



Reconstruction of Callisto's Valhalla basin using n-body and SPH simulations

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Introduction

Valhalla basin

Complex crater

Diameter: ~700km

Ring structure



Questions:

- 1) typical impact velocities and impact angles?
- 2) size of impactor?
- 3) effects of a subsurface ocean on crater formation?

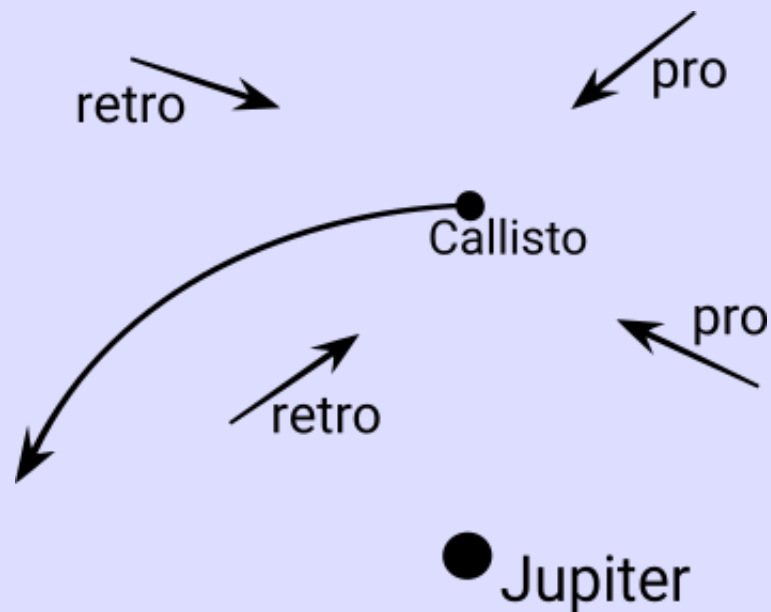
N-body simulations

- Q1) typical impact velocities and impact angles?
- three different approaches:
 - shifting @ Hill sphere of Callisto (A)
 - shifting @ Hill spheres of Jupiter & Callisto (B)
 - genetic algorithm (B)

