas it is necessary to assume a constant sediment accumulation rate between age control points in traditional stratigraphic methods, normalizing to a CFP allows a temporal resolution that is limited only by bioturbation.

The currently most established CFP in paleoceanography is ²³⁰Th. However, the use of ²³⁰Th is limited by its 75 ka half-life to sediments deposited during the past ~ 300 ka. Beyond this time-scale, extraterrestrial ³He that is delivered to the earth surface by interplanetary dust particles (IDP) is a potential candidate. As the cosmic dust is enriched in ³He by ca. 8 orders of magnitude compared to bulk terrigenous matter, IDPs are the main contributor to the total ³He concentration in many pelagic sediments and can be readily detected. If a constant IDP flux is assumed, the ³He distribution in sediments can be used to determine instantaneous sediment accumulation rates. As ³He is a stable isotope and it is extremely well preserved in marine sediments over at least 10⁷-10⁸ years, it holds huge potential for application as a CFP well back into the Mesozoic.

GP62A-09 1555h INVITED

Alternative Chronologies for Paleoclimatic Events Based on Excess ²³⁰Th and Grain Size Measurements in Marine Sediments.

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The constant production and rapid deposition on the seafloor of ²³⁰Th from the radioactive decay of ²³⁴U allows the possibility that this excess (²³⁰Th_{ex}) can be used as a chronometer in deep-sea sediments. In locations of adequate vertical settling particles and negligible lateral remobilization, the integrated sedimentary inventory of ²³⁰Th_{ex} can be used to establish a chronology over an interval as well as instantaneous

fluxes for each depth. In such ideal situations, ²³⁰Th_{ex} profiling provides a "clock" as well as a "stopwatch". Particle rain in the North Atlantic is generally sufficient to strip ²³⁰Th_{ex} from the water column today, and has been greater in the past. Core V28-82 (49°N, 22°W, 3935 m) has approximately the mean regional sedimentation rate, and appears to have a focusing factor near 1.0. It thus serves as a likely location to establish an absolute chronology based on the measured inventory of ²³⁰Th_{ex}. The ²³⁰Th_{ex} chronology provides an independent estimate for the duration of warm intervals during marine isotope stage 5 (MIS 5). In particular, warm sea surface temperatures persist at that location. At ODP Site 984 on the Reykjanes Ridge, lateral redeposition associated with a sediment drift deposit does not allow ²³⁰Th_{ex} profiling to be applied for chronology. At this location, the persistence of a millennial oscillation in bottom current strength provides a chronometer beyond the useful life of U-series disequilibria. Here, the MIS 11 interglacial has been examined and shown to have similar variability of bottom flows as in the Holocene, based on the sortable-silt proxy for current velocity. A hanging chronology based on the millennial oscillation yields an estimate for the duration of warm interglacial conditions of approximately 20 kyr. Both methods of estimating the duration of peak interglacial conditions during MIS 5e and MIS 11 yield results that are consistent with orbital tuning, and both far exceed the elapsed duration of the Holocene. In addition, the ²³⁰Th_{ex} profiling method yields absolute age estimates for events during the last ice age, including the Heinrich event iceberg discharges H4 and H5, which had previously eluded firm chronological constraints.

GP62B MCC: 121 Saturday 1615h

Magnetic Database Developments: Public Forum (joint with OS, V)

Presiding: S Banerjee, University of Minnesota

No abstracts available.

GP71A MCC: Hall C Sunday 0830h

Stratigraphic Chronologies: Determination, Interpretation, and Quality Control II Posters (joint with OS, PP)

Presiding: D McMillan, Scripps

Institution of Oceanography; P

Huybers, Massachusetts Institute of Technology

GP71A-0972 0830h POSTER

Magnetostatigraphical dating of the Majuangou Paleolithic site in the Nihewan Basin, North China

