Morphological and spectral analyses of large lunar craters

Naru Hirata[1]; Junichi Haruyama[2]; Makiko Ohtake[2]; Tsuneo Matsunaga[3]; Yasuhiro Yokota[2]; Tomokatsu Morota[2]; Chikatoshi Honda[4]; Yoshiko Ogawa[3]; Takamitsu Sugihara[5]; Hideaki Miyamoto[6]; Hirohide Demura[1]; Noriaki Asada[1]; Haruyama Jun-ichi LISM Working Group[7]

[1] Univ. of Aizu; [2] ISAS/JAXA; [3] NIES; [4] JAXA; [5] CDEX, JAMSTEC; [6] The University Museum, Univ. Tokyo; [7] -

We investigated large lunar craters including Tycho (D = 85 km) with KAGUYA/LISM data to reconstruct impact events forming the craters from distributions of its ejecta and other associated features. The non-radially symmetric distribution of the ray system of Tycho is widely accepted as a piece of evidence that it was formed by an oblique impact in the east-to-west direction. Several researchers described other morphological features of Tycho with data from previous missions or projects, and discussed relationships between them and effects of the oblique impact. Although their conclusions are generally consistent with a oblique impact from west to east, some of them show inconsistency between observed alignments of crater features and the proposed impact direction. A group of researchers pointed out that slumping structures on the inner wall are most developed in the uprange direction, but the maximum slumping structure isn't found in the western inner wall, but in the southwestern inner wall.

Our extensive analyses on Tycho reveals that there are three axes of symmetric distributions of the ejecta units and other features associated with Tycho: an east-west axis for the distal ejecta, the ejecta blanket and the melt ponds; a north-south axis for the small melt ponds, the flow ejecta and the crater floor; and a southwest-northeast axis for the forbidden zone of the melt ponds, the inner wall slumping and the central peak. The first axis is the dominant one, and its associated features are ejecta at the early stage of impact cratering. As effects of an oblique impact should dominate more strongly in the earlier stage, the impact that formed Tycho is surely an oblique impact from west to east. The rest two axes would reflect other factors, such as the pre-impact topography or subsurface structures are possible. Similar analyses on other lunar craters will unveil whether these trends are common for all lunar craters formed by oblique impacts.