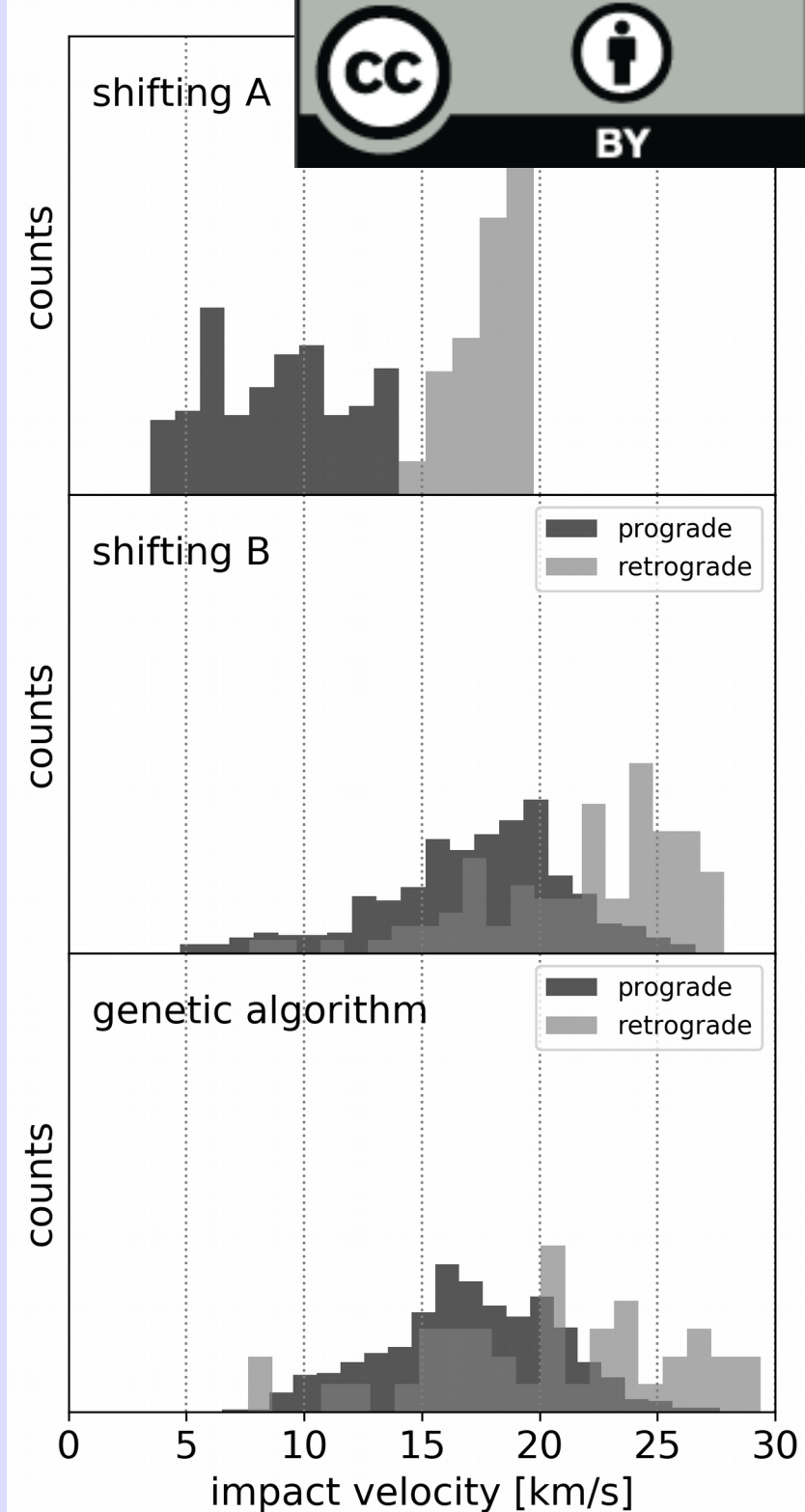
} in progress

parameter space A	parameter space B
$a \sim 5.2 \text{ AU}$ $e < 0.1$ $i < 10^\circ$	$a < 50 \text{ AU}$ $e < 0.95$ $i < 60^\circ$