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Two adjacent sections named Haojiatai (HJT, 130.8 m thick) and Majuangou (MJG, 128.8 m thick) in the Nihewan Basin, North China were paleomagnetically examined. Field observations revealed that an artifact layer occurs in the MJG section at 65 m. Stratigraphy patterns between these two sections were correlated by variations in susceptibility as well as two distinctive marker beds, including a conglomerate layer (45-m-depth at MJG and 105-m-depth at HJT) and a greyish-yellow clay layer with mollusc fossils (66-m-depth at MJG and 122.4-m-depth at HJT). Four magnetozones were recognized at the HJT section: two normal, N1 (0-49 m) and N2 (78.8-80.2 m); and two reversed, R1 (49-75.8 m) and R2 (80.2-128.8 m), and six magnetozones were identified at the MJG section: three normal, N2 (17.2-22.2 m), N3 (85-89 m), and N4 (126.6-130.8 m); and three reversed, R1 (0-17.2 m), R2 (22-85 m), and

R3 (89-126.6 m), respectively. Among these magnetozones, N1, N2, N3 and N4 correspond to the Brunhes chron, the Jaramillo subchron, the Olduvai subchron, and the Gauss chron, respectively. The stone tool layer at MJG is located at 43 m below the bottom of magnetozones N2. Assuming a constant accumulation rate R2, the age of this artifact layer is estimated to be about 1.55 Myr. This new age provided a confident evidence that humans appeared in 1.55Ma at the studied area, which is oldest humans site with confident age control.

GP71A-0973 0830h POSTER

Paleointensity confirms cm-scale sedimentation rates and suggests intervals with non-uniform deposition on the Lomonosov Ridge, central Arctic Ocean

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Chronologies of Arctic Ocean Plio-Pleistocene sediments have been mainly based on paleomagnetic reversal stratigraphy due to low microfossil-content that precludes biostratigraphic dating methods and establishment of an oxygen isotope stratigraphy. Paleomagnetic reversal records primarily from Canadian Basin sediment cores, but also from other Arctic Ocean cores, were initially interpreted as polarity reversals (chron/sub-chron) because paleomagnetic excursions have not until recently been accepted as expressions of genuine geomagnetic features. A Geomagnetic Excursion Time Scale (GETS) has not yet been established and, therefore, the use of excursions as a dating tool is largely dependent on external time control. A number of cores from different regions of the Arctic Ocean have recently been dated interpreting short polarity reversal intervals as geomagnetic excursions. Some of these data reveal narrow intervals with complex patterns of short normal/reversed zones and also absence of excursions at 'expected' depths. Although these observations may be attributed to the short duration of geomagnetic excursions, intermittent bioturbation (?) or other erasing processes, they clearly demonstrate the need for an independent dating control confirming uniformity of accumulation. Paleointensity-records could convey reliable data for relatively high-resolution dating that may disclose variations in rate and uniformity of sedimentation. We present paleointensity records from cores from the Lomonosov Ridge with cm-scale sedimentation rates that carry records of inferred excursions. One of the cores has been dated correlating MnO enriched brown colored layers with interglacial cycles, biostratigraphic marker horizons and excursions (Jakobsson et al., 2001). The absence of excursions in the upper parts of the cores remains unaccounted for. Paleointensity records are correlated with SINT-800, revealing a good correspondence back to ca 250 ka. Below this level correlation becomes blurred. Depth-age plots show two linear segments (similar slopes) separated by a short break, suggesting a temporary change in sedimentation rate (hiatus?). The break corresponds with anomalous variations in the compositional S-0.3T-parameter.

¹Jakobsson M., øvlie R., An-Hanbali H., Arnold E., Backman J. & Mørth M., 2000. Manganese and color cycles in Arctic Ocean sediments constrain Pleistocene chronology. *Geology*, 28, 23-26.

GP71A-0974 0830h POSTER

Paleomagnetic and Environmental Magnetic Studies of Pampeano Formation Loess Deposits From Centinela Del Mar, Argentina

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The Centinela Del Mar loess-like deposits of the Pampeano Formation of Argentina represent a complicated, discontinuous sequence spanning early to mid Pleistocene through the middle Pliocene. Continuous paleomagnetic and mineral magnetic measurements of ~10 m section indicate that there are two possible unconformities spanning an uncertain amount of time. The upper 6.5 m is believed to be entirely within the Brunhes Epoch and is supported by Ar-Ar dates of 0.46 ± 0.03 Ma from an impact glass found within the unit. Inclination data shows evidence of four field reversals in the bottom 3 m, one of which is located at ~9 m and has been tentatively identified as the Kaena Event (3.04-3.11 Ma).

