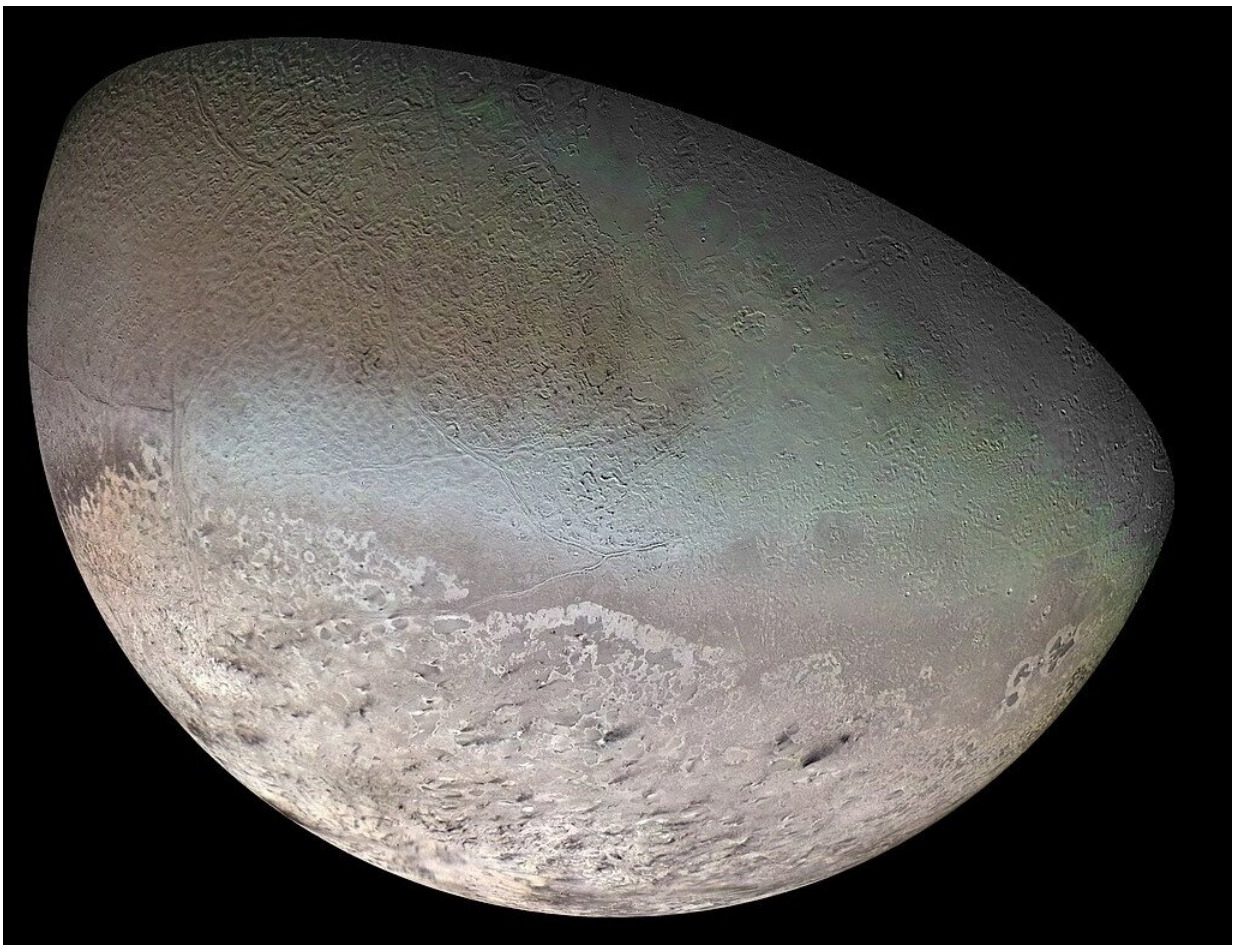
Scientists examine geological processes of Monad Regio on Neptune's largest moon, Triton

January 31 2023, by Laurence Tognetti



Global color mosaic of Neptune's largest moon, Triton, taken by NASA's Voyager 2 in 1989. Credit: NASA/JPL-Caltech/USGS

In a recent study published in the journal *Icarus*, a team of researchers at the International Research School of Planetary Science (IRSPS) located at the D'Annunzio University of Chieti-Pescara in Italy conducted a geological analysis of a region on Neptune's largest moon, Triton, known as Monad Regio to ascertain the geological processes responsible for shaping its surface during its history, and possibly today. These include what are known as endogenic and exogenic processes, which constitute geologic processes occurring internally (endo-) and externally (exo-) on a celestial body. So, what new insights into planetary geologic processes can we learn from this examination of Monad Regio?