N-body results



- typical values:
 - impact velocity: 18 km/s
 - impact angle: 40°



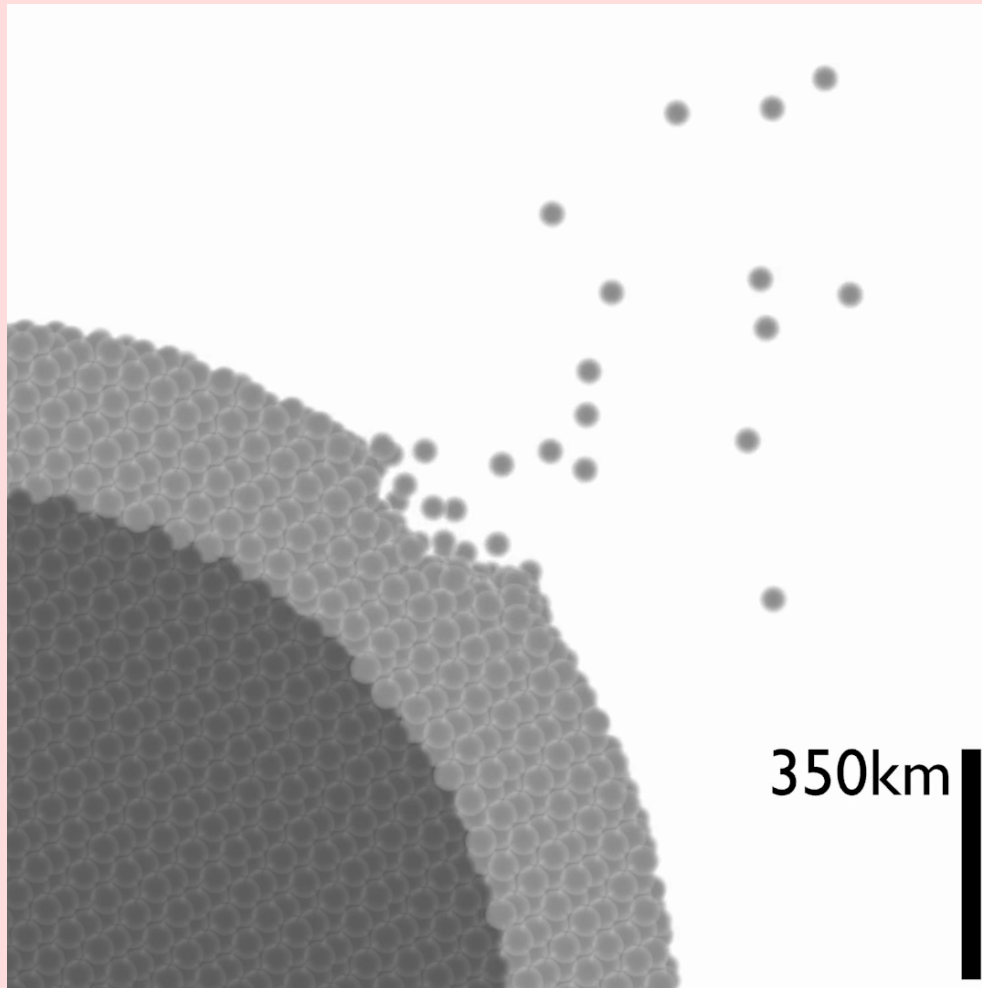
SPH simulations

- Q2) size of impactor?
- Q3) effects of a subsurface ocean on crater formation?
- miluphCUDA (Maindl et al. 2013, Schäfer et al. 2016)
 - modelling solid body physics / elasto-plastic continuum mechanics