Mineral magnetic measurements identify 4 possible depositional regimes characterized by changes in magnetic concentration (K) and magnetic grain size (KARM/K, ARM/SIRM). The uppermost unit (sim0-45 cm) is represented by coarser magnetic minerals (lower KARM/K values) and higher magnetic concentrations (higher K values). The second unit (~45-340 cm) is bound on the bottom by the first unconformity at ~340 cm and is characterized by finer magnetic grains. The third unit (~340-650 cm) has an even finer magnetic grain size and exhibits higher amplitude variability. The lowermost unit (~650-970 cm) is below the second unconformity. It has the finest magnetic grain size of the four units and also exhibits high amplitude variability.

GP71A-0975 0830h POSTER

Magnetic Signature of Late Quaternary Sediments From the Kuroshio Current

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Site 1202 was drilled during ODP Leg 195 in the southernmost Okinawa Trough off the east coast of Taiwan. The southern Okinawa Trough currently has a high rate of sedimentation due to the enormous input of terrigenous material from the East China shelf and Taiwan. The 410 m composite section recovered at Site 1202 consists of rapidly-deposited calcareous silty clay, and based on biostratigraphic evidence, the entire section is believed to be younger than 127,000 years old. Thus, the recovered sediment represents a unique opportunity to determine environmental change associated with the Kuroshio Current as well as the evolution of the Earth's magnetic field on centennial to multi-decadal time scales. We have been studying the paleomagnetic and environmental magnetic record of a suite of u-channel samples that span the upper 140 meters of the site. The sampled section appears to be yielding a reliable magnetic record although both stability and magnetic intensity decrease downcore. The NRM/ARM record from the uppermost 40 m has features that can be tentatively correlated with the Holocene paleointensity record from Fish Lake, Oregon. This suggests that Site 1202 is indeed one of the highest resolution records of the geomagnetic field and environmental change yet found.

GP71A-0976 0830h POSTER

Evaluation of the Olduvai Sub-Chron in the Orce Ravine (SE Spain), Implications for the Plio-Pleistocene Mammal Biostratigraphy and the Age of Orce Archaeological Sites

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The 4,000km² Guadix-Baza basin (Betic ranges, SE Spain) exposes a thick and continuous sequence of Plio-Pleistocene continental deposits, represented by cycles of fluvial-lacustrine sediments. The basin is rich

in fossil micro- and macro-mammal sites, which includes the archaeological sites of Venta Micena (VM), Barranco Leon (BL-5) and Fuenteneuva-3 (FN-3), that have produced anthropogenic lithic artifacts and human remains. Studies of the micro-mammal associations in this basin have generated a large body of literature on systematics, biostratigraphy, and Neogene faunal replacements. The well known Barranco de Orce (BO) section in the NE sector of the Baza basin exposes seven fossiliferous layers (O-1 to O-7) with Plio-Pleistocene micro- and macro-mammals. Biostratigraphic and magnetostratigraphic data from the BO and nearby sections have been extensively used to calibrate the late Neogene chronology of Western European mammal biozones. In Barranco de Orce, a previously identified normal event assigned to the 'Olduvai' sub-chron (C2n) has been used to calibrate the first appearance datum (FAD) of the arvicolid *Allophaiomys phiocenicus* and to discuss the use of this species in recognizing the Plio-Pleistocene boundary. The FAD of *Miomys ostramosensis* in the BO section has been used to calibrate the boundary of biozones MN17/MmQ1 (latest Neogene of Western Europe). This section has also been used to explore the timing of first human colonization of Europe, owing to the stratigraphic and geographic proximity of the BO section to the major paleontological and archaeological sites.

