# A New Hypothesis of Moscoviense Basin Formation: Double Impact Formation

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Selenodetic observations of the SELENE (Kaguya) mission provided us with globally accurate lunar gravity model[1] and high resolution lunar shape model[2]. Using those models, lunar crustal thickness model was also improved[3]. Recently, many studies, focused on interior structures of lunar impact basins, are conducted.

The Moscoviense basin is a mare-filled multi-ring basin located north-western lunar farside, and has the highest Bouguer gravity anomaly[1] and the thinnest crust on the Moon[3]. Because of ring offset and innermost partial ring (Figure 1), the Moscoviense basin formation was thought as an oblique impact. Comparing with the Freundlich-Sharonov basin (normal impact origin), the Moscoviense basin has a larger mantle plug than that of the Freundlich-Sharonov basin (Figure 1). Pre-impact depth of the Moho and outermost-ring size of both basins were almost the same (Figure 1), so the difference in mantle plug is probably due to the size of excavation. However, the excavation depth of an oblique impact is shallower than that of a normal impact. The large mantle plug of the Moscoviense basin is therefore hard to explain by a single oblique impact. We propose a new hypothesis for the Moscoviense basin formation, which is called "double-impact formation"[4]. This new hypothesis can explain offset of ring structures as difference of impact locations of first and second impact, and large mantle plug as a result of two-times of dynamic uplift process by first and second impact. The probability of occurence of double impact basin is about 50% for the Moscoviense basin case (Figure 2). This probability is not so small as to reject a double impact origin of the Moscoviense basin.

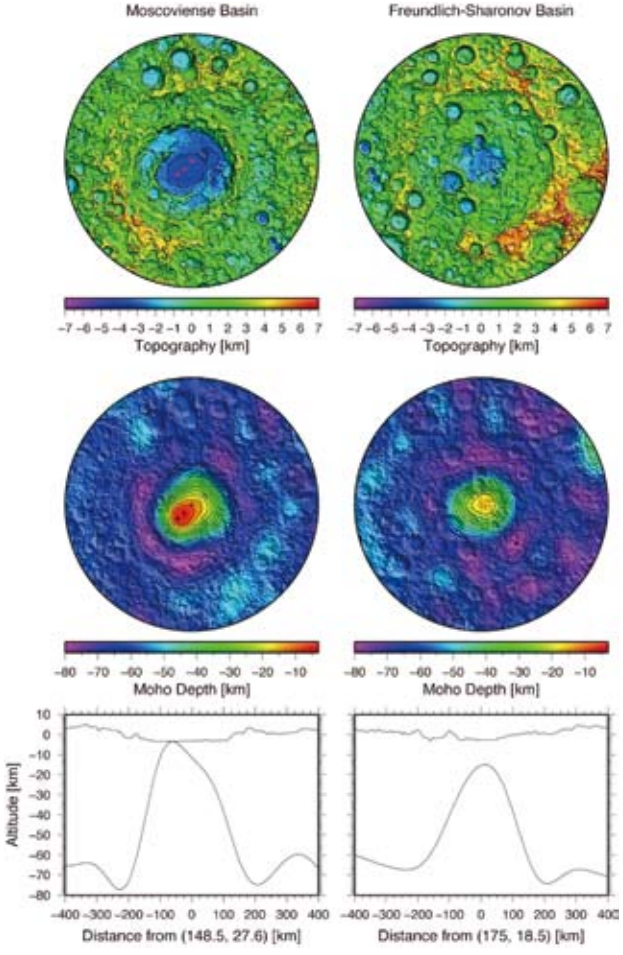


**Figure 1**: Topography (top), Moho structure (middle), and profiles (bottom) of the Moscoviense basin (left) and the Freundlich-Sharonov basin (right).

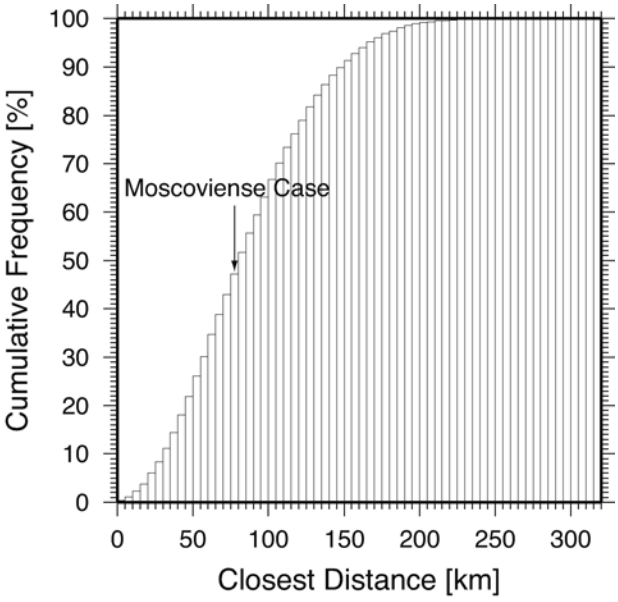


**Figure 2**: Cumulative frequency of the closest distance of impact locations for 50 random impact on the Moon. The arrow indicates the distance between the centers of the innermostand ourmost-ring features of the Moscoviense basin (80 km).

## References

[1] Matsumoto, K., et al.: 2010, *JGR*, **115**, E06007.
[2] Araki, H., et al.: 2009, *Science*, **323**, 897.
[3] Ishihara, Y., et al.: 2009, *Geophys. Res. Lett.*, **36**, L19202.
[4] Ishihara, Y., et al.: 2011, *Geophys. Res. Lett.*, **38**, L03201.