 - damage model / brittle failure (Grady & Kipp 1980)
 - Tillotson EOS (Tillotson 1962)

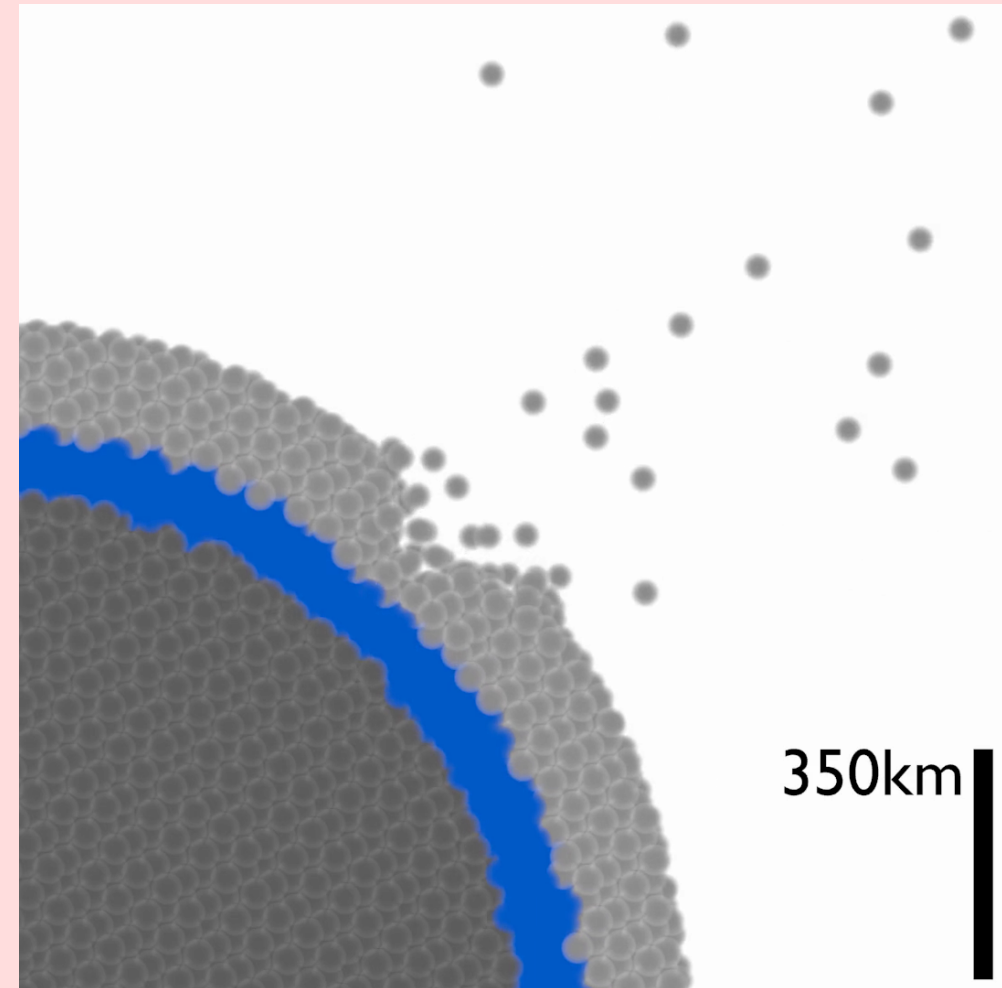
- $v_{\text{imp}} = 18.2 \text{ km/s}$
- $\lambda_{\text{imp}} = 40^\circ$ (0° is head-on, projectile coming from the top)
- $d_{\text{proj}} = 0.15 D_{\text{crater}}$ (with $\rho = \rho_{\text{ice}}$)