There are numerous weaknesses in the continued use of the BO section as a magnetobiostratigraphically calibrated boundary section, including the scarcity of fossil specimens, landslide repeated stratigraphy, and modern (normal) overprinting of the paleomagnetic record. For example, in the successive published magnetostratigraphical and biostratigraphical interpretations, the faunal association from the BO section has been assigned to a total range of four biozones, MN17 to MmQ3. Another ambiguity exists in the previous magnetostratigraphic interpretation of the age of the BO section as early Matuyama (C2r.1r), in direct conflict with an assignment of late Matuyama (C1r.2r) in the nearby BL section. These adjacent sections can be stratigraphically correlated and are considered contemporaneous on geologic grounds.

Our research shows that the Barranco de Orce section: [A] Crosses a mega-landslide, which produces repetition of parts of the sedimentary sequence, so that the seven fossiliferous layers (O-1 to O-7) are actually the repetition of only two (O-6 and O-7, 3m apart in situ in the upper part of the ravine). [B] New paleomagnetic results demonstrate the presence of reverse magnetization throughout this section. The BO magnetostratigraphy can now be directly correlated with the exclusively reverse polarity from the Barranco Leon section (published and new data) and with published reverse data from Fuenteneuva-3. Therefore, all lithic artifact and paleontological sites in the Orce area are within a reverse magnetochron (presumably C1r.2r).

GP71A-0977 0830h POSTER

A Depth-Tuned Pleistocene Age-Model: Uncertainty Estimates, Sedimentation Variability, and Nonlinear Climate Change

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A new chronology of glaciation, spanning the last 780,000 years, is estimated from 21 deep sea core sites using depth as a proxy for time. To provide uncertainty estimates for this new chronology, the spatial and temporal variability of deep sea sediment accumulation rates are estimated and modeled as an auto-correlated stochastic process. The chronology is estimated to be accurate within 9,000 years and is not inconsistent with orbitally based age estimates. When applied to the $\delta^{18}O$ record the new chronology indicates a nonlinear orbital climatic response not evident in orbitally tuned records. This suggests orbital tuning yields generally accurate ages, but may cast a false light upon orbital climate change by imposing an overly linear response.

URL: <http://www.mit.edu/~phuybers/>

GP71A-0978 0830h POSTER

Constraining the Age of Synorogenic Continental Paleogene Strata in the Eastern Cordillera of Colombia, South America: A Combined Palynological and Paleomagnetic Approach

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Several decades of palynological studies in marginal to continental Paleogene strata in the Eastern Cordillera of Colombia (EC) have yielded few constraints in the age of deposition of these rocks. Recent research in Upper Cretaceous-Paleogene strata of the EC and bordering thrust belts have suggested (1) a Late Cretaceous to Paleogene deformation in the EC previous to Neogene uplift; and (2) stratigraphic record of Paleogene strata is thicker and with fewer unconformities in the axial zone of the EC than in bordering thrust belts. Because of the importance of constraining the age of Paleogene strata for better documentation of events of deformation and fluid migration, we began a detailed palynological and paleomagnetic study of one section ca 500m thick in the axial zone of the EC. The Cosgua section (Boyaca, Colombia) is in an overturned footwall syncline of the Soapaga thrust fault. Previous works have proposed fault activity of the Soapaga and the Boyaca faults in middle Paleogene time. Details of palynological and paleomagnetic sampling strategies and expected results are as follow. Sampling for palynology was carried out at each 2-5 m, and for paleomagnetism at an interval of 8 m. Because this is a first attempt of using paleomagnetism in this region, we collected cores in lower to middle Paleogene units at different limbs of footwall folds, as well as in Jurassic and Devonian strata in the hanging wall. The results of the paleomagnetic work will determine (1) if it is possible to uncover the primary magnetization component in lower to middle Paleogene rocks, and if positive, a preliminary magnetostratigraphic column will be produced; (2) the possible uses of secondary magnetization for structural analysis; and (3) some constrain on events of fluid migration.

