RIM MORPHOLOGY OF THE KÄRDLA CRATER BASED ON REFLECTION SEISMIC INVESTIGATIONS.

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Introduction: An impact into a shallow sea during the Late Ordovician produced the Kärdla crater. The 4-km crater formed in the crystalline rocks that were covered by about 150 m thick layer of primarily siliciclastic rocks and sea water [1]. The post-impact marine sedimentation buried the crater causing its good preservation. The target plane is presently at about 80-100 m depth.

Drilling and gravity data have revealed that the crater's rim is not uniform. There are places where the rim is high (Paluküla in NE, Tubala in SW, Kärdla in NW) and where crystalline rocks have been found at a depth of few tens on meters, i.e. about 200 m above the pre-impact basement level. The Paluküla hill has been extensively drilled and well studied, but the other two are smaller and not so well defined. There are also places where the rim height is moderate or low. It has been proposed that the lows of rim in the north and in the south are gullies that were eroded by the seawater, which surged back into the crater soon after its formation [2]. However, drilling and gravity data allow to speculate that erosion of rim was widespread and not limited only to the above-mentioned gullies. We performed reflection seismics on more than 10 rim crossing profiles with the aim to study its morphology in more detail.

Methods: Reflection seismic investigation was performed using 24-channel Summit CU seismometer. 40 Hz geophones were used either as groups of 5 or as single geophones with 10 m separation. An 8-kg sledge hammer source was applied inline with offsets up to 360 m to the closest geophone or geophone group. Usually vertical stack of 20 (15-30) was used in order to improve signal to noise ratio.

Seismic data were processed with Seismic Unix and processing flow included muting of surface waves, static corrections, bandpass filtering, trace balancing, velocity analysis, NMO, residual static corrections, stacking and trace mixing.

Results: Seismic profiles agree with the drilling data showing also that the rim of crystalline rocks is not morphologically uniform. In the northeastern segment at Paluküla the rim is higher than elsewhere rising more than 200 m above the basement level in surrounding area (210-220 m bsl). The rim is wide both at its base and top. The seismic profiles are in a good agreement with the extensive drilling data.

In the eastern segment, southward of previous, but still on the Paluküla hill, the rim becomes less prominent and shows signs of collapse. There are inward dipping reflectors within the crystalline rocks and the rim may have several peaks.

In the southeastern segment the rim is lower and may have several peaks. In addition to collapse features, the rim seems to be strongly eroded as well.

In the western segment the crystalline rim is relatively low, usually with relative altitude of less than 100 m. However, some profiles suggest that the crystalline basement is raised over a considerable distance.

Discussion and conclusions: The rim morphology indicates that the rim was not formed uniformly and this has lead to differential erosion by resurging sea. In the northeastern segment the rim has remained high because it has not collapsed as much as elsewhere. However, in other parts the rim is lower and thus more easily erodable. The variations in the rim morphology can be attributed either (1) to the oblique impact with the projectile coming from the northeast or (2) differences in the properties of the crystalline target.

Lowering of crystalline rim by its collapse created favorable conditions for a widespread erosion, which is not limited to the previously proposed resurge gullies in the north and in the south.

References: [1] Puura V. and Suuroja K. (1992) *Meteoritics, 216,* 143–156. [2] Suuroja K. et al. (2002) *Deeap Sea Research II, 49,* 1121-1144.

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