Distribution of Lunar deep Quakes revisited

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The lunar seismicity data, as collected by the Apollo seismic experiment in the years 1969-77, contain about 7000 events that were identified as deep moonquakes, presumably originating at depths between 700 and 1000km. These moonquakes are observed to occur in about 250 distinct "nests" which repeatedly release seismic energy (Nakamura, 2004). As the spatial distribution of the nests may reveal important information on the properties of the Lunar deep interior, there is considerable interest in the estimates of the nest locations. However, due to the high complexity of the lunar seismograms, arrival time readings often have uncertainties of tens of seconds. The resulting confidence limits of the spatial distribution of hypocenters have rarely been fully adressed by previous workers.

We have applied a new location scheme that focuses on the uncertainty of locations instead of the best fitting solution, and is thus able to reveal the trade offs between all four hypocentral coordinates. This method does not need precise arrival times but deals with time intervals that are defined such that the arrival is certainly contained within the interval, but not necessary at its middle (contrary to the common assumption of gaussian errors). It is then possible to determine a volume within the moon that certainly contains the hypocenter. This is done using a search on a locally adaptive icosahedron grid, and is thus a fully non-linear method.

Considering the spatial distribution, a far side origin cannot be ruled out for some of the event clusters. Some of the focal depths reported earlier turn out to be only poorly constrained by the data, as the relocation reveals considerable depth uncertainties, or significant deviations from earlier locations.