GP71A-0979 0830h POSTER

Uncertain depth-age relationships in paleomagnetic records: Assessing data quality and geomagnetic content

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We present a statistical model for two types of errors that cause uncertainties in the depth-age relationship for any stratigraphic core. In an application of this model, we assess the consequences that uncertain age assignments have on combining globally distributed relative paleointensity records from sediment cores. Such records have been stacked in attempts to isolate the record of geomagnetic dipole intensity variations.

First, the model addresses errors in the ages of the control points that establish a first order age-scale. These inferred ages are generally gathered from a complementary source, such as, in the case of paleomagnetism, radiometric methods and accepted oxygen isotope age-scales. Second, we model errors in the ages of physical measurements due to interpolation of an assumed accumulation rate between control points. These inferred ages are in error due to the relatively short time-scale stochastic variations in the actual accumulation rates. Given appropriate parameters, our model provides estimates of uncertainties in inferred age at any depth for individual cores and allows simulations of plausible depth-age relationships.

Isolation of geomagnetic dipole intensity variations is complicated by other uncertainties, particularly inaccuracies in the relative paleointensity record and non-dipole geomagnetic field contributions. We use simulations from the statistical age model and from detailed numerical dynamo simulations to explore a method of data quality control and to evaluate geomagnetic content in stacked paleomagnetic records. Both are accomplished by examining the spectral content of the paleomagnetic signal resulting from the simulations. Quality control tests using records from nearby cores show that introducing age errors acts to decorrelate geomagnetic signals, primarily at shorter periods, although it is possible for nearby records to be uncorrelated in most, if not all, period bands. Modest age errors can account for the poor correlation between neighboring paleomagnetic records often observed in real data. When we consider the global stack our results show that, with the largest errors, dipole variations with periods longer than about 20 kyr are present in the stacked record of

dipole variations. Modest errors in the ages of control points can account for most of the spectral degradation, while errors due to variations in accumulation rate may have a similar effect. With adequate knowledge of age errors, this method offers the possibility of quantifying uncertainties due to other noise sources.

GP71A-0980 0830h POSTER

Magnetostratigraphy of Tertiary Sediments From the Wulanwula Lake Basin: Implications for the Cenozoic Tectonic History of the Tibetan Plateau

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We conducted an integrated paleomagnetic and stratigraphic study on a 750 m thick sedimentary sequence of the Wulanwula Lake basin, north of the Qinghai-Tibet Plateau to obtain a chronostratigraphic framework for these sediments. This section is about 300 km west of the Hoh Xil Basin and is a relatively simple structure in which strata dip gently to the south. On other flanks of the anticline, we sampled another set of continuous exposure of red sandstone for performing paleomagnetic fold test on remanent magnetization. Stepwise thermal demagnetization results indicate that our samples yield well-defined characteristic remanence (ChRM) that passes a fold test at 95 percent confidence level and appears to be an early chemical remanent magnetization residing mainly in hematite. Both normal and reversed polarities are presented. The positive results of fold and reversal tests indicate that the ChRM is a record of the paleomagnetic field close to the time of formation of these sediments. Further evidence for the magnetization of these sediments acquired close to their time of deposition is the fact that patterns of magnetic reversals can be matched with the established polarity time scale. The sequence of polarity reversals is consistent with the data in the Chroms C17-C19 (36.6 - 41.5 Ma), where the K-Ar dates for the overlying volcanic rocks (35.8-26 Ma) and intruded dykes (34.3-31.2 Ma) indicate it should be. The age of the section is therefore paleomagnetically dated as 42 - 37 Ma (middle late Eocene). Sedimentation rates derived from the magnetostratigraphy suggest that a sharp increase in basin subsidence is recorded near 40 Ma, which is also observed in the Fenhoushan formation of the Hoh Xil basin. We interpret this increased sedimentation as a response to crustal deformation caused by the final stage of India-Asia collision during the middle Eocene.

