Geophysical Research Abstracts
Vol. 21, EGU2019-11409, 2019
EGU General Assembly 2019

Modeling of the Jezero Crater Delta, Mars

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Jezero crater has been selected as the NASA 2020 rover landing site and our goal is to better understand his tim-ing and duration. We use the model of Kleinhans 2005 to estimate the duration of the Jezero fluvial system and we further test it on well constrained terrestrial cases to assess general validity. We run a number of conditions for the most uncertain and sensitive variables such as grain size and channel width. The channel width, depth and slope can be derived from visible images and digital elevation model. Channel width, depth, slope and other morphological parameters were carefully measured trough HiRISE DEM for the Jezero delta. The model is based on steady and uniform flow equal to the water surface slope and channel bed surface slope. We assume 5 meters water depth and transport of one sediment size whereas in reality there may be a mixture. We modeled several scenarios assuming one grain size per each simulation. It is not possible to determine washload from the capacity predictors because that it is supply-limited, not capacity-limited. The Jezero hydrological modeling done in this work has revealed a com-plex evolutionary basin's history. Nevertheless to constrain the minimum duration of the Jezero lake we made some assumptions and it was not possible to consider the whole 56 km3 eroded (from the whole watershed, not from the observed fan). The estimations were made only for the late-stage, fan formation of ∼5 km3 and putative 15km3. The Kleinhans model uses different parameters: fixed, derived and variable. Fixed parameters chosen using DEMs are: channel width, depth, slope, fan surface, fan volume, eroded sediment valley volume, rim diameter. Derived parameters are: discharge rates estimation (1,800-2,600 m3/s), etc.; water/sediment ratio suspension dominated (∼2000-3000), etc. Variable parameters: various grain size (D50) (fine-sand to cobbles).
The lake filling (phase 1) took few years depending on the channel width and grainsize is not relevant to estimate how much time needed for water basin infilling. The fan formation (phase 2) by continuous flow took hundreds of years varying grain size from gravel to cobble and channel width as well. As best guess we cnsidered grainsize rang-ing between 8 and 14 mm, according with grainsize measured on Mars by rover missions in similar environments. Grainsize (D50) is very relevant to estimate how much time needed for fan formation (factor of 30) more than chan-nel width (factor of 3). This duration corresponds to the minimum duration of the late stage episode, the lifespan of Jezero paleolake may have been longer but geological evidence may be harder to find. Grain size represents a key parameter because the bed load function of Bagnold 1966 and the suspended load functions decrease with grain size due to the settling velocity increase as well as the transport rate. Several authors based their hydrological estimations simply assuming a sediment concentration, instead of sediment load, which is function of the shear stress and that could lead to an incorrect estimate of the duration of the fluvial timing.