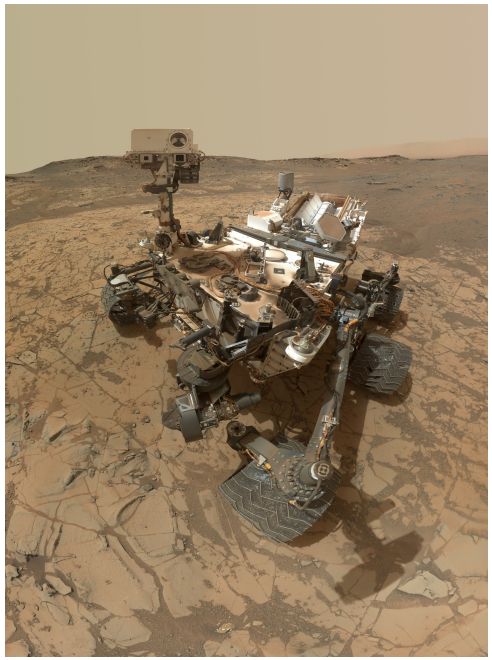
SAM Measures Unexpectedly Young Aqueous Processes at Gale Crater, Mars

What is the Science Question?

- Can we determine the formation age of a secondary mineral, jarosite, separately from the bulk age of a mudstone on Mars?

What are the findings?

- The *Curiosity* rover on Mars can determine the age of rock samples using the K-Ar radiometric dating method by combining the capabilities of the Alpha Particle X-ray Spectrometer (APXS), CheMin, and Sample Analysis at Mars (SAM) instruments.
- Using a new two-step sample heating process, the SAM team determined the formation age of jarosite, a secondary mineral in a mudstone sample, by measuring the amount of Ar released at the lower temperature (500˚C). The total age of the rock was then determined from the amount of Ar released by the more Ar-retentive primary minerals at the higher temperature (930˚C).
- Using this method, the SAM team calculated that the jarosite had a surprisingly young age of <3 billion years, while the bulk age of the rock was 4.07 billion years.

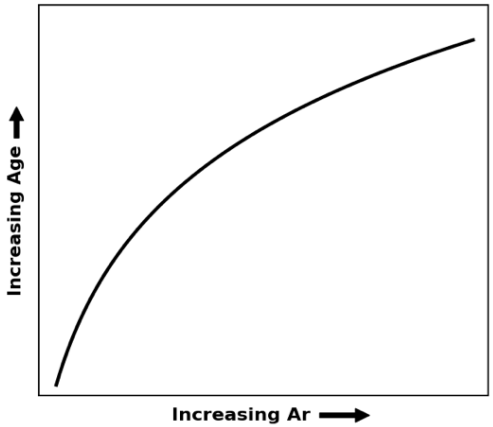


What is the impact?

- Since jarosite is a sulfate mineral that is typically formed via aqueous processes, the jarosite in the sample SAM measured must have been deposited during a time of fluvial activity (such as running water).
- This young age suggests that there may have been aqueous processes that post-date Gale Lake, with fluvial activity MUCH later in Mars' history than previously reported.

Why does it matter to non-scientists?

- Evidence of fluvial activity at a relatively recent age of < 3 billion years ago provides important new constraints on ideas about the evolution of martian environments and increases the likelihood of relatively recent habitable environments on Mars.



K decays with a known half life, producing ^{40}Ar as a daughter product. By measuring the Ar, we can measure the age of the rock.

Martin, P.E., Farley, K.A., Baker, M.B., **Malespin, C.A.**, Schwenzer, S.P., Cohen, B.A., **Mahaffy, P.R.**, **McAdam, A.C.,** Ming, D.W., Vasconcelos, P.M. and Navarro-Gonzalez, R., 2017. A two-step K-Ar experiment on Mars: dating the diagenetic formation of jarosite from Amazonian groundwaters. *Journal of Geophysical Research: Planets*, 2017