GP71A-0981 0830h POSTER

Age Control on Middle Pleistocene Sea Level Changes by use of Coastal Aggradational Stratigraphy and High-Resolution ⁴⁰Ar/³⁹Ar Geochronology

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Using the ⁴⁰Ar/³⁹Ar method, we have dated volcanic horizons found in sedimentary deposits of the Tiber River coastal plain near Rome, Italy, to determine the timing of sea level changes during the interval 250-800 ka. The timing of marine transgressions recorded in the Tiber delta are sensitive recordings of glacial-interglacial transitions, analogous to the U-series dated coral reef terraces that have been used to constrain the timing of the penultimate deglaciation. In this talk we will present new data relevant to the time interval that corresponds to marine isotopic stages 7 through 20. Combined with the data that we have already published from these sections, our work has made the Tiber River delta the most precisely dated record of middle Pleistocene sea level change. We will compare the Tiber delta chronology with those predicted by orbital dating of marine sediment cores. By doing so, we

can investigate whether there are significant systematic errors associated with the orbital dating of glacial cycles. Without the external age control provided by radioisotopes, the systematic errors associated with orbital dating remain unmeasured, and ignored.

URL: <http://dkarner.lbl.gov>

GP71A-0982 0830h POSTER

Updated Magnetostratigraphy of Ice Age Flood Deposits of the Cold Creek Bar at the Hanford Site, Southeastern Washington

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Pleistocene cataclysmic flood deposits, informally referred to as the Hanford formation, blanket the Pasco Basin in south-central Washington. This area is a depositional sink for sediments generated by jokulhlaups scouring the channeled scablands during glacial periods. A thick sequence (up to 100 m) of such flood-deposited gravel, sand, and silt underlies much of the USDOEs Hanford Site, within the Pasco Basin. Correlation of these cataclysmic flood deposits is often difficult because of a lack of marker horizons and rapid lateral facies changes. However, paleomagnetic reversals provide an opportunity to establish time-stratigraphic units within flood deposits.

We have analyzed about 280 samples derived from 15 boreholes penetrating the giant Cold Creek flood bar. Paleomagnetic samples, obtained from finer-grained facies consisted of silt to coarse-grained sand. Demagnetization experiments consisted of alternating field or thermal demagnetization or a combination of both. Demagnetization revealed both reversed and normal polarities, although a substantial number of samples were of indeterminate polarity. The magnetostratigraphy suggests that these sediments have been accumulating since the Olduvai (1.77-1.95 Ma) normal subchron. This extends the chronology of cataclysmic flooding in Southeastern Washington back by more than a million years over previous studies.

GP71A-0983 0830h POSTER

Impacts of Climate Change and Euroamerican Agriculture on Magnetic Properties of Sediments From 18 Lakes in Southern Minnesota

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We conducted a multi-proxy study of 18 glacial lakes from southern Minnesota combining sedimentological, palynological and rock magnetic analyses to constrain the nature of links between environmental change and sediment magnetic properties. Pollen analyses record a shift to a more forested landscape 1000-1100 AD corresponding to the Medieval Climate Optimum and onset of the Little Ice Age, and pollen analysis was used to identify the Ambrosia-rise in each core which corresponds to the onset of Euroamerican agriculture in 1860 AD.

Broadly speaking, magnetic concentrations increased while magnetic grain size decreased with the onset of the LIA. This change was most evident for lakes that are presently situated in forested watersheds, which is suggestive of a subtle vegetation feedback, probably due to changes in water and sediment chemistry. With the onset of plow agriculture high rates of soil erosion initially increase the supply of highly magnetic sediment, but ultimately lead to increases in organic productivity and the dilution or reductive dissolution of magnetic minerals. This process is reflected in a decrease of concentration dependent parameters, such as magnetic susceptibility and SIRM, and coincides with a shift to coarser grain sizes as evidenced in lower ratios of ARM/IRM.

GP71A-0984 0830h POSTER

A Composite Paleointensity Stack for the Last 75 kyr

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Paleointensity records from sediments are often stacked to minimize possible local effects due to deposition/environmental conditions at different sites which may locally affect the fidelity of the records. The fidelity/reliability of each individual record may however change along the sedimentary column, so that in a given time interval, one record may provide an accurate recording of the geomagnetic field intensity, while in some other interval, the same record may be affected by environmental factors and yield a less accurate image of the field.