"Exogenic geological features, such as glaciers, channels, and coastlines, characterize the bodies of the solar system that possess, or possessed, a dense atmosphere," Dr. Davide Sulcanese, who is a Junior Scientist within IRSPS and lead author of the study, recently told Universe Today. "The surface of Earth, Mars and Titan contains a large variety of similar features. Surprisingly, we observed that even in one of the farthest and coldest bodies of the solar system, the icy satellite Triton, the surface can be reshaped by exogenic processes, including deposition and flowing of ice (though in this case we refer to nitrogen ice)."

"Such exogenic activity has already been observed on another body of the outer solar system, Pluto, where the high-resolution images acquired by the New Horizons spacecraft in 2015 revealed for the first time the presence of active glaciers and dendritic channels on its surface," Dr. Sulcanese continued. "We showed that also the surface of Triton (at least in Monad Regio) could host several ice flow-related features, like glaciers, moraines, ogives, and subglacial channels, that have probably played a fundamental role in the rejuvenation of its surface."

For the study, the researchers created a geomorphological map at a scale of 1:1,000,000 of an extended area of Monad Regio, meaning the measurement of 1 on their map is equivalent to 1 million of the same

measurement on Monad Regio. They then used a combination of images from NASA's Voyager 2, a roughness map of the study area, and a digital elevation model to conduct their geological analysis of the area. Their findings indicate that an endogenic phase is potentially followed by an exogenic phase, which could help explain the surface features we see today.

"Most of the morphologies we observed on Triton are a consequence of the internal geological activity of the moon, like diapirism, explosive events, faulting, cryovolcanism and consequent flow of cryolava," Dr. Sulcanese recently told Universe Today. "However, we infer that after this first endogenic phase, some of these landforms in Monad Regio have been further modified by deposition and flow of solid and liquid nitrogen, forming features strikingly similar to terrestrial glaciers, morains, ogives, channels, and even coastlines." The study notes that while endogenic processes could be responsible for reshaping the surface early in the moon's evolutionary history, it is the exogenic processes that could be responsible for actively reshaping its surface today.

"The almost total absence of craters on Triton denotes that its surface is extremely young, geologically speaking," Dr. Sulcanese recently told Universe Today. "This means that there is some kind of process that modified, or perhaps is still modifying, its surface. While in the south polar region of Triton the reason of such rejuvenation is probably attributable to the active geyser-like plumes (observed by the Voyager 2 spacecraft in 1989), in Monad Regio the cause could be the exogenic processes mentioned above."

NASA's Voyager 2 spacecraft is still the only spacecraft to have visited Neptune and its largest moon, Triton, meaning the only images we have of Triton are over 30 years old, which Dr. Sulcanese informed Universe Today as being "the challenge of this work."

"Still now, the only available information we have about the surface of this satellite derives from these images," Dr. Sulcanese recently told Universe Today. "Many of our findings were made possible thanks to the availability of a digital elevation model (DEM), that we were able to generate here at the International Research School of Planetary Sciences (IRSPS) (University of G. d'Annunzio in Pescara), by applying a technique called photoclinometry. This is to say that, although new space missions are crucial for improving our knowledge of planetary bodies, modern software can help rework old data in a different way and extract new information that was not accessible earlier."

While there are currently no missions slated to return to Neptune, NASA's Neptune Odyssey mission was one of the finalists for a NASA Discovery mission, but it was announced in June 2021 that it was not selected, as two missions to Venus, DAVINCI and VERTITAS, were chosen instead.

More information: Davide Sulcanese et al, Geological analysis of Monad Regio, Triton: Possible evidence of endogenic and exogenic processes, *Icarus* (2022). DOI: 10.1016/j.icarus.2022.115368

Provided by Universe Today