Geophysical Research Abstracts,
Vol. 10, EGU2008-A-02287, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-02287
EGU General Assembly 2008

A new model of the lunar magnetic field: Implications for dynamo timing

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A new magnetic map of the moon provides an assessment of ambient magnetic fields during basin development. An interpretation of the map strongly suggests a magnetic era, and a possible dynamo, in Nectarian, but not Imbrian times. Published paleointensity interpretations from Apollo samples suggest a later magnetic era, in late Nectarian and Imbrian times, but recent results by Lawrence et al. (2007) suggest that the earlier paleointensity determinations may be unreliable. The new magnetic map using Lunar Prospector (LP) low-altitude data is developed using a novel, correlative technique, after first removing a simple model of the external magnetic field. The technique uses internal dipoles as basis functions while exploiting LPs orbit geometry; incorporating vector component data from immediately adjacent passes into the model. These adjacent passes are closely separated in space and time and are thus characteristic of a particular lunar regime. Each dipole model represents the correlative parts of three adjacent passes, and provides an analytic means of upward/downward continuing the data. Combining these individual models, a model is developed for the wake and tail regimes in which more than 99% of the 720x720 grids covering the lunar surface are filled. The resulting spherical harmonic degree 178 model is estimated to be robust below about degree 150. Polar regions are considered to be the least reliable. In one scenario, the dynamo is initiated after magma ocean overturning and subsequent heating within the iron-rich cumulate establishes a thermal regime favorable to a dynamo. This scenario ends with the eruption of the lunar mare basalts, and the ultimate demise of the dynamo. This presentation will discuss alternate dynamo scenarios, and consider ways in which we can discriminate among them.