Here we attempt to construct a paleointensity stack using a novel approach designed to minimize these local effects. The six records meeting stringent criteria for paleointensity estimate obtained from rapidly deposited North Atlantic sediments used to construct NAPIS-75, were considered. These records, all reported on the GISP2 age model, were interpolated every 200 years for each core (325 points). At each point, using a jackknife technique, we determined in a first step which record and in a second step which 2 records contributed the most to the scatter of the stack. This (these) record(s) was(were) then rejected from the stack and the procedure repeated for the next point.

This approach results in a paleointensity stack of 5 (4) cores at each horizon, but not necessarily the same cores at each horizon. This procedure should therefore remove or at least significantly reduce environmental effects affecting limited intervals of the cores and result in a stack more closely reflecting geomagnetic field changes. Results of the same procedure applied after the same 6 cores have been corrected for environmental effects using a recently proposed method (Mazaud et al., this session) will be discussed. The results obtained using records by other authors will also be presented.

GP71A-0985 0830h POSTER

ESR signals in a core from the lake Baikal: implications for climate change

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Electron spin resonance dating method has been used for obtaining ages of Quaternary events using speleothem, corals, shells, hydroxyapatite in tooth enamel, gypsum, and quartz (Ikeya, 1993). Recently, it was also found that an ESR signal in quartz of loess is useful to discuss the variation of its origin (e. g. Ono et al., 1998). The method is based on the signal intensity of the heat treated (gamma ray irradiation and heating, Toyoda and Ikeya, 1991) E_{1f} center (an unpaired electron at an oxygen vacancy) correlates the original (crystallization) age of quartz (e.g. Toyoda and Hattori, 2000). If there is variation in ages of basement rocks (origin of loess), ESR signal intensity may differentiate the origins.

We applied the present method to sediments taken from the core of the lake Baikal with the length of 600m. The ESR intensity of the heat treated E_{1f} center was determined by an ESR measurement at room temperature for about 100 mg of the bulk samples, with a microwave power of 0.01 mW, field modulation amplitude of 0.1 mT, and with a scan range of 5 mT around g=2.001 after gamma ray irradiation to 1 kGy and subsequent heating at 300C. The ESR signal of the E_{1f} center was clearly observed although other minerals are also included in the bulk sample. The peak to peak height was taken as the signal intensity after normalizing the height with the gain (the instrumental setting at the time of measurement), mass, and the intensity of the standard simultaneously measured with the sample.

The concentrations of the quartz in the bulk samples were obtained by the X ray diffraction study, normalizing the peak intensity with a standard CeO sample.

The variation of the ESR signal intensity with depth of the core will be presented together with the possible climate change which may have caused the variation.

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GP71A-0986 0830h POSTER

Rates of Sedimentation in the Central Arctic Ocean

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The Arctic Ocean is presently undergoing geoscientific investigations of the type that occurred during the late 1940's through 1960's in the Atlantic, Indian and Pacific oceans. Seismic reflection and refraction data are scarce in the Arctic Ocean and large areas are virtually unsampled with respect to piston or gravity coring. The vast majority of available cores are less than 10 m in length and largely lack biostratigraphically useful calcareous and siliceous microfossils. No drill cores exist from the ridges or deep basins in the central Arctic Ocean. Considering the limited geophysical and geological data available, it is not surprising that current concepts about Arctic Ocean sedimentation rates are diverging. The main point of difference is whether or not strongly subdued rates of sedimentation persisted in the central Arctic Ocean during Plio-Pleistocene times. The low sedimentation rate scenario is based on age models suggesting Plio-Pleistocene rates that vary between about 0.04 and 0.4 cm/ka. This scenario is chiefly derived from cores raised from ridges in the Amerasian Basin and implies that the majority of cores presently available extend well into, or encompass the entire, Pliocene. The contrasting high sedimentation rate scenario is based on age models suggesting rates that vary from about one to a few cm/ka, derived from cores from ridges and basins in both the Amerasian and Eurasian parts of the central Arctic Ocean. The latter scenario implies that most short cores rarely extend beyond the Pleistocene.

