

similar characteristics as the global models of secular variation, and do not support the hypothesis of any specific anomaly in the central Pacific, as suggested also by a recent independent study.

GP42B MC: 303 Thursday 1600h

Cox Lecture

Presiding: W Lowrie,
ETH-Honggerberg

GP42B-01 1605h INVITED

Paleomagnetic Observations of Reversals: the Search for Systematics

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With the appearance of sophisticated computer models in recent years, we are much closer to a global, space-time solution of the reversing geodynamo problem. Of course, the significance of any reversal model relies on its ability to simulate what has actually been observed in the paleomagnetic record acquired over the past forty years. In this, the last talk of the Cox Lecture series, I trace the development of our understanding of transitional field behavior derived solely from paleomagnetic observations since the time of Allans varied, seminal works on reversals. Because each reversal record provides, at best, a reliable chronological accounting of field behavior experienced at one site during one particular dynamo event, researchers have long sought signs of recurrent transitional field structures and systematics in short, some degree of predictability. The talk will focus on progress over the past decade in this search. Examples: What is the paleomagnetic evidence for lower mantle influence on the geodynamo during transitional times? What can be said about dynamo behavior during the last reversal? How are the processes of reversals and geomagnetic excursions related?

GP51A MC: Hall D Friday 0830h

Full Vector Field Behavior on Historical to Million Year Timescales (joint with T, V, DI)

Presiding: E Herrero-Bervera,
University of Hawaii at Manoa; C
Johnson, Scripps Institution of
Oceanography

GP51A-0272 0830h POSTER

Ultrahigh-Resolution Holocene Geomagnetic Paleosecular and Relative Paleointensity Record From the St. Lawrence Estuary, Eastern Canada

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Sedimentation rates exceeding 0.5 cm/yr are recorded in the St. Lawrence Estuary allowing very high-resolution time series to be set from long core studies. Here, we present u-channel paleomagnetic data from two cores collected during the 1999, IMAGES-V (*International Marine Past Global Change Study*) cruise (MD99-2220: 48°38.32'N/68°37.93'W, water depth: 320 m, length: 51.6 m; MD99-2221: 48°10.60'N/68°30.35'W, water depth: 212 m, length:

31.0 m). In both cores, a post-glacial unit composed of muds (MD99-2220) or muddy sands (MD99-2221) overlies laminated glacio-marine clays dating from the deglaciation (> 8500 cal yr BP). Eighteen AMS ¹⁴C ages provide a timeframe for the depositional sequence. The natural remanent magnetization (NRM) of the cored sediments was studied by progressive alternating field demagnetisation. Orthogonal projections of the NRM, constructed at 1 cm spacing, indicate that for most intervals these sediments are characterized by a strong, stable, single component magnetization. Aside from certain intervals in the upper post-glacial unit of MD99-2221 (~1.5-5 m), the inclinations of the post-glacial sediments vary about the expected inclination for the latitude of the site, with MAD values generally lower than 2° and 6° for cores MD99-2220 and -2221, respectively. Shallow inclinations or higher MAD values are observed in the underlying laminated glacio-marine clays of both cores. High frequency sedimentological variability along with sedimentation rates that exceeded 3 cm/yr may account for the poorly recorded NRM in this unit. In the overlying post-glacial muds of MD99-2220, u-channel and hysteresis data suggest that pseudo-single-domain magnetite is the dominant magnetic remanence carrier. The carrier in the post-glacial unit of MD99-2221 is dominantly coarse-grained multi-domain magnetite. Initial results indicate that the post-glacial mud unit of core MD99-2220 passes the criteria for paleointensity studies, therefore, normalized remanence records are likely to reflect changes in the intensity of the geomagnetic field. The inclination and declination records from the post-glacial units of both cores show similarities with Holocene lacustrine records from North America, suggesting that secular variation could serve as a stratigraphic tool in this region. However, when each core is placed in its own independent AMS ¹⁴C chronology, small temporal offsets within the declination and inclination patterns are observed. As the cores are less than 100 km apart and assuming that the magnetic directions are accurately recorded, these offsets reflect either dating anomalies or variable lock-in depths. Normalized remanence records of the post-glacial unit in core MD99-2220 reveal features with a wavelength in the order of 1000 years that compare with those recorded in the Lake Pepin (Minnesota, USA) sediments, suggesting that paleointensity may be recorded in these sediments. Higher frequency variations are also observed. Whether they are due to uncorrected environmental variability or geomagnetic intensity changes is presently unknown.

