

An Ocean Below Enceladus' Icy Crust?

- NASA's Cassini spacecraft has observed plumes of material escaping from Saturn's small icy moon, Enceladus
- The plume is mostly water vapor, with tiny ice particles and other gaseous molecules mixed in (e.g. CO₂, CH₄, C₂H₆)
- The plume supplies ice particles to one of Saturn's rings
- Some ice particles contain salt, which may indicate they originate in an ocean deep below the icy crust

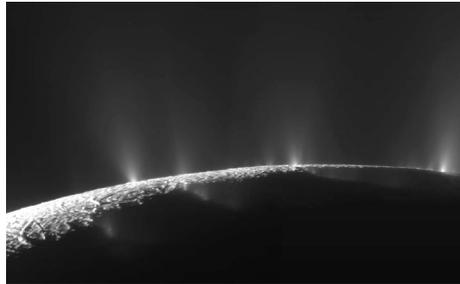


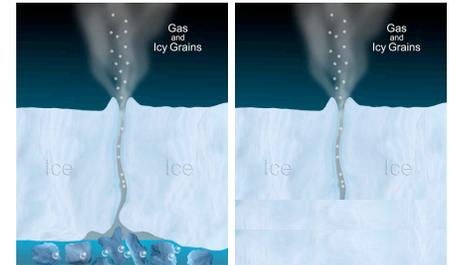
Image mosaic of Enceladus taken by Cassini, showing individual plumes of gas and ice escaping from the surface. The plumes extend 100's of km into space from the ~500 km diameter moon.

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What Process Creates the Plume?

- Plumes may be material escaping through surface cracks from an internal salty ocean or lake
- Alternatively, ice along cracks may sublime or melt, followed by escape of water vapor and icy particles
- Many scientists find the salty ocean model most convincing, but others favor combinations of alternative explanations



Left: Enceladus may have a salty subsurface ocean that releases material to space through cracks in the moon's icy shell. Right: The walls of icy cracks in the surface may melt or sublime, venting gas and icy particles to space.

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The Big Picture

- Enceladus is surprisingly active for such a small body - likely a consequence of tidal heating
- Future flybys of Enceladus by Cassini may help to resolve whether Enceladus joins the growing "club" of solar system bodies believed to have oceans
- If Enceladus has an ocean, then it contains all of the 'ingredients' known to be important for life: liquid water, molecular building blocks, and energy

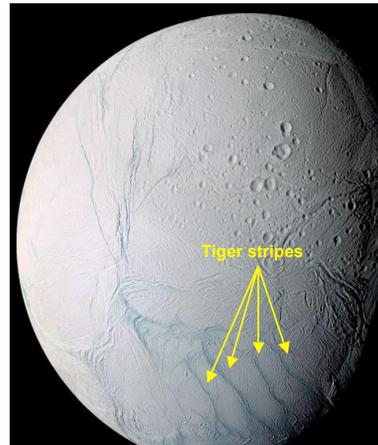


Image of Enceladus showing the 'tiger stripes' region in the southern hemisphere, where the plumes originate

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For More Information...

Press Releases

- Space.com - 06/14/09 - "Ocean Hidden Inside Saturn's Moon"
<http://www.space.com/scienceastronomy/090624-enceladus-ocean.html>

Images

- Enceladus plume image courtesy NASA/JPL/Space Science Institute/E. Lakdawalla
<http://antwrp.gsfc.nasa.gov/apod/ap091124.html>
- Europa plume cartoons adapted from image courtesy NASA/JPL
<http://saturn.jpl.nasa.gov/photos/imagetails/index.cfm?imageId=2944>
- Enceladus image courtesy NASA/JPL/Space Science Institute
<http://saturn.jpl.nasa.gov/photos/imagetails/index.cfm?imageId=2032>

Source Articles (on-campus login may be required to access journals)

- Postberg et al., 'Sodium salts in E-ring ice grains from an ocean below the surface of Enceladus', *Nature*, **459**, p. 1098, doi: 10.1038/nature08046, 2009.
<http://www.nature.com/nature/journal/v459/n7250/full/nature08046.html>
- Schneider et al., 'No sodium in the vapour plumes of Enceladus', *Nature*, **459**, p. 1102, doi: 10.1038/nature08070, 2009.
<http://www.nature.com/nature/journal/v459/n7250/full/nature08070.html>
- Porco et al., *Science*, **311**, p.1393, 2006. <http://www.sciencemag.org/cgi/content/abstract/311/5766/1393>
- Nimmo et al., *Nature*, **447**, p.289, 2007. <http://www.nature.com/nature/journal/v447/n7142/full/nature05783.html>
- Kieffer et al., *Science*, **314**, p.1764, 2006. <http://www.sciencemag.org/cgi/content/abstract/314/5806/1764>

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