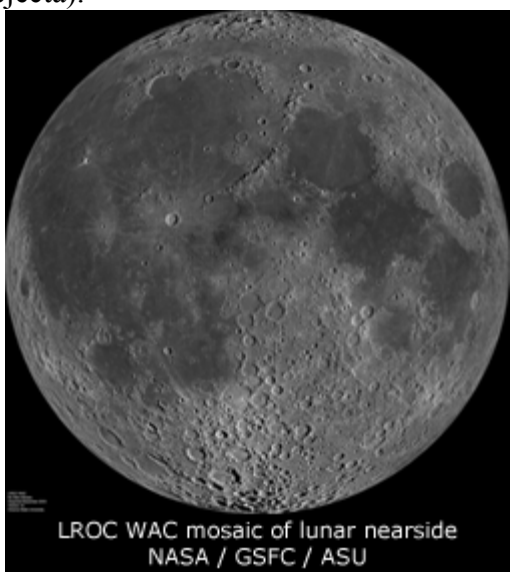
PLANETARY SCIENCE RESEARCH DISCOVERIES
CosmoSparks
Quick Views of Big Advances

Lunar Rock Densities

Robust geophysical modeling of the Moon requires accurate measurements of the ***density*** and ***porosity*** of lunar rocks. Apollo-era density measurements yielded errors of 2–5% or more, or had no reported uncetainty, and few of these reports included porosity measurements. To improve the situation, a team of scientists has been obtaining new measurements of density and porosity of lunar samples based on non-destructive, non-contaminating methods perfected by Consolmagno and Britt in the late 1990s on meteorites in the Vatican meteorite collection. Recent studies by Walter Kiefer (Lunar and Planetary Institute, Houston), Robert Macke (previously at University of Central Florida and now at Boston College), Daniel Britt (University of Central Florida), Anthony Irving, (University of Washington), and Guy Consolmagno (Vatican Observatory) show results for 13 samples that include all three major lunar rock types (seven ***mare*** basalts, four ***feldspathic highlands*** rocks, and two ***breccias*** from imapct basin ejecta).



The seven mare basalts range in grain density from 3270±10 to 3460±50 kg/m^3. These lunar basalt densitites are larger than for terrestrial basalts, which reflects the much higher abundance of FeO in lunar basalts. For a typical lunar mare porosity of ~7% (range 2–10%), the bulk density (the relevant parameter for gravity models) ranges from 3010±40 to 3270±50 kg/m^3.

The four feldspathic highlands rocks range in grain density from 2840±10 to 2910±10 kg/m^3 with porosity ranging from 2–11%; the bulk densities range from 2510±20 to 2840±40 kg/m^3.

Grain densities of the two impact breccias are 3030±30 and 3050±10 kg/m^3. Porosity ranges from 17–22%. Bulk densities range from 2360±40 to 2520±30 kg/m^3.

The new data were collected from Apollo samples as well as (the more globally representative) lunar meteorites; the full table appears in the published paper. Though this sampling database is still small, the researchers are continuing their laboratory work and have ideas to combine the measurements with remote sensing data to estimate densities for rock units on the Moon not yet sampled. Differences in the density of lunar rocks (both surface and subsurface) and topography correlate with variations in gravitational field. So the improved rock density data are a boon to geophysicists interpreting gravity data, such as the high-resolution, high-accuracy datasets being acquired by the current NASA ***GRAIL*** mission.

For more:

· Kiefer, W. S., Macke, R. J., Britt, D. T., Irving, A. J., and Consolmagno, G. J. (2012) The Density and Porosity of Lunar Rocks. *Geophysical Research Letters,* v. 39, L07201, doi:10.1029/2012GL051319. [***NASA ADS entry***]
· ***NASA GRAIL Mission*** (Gravity Recovery and Interior Laboratory) homepage.

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