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Constraints on lunar dynamo mechanism for interpreting lunar-wide magnetic field

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Moon, once considered an in-active celesitial body, surprisingly showed evidences of magnetized crust in satellite and returned samples from Apollo mission. Several mechanisms have been suggested in the past for the origin of the lunar magnetization, but the origin of the magnetization remains unknown. Among the suggested mechanisms is the paleo lunar dynamo, i.e. the crustal magnetization was acquired in an internal magnetic field generated by a dynamo once operated in the lunar core. A key for this to work is that the generated field strength should be sufficient to explain observations. The paleo field strengths from the past paleomagnetic measurements of returned samples show that they vary from different sample sites, ranging from 33.3 ($\pm$8.18) to 5430 ($\pm$1330) nT. Results from the satellite data are more than an order of magnitude weaker than those from the samples. The dynamo field strength could be significantly weaker. Simple envelope estimation of magnetic induction can lead to the necessary condition for a dynamo is magnetic Reynolds number $\geq$ 10, which is approximately two orders of magnitude smaller than that estimated for the Earth's core. Our estimation with a strong-field lunar dynamo suggests that the field strengths are between 155 and 700 nT, depending on the lunar core size. This estimation is consistent with more recent results from paleomagnetic analysis of Apollo sample (76535) which provides paleointensity of the Moon to be at least 300 to 1000 nT.