JEZERO CRATER, MARS: ESTIMATING THE IMPACT CONDITIONS.

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Introduction: In this work the topic of interest is the estimation of both the impact conditions of the Jezero crater and the possible hydrothermal phases that could have been induced during and after of the impact. This crater with an approximate diameter of 50 km [1], is the landing site for the Perseverance rover of the Mars 2020 mission [1]. The models used here are based on some equations postulated by Holsapple (crater depth) [2], scaling, polynomial analysis, and an adaptation of quantum formalism for the mathematical representation of the energy pulse generated on the impact point, in where besides is used one solution (soliton type) of the Korteweg-DeVries's equation [3].

Results obtained with the models: The formation of this crater is carried out in four stages [4], in which are specified the variables of impact processes more common (here in addition to the use of scaling, both orbital and gravitational factors are considered) as follows: a). Contact/Compression Stage: In this stage the associates variables are estimated as: Diameter of the Impactor ~ 5.34 km ; Velocity of Impact ~ 7.07 km/s ; Impact Angle ~ 70.35° ; Density of the Impactor ~ 1.10 g/cm^3 ; Crater Depth (before sediment entry) ~ 3.67 km [2] ; Melt Volume ~ 204.47 km^3 ; Total Energy of Impact ~ 2.20×10^{28} Erg (~ 5.23×10^5 megatons) ; Pressure to 1 km of the Impact Point is ~ 190.67 Gpa ; Seismic Shock−Wave Magnitude ~ 11.03 (according to Gutenberg−Richter's law, 1956). b). Modification/Excavation Stage: In this stage the associates variables are estimated as: Diameter of Transient Crater ~ 31.87 km ; Number of Ejected Fragments ~ 5.33×10^9 ; Average Size of the Fragments ~ 12.51 m ; Average Density of Fragments ~ 2.46 g/cm^3 ; Minimal Distance of Ejection of the Fragments ~ 163.92 km ; Velocity of Ejection ~ 1,217.23 m/s ; Minimal Angle of Ejection ~ 12.12° ; Minimum Height of Ejection ~ 8.8 km. c). Collapse/Modification Stage: In this stage the pressure toward the final crater rim decrease to ~ 0.31 Gpa. d). Final Crater Stage: And in this stage the associates variables are estimated as: Relation Between the Transient Crater and the Final Crater ~ 0.64 (value that is in accordance with the specification realized by Bevan French [4]) ; Time of Creation for the Final Crater ~ 57.20 s (according to Schmidt and Housen [2]) ; Hydrothermal Zone could spread from ~ 419 m to ~ 15.94 km from the nucleus of impact, i.e., a Hydrothermal Band of ~ 15.52 km ; Lifetimes for this Hydrothermal Band from ~ 0.52 Ma to ~ 0.81 Ma, with uncertainties of ~ (+/-) 1.15 % to ~ (+/-) 3.30 %, i.e., from ~ (+/-) 0.01 Ma to ~ (+/-) 0.03 Ma ; Hydrothermal Temperatures from 0.25 years to 1,400 years after of the impact, from ~ 451.35 °C to ~ 13.47 °C (without considering environmental conditions external to the crater).

Discussion: 1.) In relation to the calculated hydrothermal band, there are two study intervals to consider: i). Highest probability interval, which establishes the range from the point of impact with the highest possibility of finding traces of hydrothermal activity on the crater floor. This interval only shows a probability band, therefore it does not guarantee total certainty, and is expressed as: $HB_{(MAXIMUM)} \in$ [419 m, 15.94 km]. ii). Least probability interval, which establishes the range from the point of impact with the least possibility of finding traces of hydrothermal activity on the crater floor. As in the case shown in (i), here we also have a probability band that does not guarantee total certainty, and is expressed as: $HB_{(MINIMAL)} \in$ [impact point, 419 m [. 2.) In relation to the residual heat linked to the possible hydrothermal temperatures within the interval [0.25 years; 1,400 years], we can describe the following: i). 200 years after the impact, residual temperatures are estimated to be between 340.66 ° C and 341.9 ° C, indicating a possible link to a katathermal period. ii). In the same way, 1,400 years after the impact, residual temperatures are estimated between 176.91 ° C and 181.36 ° C, possibly linked to an epithermal period. 3). Additional information about the Jezero crater can be found in the reference specified in [1]. 4). Some numerical results were contrasted (for reference only) with the impact calculator of H. J. Melosh and R. A. Beyer, Purdue University [5].

References: [1] Stack K. M. and the Mars 2020 Science Team (2020) *Planetary Geologic Mappers*, Abstract #7017. [2] Holsapple K. A. "*Theory and Equations for Craters from Impacts and Explosions*". [3] Echaurren J. C. and Ocampo A. C. (2003), *Geophysical Research Abstracts*, *EGS-AGU-EUG Joint Assembly*, Vol. 5, 04450. [4] French B. M. (1998) "*Traces of Catastrophe: A Handbook of Shock-Metamorphic Effects in Terrestrial Meteorite Impact Structures*". [5] Melosh H. J. and Beyer R. A., Impact Calculator, Purdue University.