COMPLEX CRATER FORMATION: VERIFICATION OF NUMERICAL MODELS. B. A. Ivanov, Institute for Dynamics of Geospheres, Russian Academy of Sciences., Leninsky prospect., 38-6, Moscow, 117334, Russia (baivanov@onlime.ru, ivanov@lpl.arizona.edu).

Introduction: The growing capability of modern computers offers increased possibilities for numerical modeling of impact crater formation. However, complex crater formation include various particular models of rock massifs dynamical behavior in a wide range of thermodynamic parameters and strain rates. At the same time geological and geophysical investigations of impact craters give only the final structure of craters and geophysical fields around. The verification of numerical models should take into account comparison of computed results with maximum possible set of observational data.

Ground truth: The list of parameters one should compare includes crater morphology and morphometry, deformation of stratigraphic layers and their structural uplift; impact melt volume; shock wave decay; geometry and size of fractured zone, and individual specific features available for some terrestrial craters (presence of tektites, evidences of underwater formation etc.).

Primary experience: The list of recent publication gives an impression about strong and weak topics in the current state of model's verification.

Crater morphology and morphometry.. Models for many craters has been published, however rare papers deals with a systematic investigation of a crater shape in a wide range of crater diameters with the *same model*. A good example is done in [1] where the depth/diameter relation bend is reproduced qualitatively for the moon, Earth and Venus. However, quantitative fit of models to measurements is still an open question.

Deformation of stratigraphic layers and their structural uplift. First attempts to compare models for specific craters has been published for Chicxulub [2] and Puchezh-Katunki [3]. Again, qualitative fit of models is obtained with many quantitative misfits.

Impact melt volume is the best-studied model value [4] ready to be compared with observational data [5]. One can state the good fit of models to field data. The fit demonstrate that current scaling laws allow us to estimate impact energy for a given crater with the accuracy of factor of 2. However, the melt production in oblique impacts is still under investigation [6, 7].

Shock wave decay is easy to get in a numerical model and is very hard to compare with observations: due to a structural uplift formation the final position of shocked rocks are very far from their initial position in a target. Hence only full model of a complex crater modification allow us to verify models with a shock wave decay [3] (Fig. 1).

Geometry and size of fractured zone are just began to be used in model/nature comparisons. Rare papers for several craters has been published (eg. [8]). At the same time namely modeling of a fracture zone allow to compare code results with available gravity and seismic survey. This direction looks like a promising way for future modeling evolution.

Individual specific features for several terrestrial craters allow to verify a complex interaction with layered targets. One can refer for recent estimates of a tektite origin [9] and underwater crater modeling [10]. The modeling of individual specific features is also fast evolving approach to verify numerical models of impact cratering.

Conclusion: Numerical models of complex impact crater formation can be and should be verified by comparison with field geological and geophysical data.

References: [1] Wünnemann, K.. et al. (2002) *LPS XXXIII,* Abstract #1277.. [2] Collins, G. S. et al. (2002) *Icarus 157*, 24-33. [3] Ivanov, B. A. (2002) *LPS XXXIII,* Abstract #1286. [4] Pierazzo E. et. al. (1997) *Icarus 127* 408-423.. [5] Grieve R. A. F. and Cintala M. J. (1992) *Meteoritics 27*, 526–538. [6] Pierazzo E. and Melosh H. J. (2000) *Icarus 145*, 252-261.[7] Ivanov B.A. and Artemieva N. A. (2002) *GSA Spec Paper 356*, 619-630. [8] O'Keefe, J. D.and Ahrens, T. J.(1999) LPS XXX, Abstract #1304. [9] Artemieva N.A. (2002) In *Impact studies*, Springer Verlag, Berlin, pp. 257-276. [10] Ormö, J. et al. (2001) MAPS 36, Suppl. p.A154.

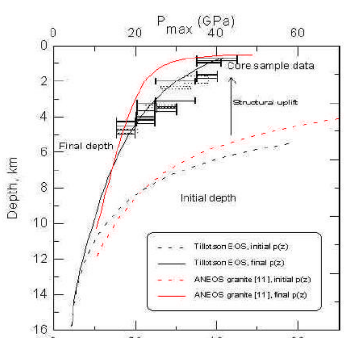

Fig. 1. The apparent shock wave decay with depth along the deep drill hole in the center of the Puchezh-Katunki crater, diameter D~40 km Maximum shock pressures recorded in minerals are shown as error bars. All EOS's used show that the central uplift top is constructed of rocks uplifted from ~6 km depth [3].