Astrobiology News September 2015:
The Ocean of Enceladus

Two years ago, in Astrobiology News for August 2013, I wrote about a proposed mission to the Jovian moon Europa. A major reason such a mission would be of interest is the evidence for a subsurface liquid ocean on Europa. Years before any spacecraft data were available, Guy Consolmagno (who was recently appointed Director of the Vatican Observatory by Pope Francis[1]) suggested that Europa should have a liquid ocean under its surface based on detailed computer models he performed as a graduate student at MIT. Just this month, we learned there is strong evidence that the Saturnian moon, Enceladus, has a warm global ocean beneath its icy crust. These results suggest that some of the natural satellites of giant gaseous planets may provide subsurface environments conducive to life.

More than seven years of data obtained by the *Cassini* spacecraft provide independent lines of evidence that Enceladus (Saturn's 6th largest moon) harbors a subsurface ocean.[2] Icy plumes emerging from fissures near the moon's south pole provided previous evidence of a subsurface body of water. Furthermore, changes in the speed of *Cassini* as it passed through Enceladus' gravitational field during flybys from 2010-2012 suggested the presence of a feature denser than ice but less dense than water below the surface of Enceladus. The most likely explanation, consistent with the observed plumes, is the presence of a subsurface ocean.

The latest results are based on careful mapping of surface features (primarily craters) across hundreds of images that have enabled *Cassini* scientists to measure changes in Enceladus' rotation with high precision. These observations indicate that Enceladus wobbles as it orbits Saturn, to a degree best explained if its outer ice shell and core are not rigidly connected, but separated by a global subsurface ocean. This vast ocean feeds the spray of water vapor, icy particles, and organic molecules erupting from fractures near Enceladus' south pole. Although the mechanisms that may have prevented Enceladus' ocean from freezing are not yet understood, tidal forces from Saturn may be heating the moon's interior to a larger extent than previously thought, and heat provided by ongoing hydrothermal activity may provide an environment suitable for living organisms. On October 28, Cassini will fly through the plumes just 30 miles above the surface of Enceladus, so stay tuned for future surprises from this distant, enigmatic world!

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[1] http://www.catholicnews.com/services/englishnews/2015/pope-names-us-jesuit-to-head-vatican-observatory.cfm

[2] http://saturn.jpl.nasa.gov/news/newsreleases/newsrelease20150915/

In other news, if you haven't yet seen the latest images of Pluto sent back by the *New Horizons* spacecraft, check them out because they are absolutely amazing![3] Also, if you enjoy my brief monthly articles, I encourage you to explore the Adler Planetarium's social media channels, such as #AstroHangout on YouTube.[4] On a final note, I will be giving a presentation entitled *Cosmic Time in "Big History"* at Dominican University in River Forest, Illinois on October 8, 2015. I invite you to check out the details on the web page listed below – perhaps some of you who live in the Chicago area will even be able to attend![5]

Until next month,

Grace

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[3] http://www.nasa.gov/feature/pluto-wows-in-spectacular-new-backlit-panorama

[4] https://www.youtube.com/user/adlerplanetarium

[5] http://events.dom.edu/cosmic-time-%E2%80%9Cbig-history%E2%80%9D