CENTRAL UPLIFT FORMATION IN COMPLEX IMPACT CRATERS – COMPARISON OF LUNAR AND TERRESTRIAL CRATERS. C. Koeberl[1] [1]Department of Lithospheric Research, University of Vienna, Althanstrasse 14, 1090 Vienna, Austria (e-mail: christian.koeberl@univie.ac.at).

Introduction: The exact mechanism of the formation of central peaks and central uplifts in impact structures is still not clear. On Earth, most craters are either deeply eroded or covered, and thus not accessible or not in pristine condition. A high resolution study of lunar craters woulkd be highly desirable to provide data on structural elements of central uplifts of iimpact craters of various sizes.

Complex craters: Impact craters (before post-impact modification by erosion and other processes) occur on Earth in two distinctly different morphological forms – simple and complex craters (the exact change-over diameter between simple and complex crater depends on the composition of the target). On the Moon the changeover diameter is at about 15-20 km crater diameter, and very large craters are multi-ring basins, which are rare on Earth.

Complex craters are characterized by a central uplift. Craters of both types have an outer rim and are filled by a mixture of fallback ejecta and material slumped in from the walls and crater rim during the early phases of formation. Such crater infill may include brecciated and/or fractured rocks, and impact melt rocks. Fresh simple craters have an apparent depth that is about one third of the crater diameter. For complex craters, this value is closer to one fifth or one sixth. The central structural uplift in complex craters consists of a central peak or of one or more peak ring(s) and exposes rocks that are usually uplifted from considerable depth.

Uplift Formation: The formation of the Major readjustments of the transient cavity occur for the formation of complex craters, while the bowl-shaped transient crater is quasi not modified in the case of simple craters. Two competing processes act during the modification stage; downward-directed gravitational collapse of the inner rim and uplift of the transient crater floor. The initially steep walls of the transient crater collapsed under gravitational forces forming characteristic terraces. Concerning the development of the central uplift, the formation is thought to occur by displacements along faults as a brittle component in the case of moderately sized impact structures (such as for Bosumtwi, see below), whereas in the case of larger impact structures central uplifts involve fluidization and/or large differential movements of target blocks.

A Terrestrial Example: Recent work in our group [1] characterized the shock wave attenuation in the uppermost part of the central uplift of the Bosumtwi impact structure, a moderately sized (10.5-km-diameter) and well preserved complex impact structure that was recently the target of a multidisciplinary and international drilling project. The data acquired in the couse of the drilling, the related geophysical (e.g., seismic) investigations, and subsequent drill core studies were used by [1] to reconstruct the original position of the sampled section in the target prior to crater modification. This was done by combining petrographic investigations (at the micro-scale) with modeling of inelastic rock deformation (at the meso-scale) and modification processes during uplift (at the mega-scale). This approach allowed to constrain shock wave attenuation and rock deformation during central uplift formation. An example is given in Fig. 1.

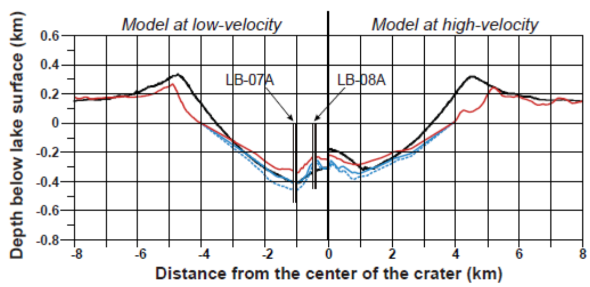

Fig. 1. Model crater profiles (black; using ANEOS granite equation of state for target and projectile) versus observed (i.e., actual) crater profile (red and solid blue lines for the apparent and true crater profiles, respectively, and dashed blue line for the lower limit of the monomict impact breccia).

Only few craters on Earth have been studied by this method. Our results imply that for moderately sized impact craters, the rise of the central uplift is dominated by brittle failure, whereas in the case of larger impact structures, and also depending on rock proprieties, the uplifted, relatively stronger shocked rocks may behave in a more ductile manner.

I am proposing a detailed photogeological study of a series of relatively fresh lunar impact craters near the simple/complex changeover, and of large (100-km-diameter-range) craters to determine of the block-uplift (brittle failure) vs. fluidization models can be distinguished. This would also have important implications for the understanding of impact crater formation in different types of target rocks, especially as a result of layering in the target.

References: [1] Ferriere, L., Koeberl, C., Ivanov, B., and Reimold, W.U. (2008) *Science 322,* 1678–1681.