Activity of Enceladus and proto-Enceladus

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Introduction: Enceladus, a satellite of Saturn, is the smallest celestial body in the Solar System where endogenic activity is observed. Since its accretion, Enceladus has lost about 20% of its mass. This is the base of hypothesis about proto-Enceladus [1, 2]. It means that this satellite should be treated as new type of the celestial body, the body that is losing its mass as a result of internal activity.

Present activity: Activity of Enceladus is concentrated in the South Polar Terrain (SPT). The mass of matter ejected into space by volcanic activity of Enceladus is 200 kg s\(^{-1}\) [e.g. 1, 2, 3]. We have suggested that this mass loss is a main driving mechanism of the present Enceladus' tectonics [1, 2]. Usually the loss of matter from the body's interior (or thermal contraction) lead to global compression of the crust. Typical effects of compression are: thrust faults, folding and subduction [5]. However, such forms are not dominant on Enceladus. We proposed tectonic model that could explain this paradox [1, 2, 5].

Proto-Enceladus: Just after the accretion, Enceladus could be substantially larger. Its radius was \(~300\) km. We refer here this body as proto-Enceladus [2]. Two assumptions could be used for calculation of the size of proto-Enceladus. Both approaches give similar results [2]. Note also possible biological role of proto-Enceladus [6].

Past activity: There are some traces of past activity on the surface of Enceladus [4]. The traces could be interpreted as indication that the past activity was similar to the present one (similar features like 'tiger stripes'), but we do not know how old are these traces.

Model of activity: We found some places where signs of the past activity are observed. However, we need a better model of this activity. The only known type of activity is the center in SPT. Are other forms of activity possible? We uses numerical model to find these other possible forms. Preliminary results indicate some possibility of smaller centers. Calculations indicate also that that the activity could be periodic.
Future activity center: We suggested that ovoid-shaped depression down to 2 km deep, of size 200×140 km with the centre at 200E, 15S is a good candidate for the future center [5]. However, our recent calculations using numerical model are presently inconclusive.

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References