Early paleomagnetic chronologies of sediment cores retrieved from the Amerasian Basin were based on the assumption that zones with negative inclination represented genuine polarity reversals. The first encountered down-core zone with negative inclination was interpreted to be the Brunhes/Matuyama boundary. This approach yielded mm-scale Plio-Pleistocene sedimentation rates. Biostratigraphy, cyclostratigraphy, and OSL dating, subsequently have indicated that many of these negative inclination changes represent Brunhes geomagnetic excursions, thus providing cm-scale Pleistocene sedimentation rates. All longer-term, Cretaceous through Cenozoic, sedimentation rates derived from seismic reflection and tectonic models of bedrock age are on the order of cm/ka.

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Rock-Magnetic Records of 0 - 2.5 Ma Deep-Sea Core Sediments in Pacific Region

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In conjunction with magnetostratigraphic results, a rock-magnetic investigation is carried out to clarify paleo-environmental changes in sedimentary sequences of piston core recovered from abyssal basin of Pacific. Study area is surrounded by Marshall islands to the east and Mariana islands to the west. Sampling site is

located in abyssal basin between OSM 01 (Ita Mai Tai seamount) and OSM 02 (unnamed seamount). Magnetic susceptibility, anhysteretic remanent magnetization (ARM), and saturation isothermal remanent magnetization (SIRM) were measured on core sample. In previous results, the age of sediments was from late Pliocene and Pleistocene determined by matching the polarities with the geomagnetic time scale. Sedimentation rates were ranged from 63 to 85 cm/Ma. Rock-magnetic experiments indicate that remanence is carried by ferrimagnetic minerals having low coercivity. With core depth, the fluctuations of rock-magnetic parameters in depth of lithologic change appear to be caused by the input change of magnetic minerals reflecting the variation of paleo-depositional condition.

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GP71A-0988 0830h POSTER

A High Resolution Paleomagnetic Record from East China Sea

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A high-resolution paleomagnetic record was obtained from a piston core MD982195 taken in the northern East China Sea during IMAGES IV cruise. A total of 33.65 m long sediment column was recovered at a water depth of 746 m in the Danjo Basin west of Kyushu Island (31°38.33'N 128°56.63'E). Sediments were mainly composed of silty clay. Two wide spread tephra layers, K-Ah (7,300 calendar year) and AT (27,500 calendar year), were recognized at 5.1-6.0m and 21.8-22.9m. In addition, AMS 14C ages were obtained for 14 horizons using foraminifera in the sediments (Kawahata and Oshima, submitted). The estimated age at 32 m is 41.4 kyr and the sedimentation rate ranges from 26 to 270 cm/kyr.

Cube samples were taken at 5cm intervals from the core and were subjected to the study of anisotropy of magnetic susceptibility. U-channel samples were taken continuously from the core and the measurements of NRM, ARM, and IRM were conducted at 5 mm or 1 cm intervals. The results were deconvolved using ABIC minimizing algorithm by Oda and Shibuya (1996).

The principle component directions of anisotropy of magnetic susceptibility were plotted relative to the core north calculated from the average NRM. The results suggest a rather consistent current flowing from southeast to northwest. Top 2m and 8-10m show unstable nature with Kmin inclination of lower than 45 degrees. The depth interval of 8-10m corresponds to the termination of the last glacial period. Other parts show stable feature with primary sedimentary fabric. Relative geomagnetic paleointensity was estimated, and compared with those obtained from Core PS-2138-1 SL (Nowaczyk et al., 2000) and ODP Site 983 (Channell, 1997) spanning from 10 to 40 ka. Several intensity minima could be recognized including that corresponding to the Mono Lake excursion. However, the excursions are not obvious in inclination record. Inclination record of MD982195 for the past 10kyr was compared with those around Japan. Some characteristic features can be correlated with each other. In fact, high frequency features (100years) were recovered beyond the limit of errors around 5000 yr BP, demonstrating the ability of u-channel sampling (less sampling noise) combined with deconvolution for the secular variation study.