no ocean



ocean

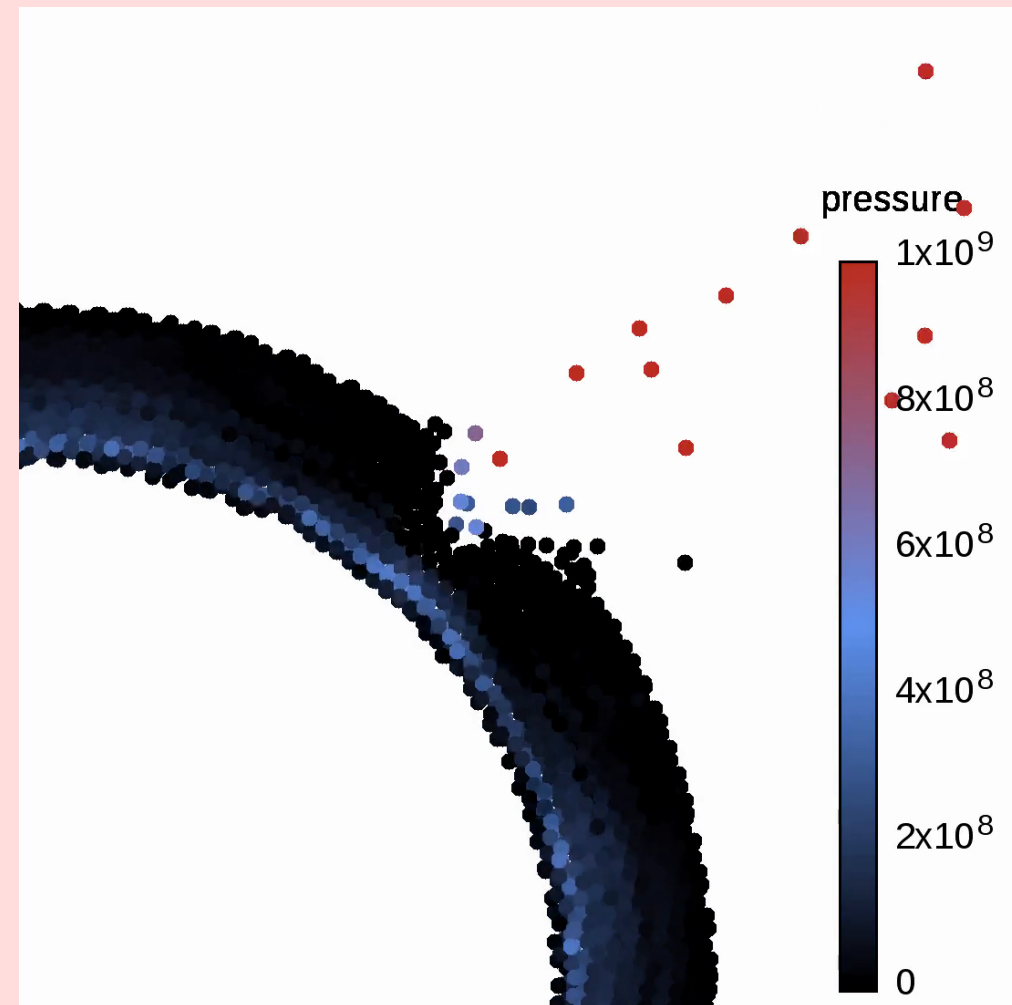
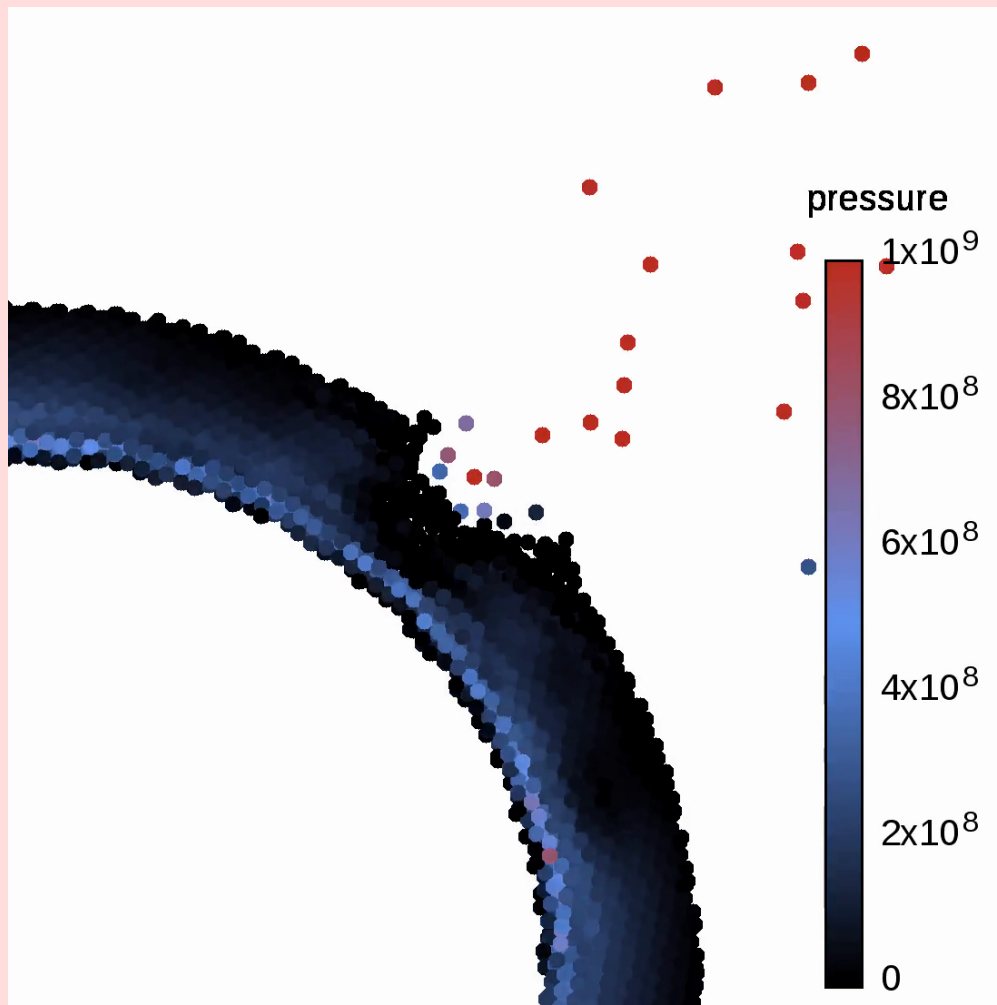


