LUNAR MAGNETISM: PROGRESS AND REMAINING ISSUES. Lon L. Hood[1], [1]Lunar and Planetary Laboratory, 1629 E. University Blvd., University of Arizona, Tucson, Arizona, 85721 (lon@lpl.arizona.edu).

Introduction: During the 10 years that have elapsed since publication of *New Views of the Moon,* major progress has been made in the interpretation of lunar magnetism. Most importantly, it is now generally accepted on the basis of both sample paleointensity analyses and orbital measurements that the Moon once possessed a global magnetic field generated by dynamo processes in its metallic core. In addition, the Japanese Kaguya mission has provided new measurements of the crustal field that complement the dataset acquired by Lunar Prospector. Analyses of the crustal field data for a number of applications (e.g., solar wind interaction with crustal anomalies, origin of the lunar "swirls"; history of the core dynamo, paleomagnetic pole positions) have been conducted and are continuing.

Progress: As summarized in the 2006 chapter by Wieczorek et al. [1], it was unclear at that time whether a core dynamo magnetic field was required to explain the paleomagnetism of the returned samples or the crustal magnetism observed from orbit. The small size of the lunar metallic core (radius < 400 km) combined with paleointensity estimates exceeding 1 Oersted (100 μT) were difficult to explain via conventional dynamo theory for a thermally convecting core. Several aspects of the crustal field observations, including the apparent concentration of anomalies antipodal to the youngest and largest impact basins, suggested that transient magnetic fields associated with impact processes may have been responsible for imparting some or all of the crustal magnetization.

During the last 10 years, laboratory paleomagnetic analyses of returned samples have improved substantially, leading to two main conclusions: (a) at least some mare and highland igneous samples acquired their primary magnetization via thermoremanence, requiring slow cooling in a steady magnetic field; and (b) the magnetizing field for such samples with ages between ~ 3.56 and 4.25 Gyr had amplitudes in the range of several tens of μT, up to 60-80 μT [2,3,4].

From an orbital standpoint, the most important new development during the last 10 years has been the gradual realization that at least one class of crustal anomalies almost certainly requires a former core dynamo. These are anomalies within the rims of large impact basins such as Moscoviense and Crisium [5,6]. The sources of these anomalies most probably consist of impact-produced melt that was heated to high temperatures following the impact and required long time periods (up to 1 Myr) to cool through the Curie blocking spectrum. The long cooling timescale requires a steady, long-lived ambient magnetizing field, i.e., a core dynamo field.

Remaining Issues: Several important issues relating to the crustal magnetism are not yet resolved. These include (but are not limited to): Origin of strong anomalies in the lunar highlands; origin of the lunar swirls; reliability of inferred paleomagnetic pole positions; and history of the former core dynamo.

As of 2006, the leading hypothesis for the origin of strong anomalies in the highlands was that the sources consist of impact basin ejecta deposits. This hypothesis stems from surface observations of strong magnetic fields at the Apollo 16 landing site, which is dominated geologically by the Cayley Formation, a smooth plains unit with an impact basin ejecta interpretation [7]. Statistical studies of the Lunar Prospector electron reflectometer data showed that the Cayley Formation is the single geologic unit that correlates best with surface field strength on the near side [8].

Since 2006, alternate hypotheses have been advanced, including that the sources consist of ejecta from an iron-rich asteroid that produced the South Pole-Aitken basin [9] or that they consist of magnetized subsurface dike swarms that fed mare basalt patches emplaced within the SPA rim [10]. On the other hand, further evidence in support of the ejecta model and for the concentration of anomalies antipodal to young impact basins has also been presented [11].

Current work focuses on investigation of paleomagnetic pole positions [12,13] and on providing macroscopic evidence in support of sample data for the history of the former core dynamo [14].

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