GP51A-0273 0830h POSTER

Paleomagnetic Secular Variation of Pliocene-Quaternary Lava Flows From Southern Patagonia

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Paleomagnetic directions were obtained from step-wise AF or thermal demagnetization of 53 lava flows from Southern Patagonia (latitudes 49.5° - 52.1° South) that include the Pali-Aike Volcanic Field and the Meseta Viscahas Plateau Lavas. Previous Pliocene-late Quaternary ages of these flows were confirmed with ⁴⁰Ar/³⁹Ar dating of 11 of these sites that range from 0.1 to 4 Ma. All except one of the magnetic polarities coincide with the expected polarities of the magnetic polarity time scale (Cande and Kent, 1995) for the obtained ⁴⁰Ar/³⁹Ar ages. The mean direction from 36 sites (rotated 180° when reversed) with $\alpha_{95} \leq 5^\circ$ and age ≤ 4 Ma is Dec = 0.8°, Inc = -67.8°, a value that coincides within the statistical uncertainty with the direction of the GAD for that area (Inc = -68.1°). Likewise the mean VGP coincides within the statistical uncertainty with the geographic North. Both the Normal and Reverse sites have a fisherian distribution and pass the reversal test at a 95% confidence level with a B classification (McFadden and McElhinny, 1990). The secular variation described by the VGP angular standard deviation for these sites is 17.6° a value expected for that latitude according to Model G of paleosecular variation (McFadden et al., 1991). The characteristics of the data presented is optimum for TAF studies because of the good age control and good quality of the paleomagnetic data: (a) the primary component of

magnetization was obtained using principal component analysis (Kirschvink, 1980) from at least 3 points and MAD < 5°, (b) site mean direction was calculated with Fisher statistics using at least 5 samples and (c) 39 of the 53 flows had $\alpha_{95} \leq 5^\circ$. No results (5 sites) or high α_{95} values (> 5°) were obtained primarily from sites affected by lightning.

GP51A-0274 0830h POSTER

Long-term Secular Variation of Geomagnetic Field Inclination With 100 kyr Periodicity During the Last 2.3 Myrs

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Recent progress in sedimentary paleointensity revealed the presence of long-term variations (~ 10 to 100 kyrs) during Brunhes. Some studies found the Milankovitch orbital frequencies in paleointensity records, but others resulted in contradicting conclusions: no stable frequency, or artifact caused by paleoclimatically induced rock-magnetic changes. Long-term changes are expected to exist also in directions if outer forces energize the geodynamo. A few studies suggested possible occurrence of such changes, but they were suspicious because of the lack of continuous and long-enough records with good age-control.

We present a record of secular changes in inclination during the last 2.3 Myrs. A piston core of 42m long was taken at 3 deg N, 135 deg E. The sediments have rock-magnetically favorable nature, which enabled recovery of geomagnetic field variations both intensity and direction. A polarity sequence down to Reunion I was identified clearly from declinations. Average inclination is approximately zero as expected from the site latitude. Relative paleointensity was estimated from NRM intensities normalized by ARM. The variations during Brunhes closely resemble to the Sint-800 stack, from which the depths of the core were converted to ages. The age control before B/M boundary is based on the magnetostratigraphy. Inclination fluctuations show long-term cyclic changes. Frequency analysis indicates the presence of ca. 100 kyr periodicity. Cyclic lithological changes may induce cyclic changes in the magnitude of the inclination error, and then inclination. This, however, cannot explain the variation observed here. In equatorial regions like this site, inclinations are close to zero, and thus the inclination error should be negligibly small. Furthermore, a shift from 40 to 100 kyr periodicity occurred at about 0.9 Ma in magnetic susceptibility, which reflects the paleoclimatic change known as the mid-Pleistocene revolution, but did not in inclination. This fact strongly suggests our inclination record reflecting geomagnetic field. The period of 100 kyr is much longer than electrical diffusion time of the core, and thus considered to be excited from outside the core. The 100-kyr periodicity suggests a connection between the geodynamo and the orbital eccentricity.

GP51A-0275 0830h POSTER

A Paleomagnetic Study of 0-3 Ma Volcanic Rocks from Costa Rica

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Suitable volcanic rocks play an important role in determining the structure of the geomagnetic field and its very long term secular variations. Paleomagnetic samples from Costa Rica were collected in 1998 and 2000 as part of a larger study of the global time-averaged geomagnetic field and its paleosecular variation for the past 5 Myr. At least 10 samples per site were drilled from 32 lava flows/ignimbrites in the Cordillera Central and Guanacaste regions. We present results from 26 normal and 6 reverse polarity sites, with ages ranging from less than 1 kyr to about 3 Ma.