Crater features on the Elysium Planitia and its relationship to the subsurface permafrost layer on Mars

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We see many surface features on Mars which would be closely connected with the subsurface permafrost layer. The polygonal fractures and the possible thermokarsts observed on the martian surface are analogous to the terrestrial features located on the permafrost region. Many observational facts suggest the existence of the permafrost layer on Mars, which is almost a general agreement now. The traces of erosion and/or sedimentation with water or its mixture would also be connected with the aquifer or the meltwater of the permafrost. In this presentation, we take up the rampart/double lobes craters for discussion.

The rampart/double lobes craters are such craters as have plural ejecta-petals ending with ramparts. The colony of petals forms one lobe. The rampart/double lobes craters are common on Mars. It is generally assumed that they are formed at the impact, excavating the ground so that the ejecta should be mixed with the subsurface volatile such as water and flow on the ground. It is quite probable that the process would strongly be controlled by the existence of the underground permafrost. However, almost no estimation has been made so far for the quantity of the volatile elements nor their distributions. The forming process of the rampart/double lobe craters would be still under veil. There still remains the possibility that the martian atmospheric structure should play a critical role in forming these craters.

We watch the western region of the Elysium Planitia, ranging 225-275 west and 30-45 north. The typical polygonal fractures are commonly observed and the place is one of the lowest lands on Mars. The existence of permafrost layer is quite probable here. Above all, a large number of rampart/double lobe craters are observed in this region with quite clear shapes and well-developed lobes.

We make the database of the morphology (height/thickness, volume, lobateness) of such craters using the MOLA (Mars Orbiter Laser Altimeter) data for this region. The craters observed here should range from a few to about 70 km in diameter and the total count is about 300. We must pay attention especially to the outer lobe for each crater because it shows the most flow-like features in the whole parts of one crater. The formation should be connected with the subsurface volatile elements.

The correlation of the morphology with the cavity diameter is quite interesting and important. Based on the observational data, we discuss the potential role of the subsurface volatile elements, connecting with the crater formation on Mars. We also try another analysis such as the measurements of the radial ray and albedo.

We think the starting area of the impact ejecta might contain the hydrothermal minerals. The interaction of ejecta with volatile at high temperatures in impact events could possibly generate such minerals. We search for the freshest crater to propose it as one of the observational targets for the Nozomi and MEX missions, both of which should substantially start from this year.