L13 The maria < hotspot basalts >

The cold star-bane has cloven and rent their hearts in twain / and dead is all their human truth.
—William Butler Yeats.[1]

The maria are the relatively smooth, little cratered, lunar lowlands, seen against the blackness of space as grayish areas in the brighter regions of the terrae where sunlight brilliantly illuminates Moon's surface (which has the overall reflectivity of a lump of coal that reflects 7% of sunlight).[2]

The maria formation, which is the rock of the maria, is made of fissure-erupted plateau basalts composed of the minerals pyroxene, plagioclase, and olivine. The maria formation occupies lowlands, which are giant impact craters that arriving planetesimals punched out of the igneous terrae-crust soon after it had solidified.

The youngest basalts are in the middle of maria. Successive basalt flows can be distinguished where the younger of these do not completely cover over the older. Younger flows are less cratered than are the older ones. The basalt exposures are typically concentric rings of increasing age outward. The weight of younger basalt flows caused the older to subside,[3] in places to depths of as much as 4 km.

Individual basalt flows photographed in section in Hadley rille, have thicknesses of less than a few hundred meters each but by the way they mask over topographic features that are projectionable into their areas, their stacked thickness is 1-2 km. Radiometric dating of *Apollo*-returned lunar rocks has determined that the maria basalt outpourings continued episodically for 700 million years and began 3.8 Ga (although some basalt fragments of like composition in highland breccias date 4.3 Gy).

The maria rocks are volcanic outpourings of basalt magma produced by hotspot partial melting of Moon's mantle. No maria occur on Moon's farside.[4] This was unanticipated and was revealed by photography. There, where terrae crust is thick, molten basalt did not have the buoyancy to rise passively through it. This is shown by two giant basins carved by impacts on the farside which do contain "ponds" of erupted basalt—much younger (by their sparse cratering) than the containing craters. Evidently, the great impacts into the highlands that formed the lowlands did not generate the basalt lava.[5] Also, basalts were not supplied uniformly to Moon's farside, for regions of extremely thin crust there are not breached by maria basalts. ❑

Figure L16.1 [1]

Growth-increments in stromatolites and tidal rhythmites are found to record that the number of days and months in a year were more the further one goes back in time. The logarithmic curve fitted to the data is, as a first approximation, a straight line back to 2 Ga, but for older times it must flatten or, shortly before, Moon could only have been fragmental due to tides stronger than rock strength and, as Moon's terrae crust crystallized 4.5 Ga, this was not so.