



Representation bias on Mercury

Annie Lennox explores Mercury's craters and volcanic features, and addresses the biases in planetary naming conventions

Q Tell us about your research

Annie Lennox: For geological mapping, Mercury is split into fifteen areas called quadrangles. I've mapped a quadrangle in the south polar region as part of my PhD research. Mercury is an interesting place to study because it's relatively unexplored. There have only been two missions to Mercury: Mariner 10 and MESSENGER. A third mission, BepiColombo, is en route. It launched in 2018 and is due to start orbiting the planet in 2026. My geological map will contribute to a global map that's being compiled to aid the

BepiColombo mission – I've noted areas of scientific interest that could be targeted. I use a combination of various types of MESSENGER remote sensing data to study the morphology of surface features: a monochrome base map composed of different wide- and narrow-angle camera images, as well as a digital terrain elevation model, images with different illumination conditions, and colour maps.

Q What are the main features you've found?

My research has also focused on impact

craters with unusual ejecta (within the mapped quadrangle) and effusive volcanic features globally. Ejecta, the material that is excavated when an impactor hits the surface, usually deposits following ballistic trajectories forming a unit that surrounds the crater and thins with distance. The craters I have found exhibit lobate ejecta deposits that maintain their thickness with distance from the crater and have a steep, lobate margin. The formation of such deposits is almost certainly controlled by pre-existing topography, most examples have formed by impacts that hit the edge

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Images from the MESSENGER spacecraft that flew by Mercury in October 2008 show previously uncharted regions of the planet

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flows. The youngest extensive plains unit is ~3.5 billion years old and it’s generally accepted that effusive volcanism stopped around this time. Mercury’s small-scale, effusive deposits have not been as well characterised, so I’ve conducted a global survey of the planet for patches that are very smooth and usually on the scale of hundreds of kilometres along their longest axis. These small-scale deposits potentially represent a protracted waning phase of effusive volcanism on Mercury and are linked to the planet’s thermal and tectonic history.

Q Tell us about your work on crater names

Naming craters has been one of the most exciting and unexpected parts of my PhD! The first crater I named had a lobate ejecta deposit and I named it Nairne, after Lady Carolina Nairne, a late 18th and early 19th century Scottish poet whose songs I grew up singing. I wanted to name my first crater after a woman because within the quadrangle I’m mapping, I’d noticed that only 8% of the 37 named craters were named after women. This poor gender representation was disappointing but not unexpected. Nairne generally didn’t publish her poems or songs under her own name because it wasn’t considered proper at that time for women to be poets. It wasn’t until she died that the songs were correctly attributed to her. In many instances they were attributed to Robert Burns, who also has a crater named after him on Mercury. Naming the crater after Nairne felt fitting: she didn’t receive the recognition she deserved in her own lifetime, but now she’s represented on another planet!

The process of naming Nairne Crater brought the underrepresentation of women in space science nomenclature to my attention. All Mercury’s craters are named after contributors to the arts, but only 12% globally are named after women. Looking to Mars and the Moon, that shrinks to 1.8 and 2.0%, respectively. Craters on Mars and the Moon are named after scientists and astronauts, fields of work that have historically been particularly exclusionary towards women. Women have always been artists and scientists, but their stories aren’t well recognised, and their contributions are rarely celebrated in the same way as men’s. But this issue is not limited to gender and there is a broader sense of diversity that is lacking in our space science nomenclature.

Q What are the issues with having bias in crater names?

Space science, and science generally, is shifting towards being more inclusive and encouraging of all forms of diversity. But we can’t do that by simply trying to convince people that they should be involved in science, we need to ensure that the scientific systems already in operation are fair and promote diversity. There is an incredible database of named features on every observed planetary body, but the eponyms of these features are mostly not disaggregated. Therefore, it is not fully known which types of people, places or cultures are overrepresented, underrepresented, or missing entirely.

Naming conventions are set and maintained by the International Astronomical Union (IAU), but aspects of these conventions may negatively affect →

of an older, pre-existing crater. While analysing images of six lobate ejecta deposits, I found a crater with pools of impact melt, which forms due to the intense pressure of an impact, on top of the lobate ejecta deposit. This is the first evidence for the relative timing of the formation of these features because it implies that the lobate ejecta must have formed prior to the deposition of the impact melt, which happens earlier in the crater-forming process.

Much of Mercury’s surface is covered with plains formed by differently aged lava



“ The President-elect of the IAU contacted me to say that the rules are changing such that rejection based on pronunciation will not happen going forwards ”

A 3D colourised render of Mercury

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diversity. Craters are commonly named after real people, and that person must be deceased for a minimum of three years and be demonstrably famous for a minimum of 50 years. Historically, not all people were able to achieve fame and contributions from marginalised groups then are not well preserved, leading to poor representation now. The IAU are vocal about promoting internationality and geographical distribution in their choice of names, which I support, but I question why other forms of diversity don't have the same support in the regulations.

Q How can we alter these biases?
You can't expect people to assume that our scientific systems are unfair, so raising awareness by talking about bias encourages people to consider diversity when proposing names.

Gender and nationality are not the only forms of diversity. I've held data-entry hackathons where a group of us review named features in the Solar System and catalogue the protected characteristics of the eponym, the person the feature is named after. The hackathons are open to anyone from any career stage, and held in person and online. You don't even need to be a scientist; you just have to care

about representation. We catalogue, for example, the person's gender, sexuality, ethnicity, and nationality. Of course, we cannot know how a person identified themselves, so some interpretation is based on the records of their life, but we hope to provide the groundwork for understanding who is missing from planetary nomenclature and who we should better represent going forward – that's the goal!

Q Can crater naming conventions change?

Changes can and should happen. For example, a crater on Mercury was named after the Chilean poet, Pablo Neruda, who, by his own admission, was a sexual abuser [Neruda documents abuse in his memoirs from 1929]. I, my colleague, Ben Man, and our supervisor, David Rothery, brought this to the attention of the IAU. Wide-scale renaming of objects could cause confusion in the existing literature, so in this case the IAU decided to keep the name Neruda, but change the origin. The crater is now named after two alternative people with the surname Neruda: Jan Neruda and Johann Neruda, both Czech artists. Since name duplication is not permitted, allowing multiple origins for names could

help overcome the de facto majority of male names in space and increase representation for women and people from other marginalised groups.

In another example, I recently suggested the crater name, Kngwarreye, after the aboriginal Australian painter with incredible works, Emily Kame Kngwarreye. The Mercury Task Group initially rejected it, saying that the name would be difficult to pronounce. This, I think, shows implicit bias in space science nomenclature and is actively discriminatory. We were allowed to resubmit the name, which was formally rejected because we couldn't demonstrate that Kngwarreye had been famous for 50 years, but it did bring about positive change; the President-elect of the IAU contacted me to say that the rules are changing such that rejection based on pronunciation will not happen going forwards. These cases prove that conventions and rules can be changed, and I hope such changes will be enacted in future. **G**



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This interview is an excerpt from the podcast episode Geo Conversations: Annie Lennox. Listen to the full interview at [geoscientist.online](https://www.geoscientist.online).

Interview by Marissa Lo, Associate Editor, *Geoscientist* magazine

FURTHER READING

A full list of further reading is available at [geoscientist.online](https://www.geoscientist.online).

- Neruda, Pablo. *Memoirs* (Translated by Hardie St. Martin). Farrar, Straus, and Giroux (1977), 384 pp.