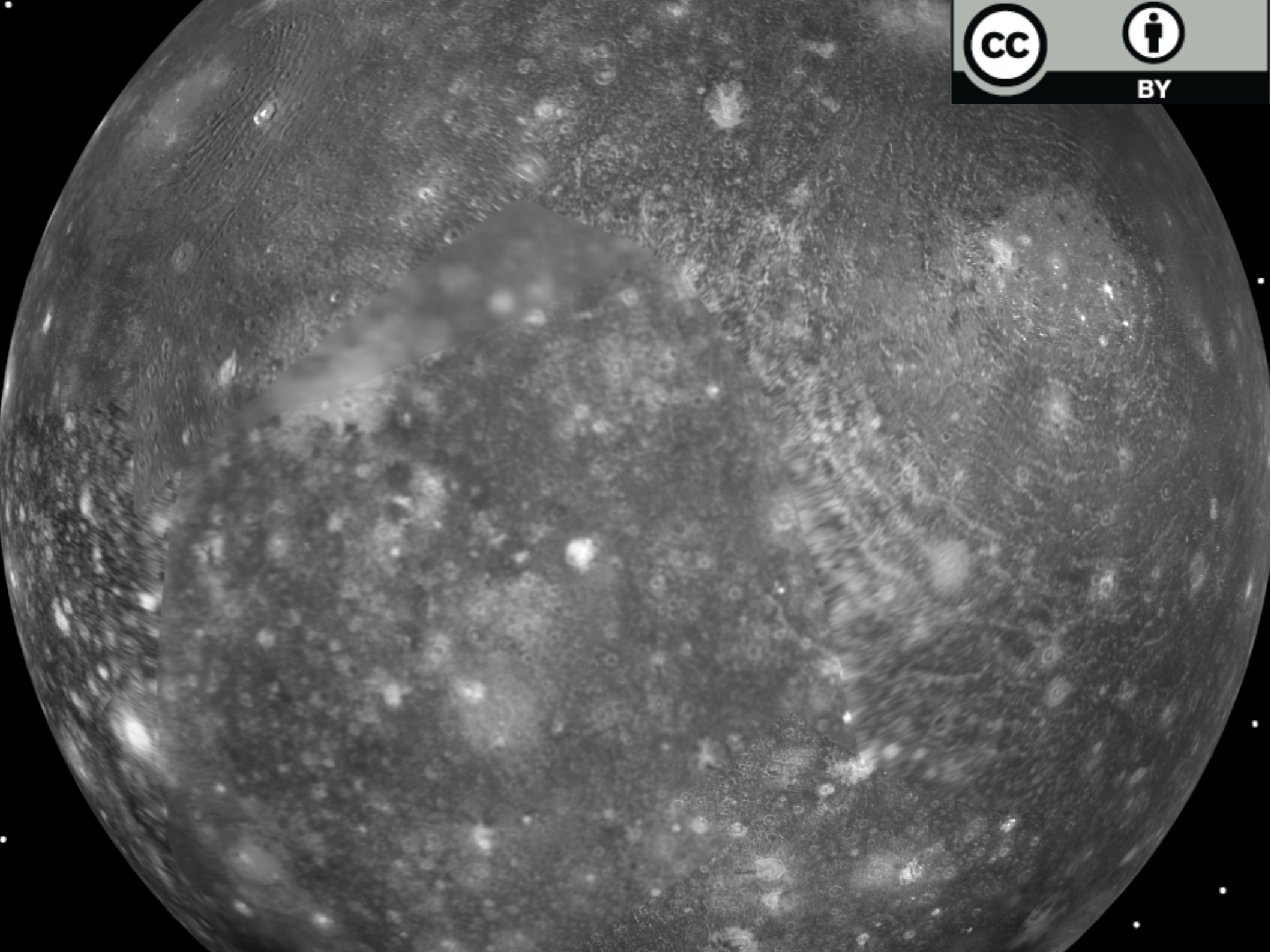
- challenges: resolution & models
- conclusion: different crater formation process?



no ocean

ocean





BY