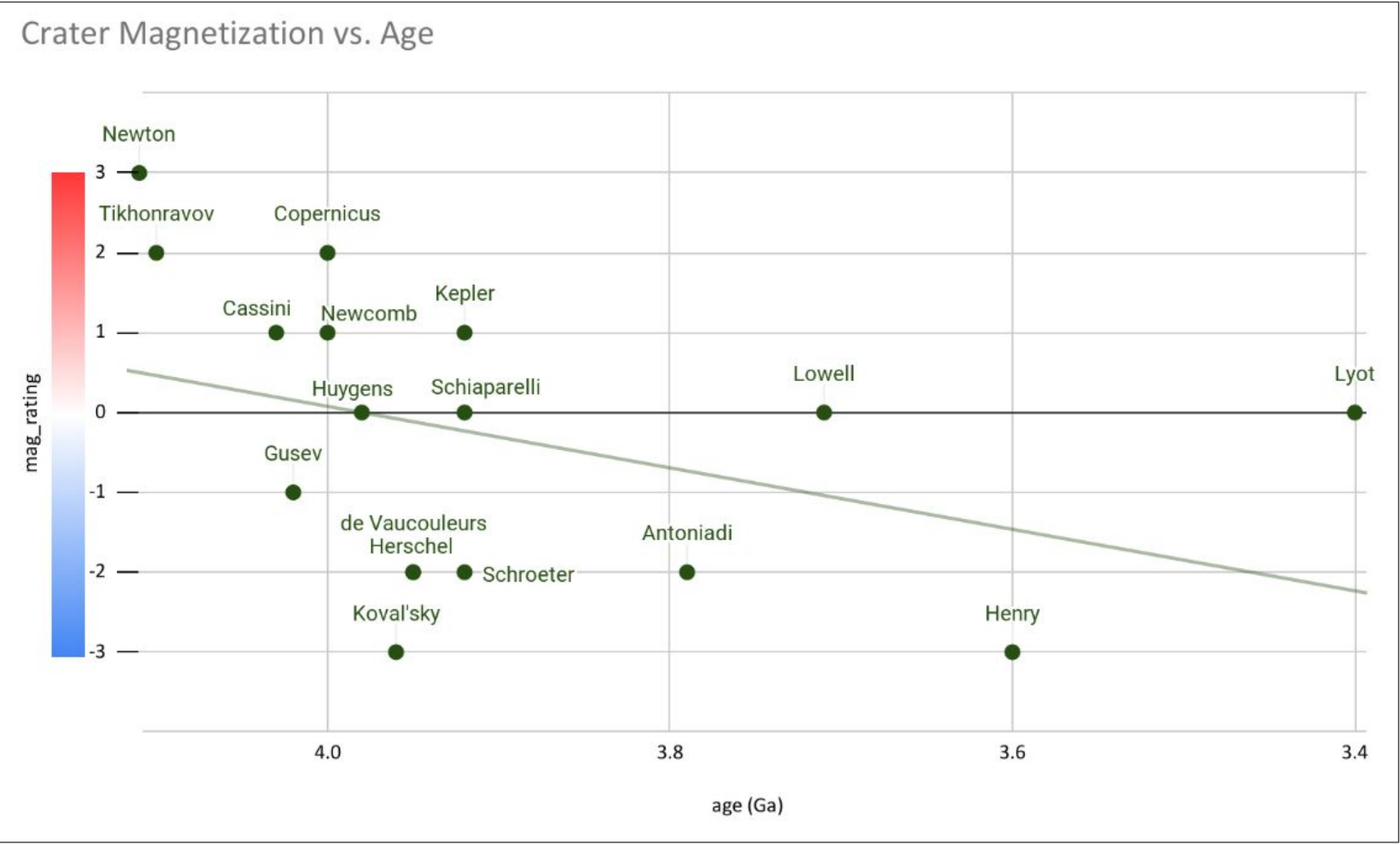
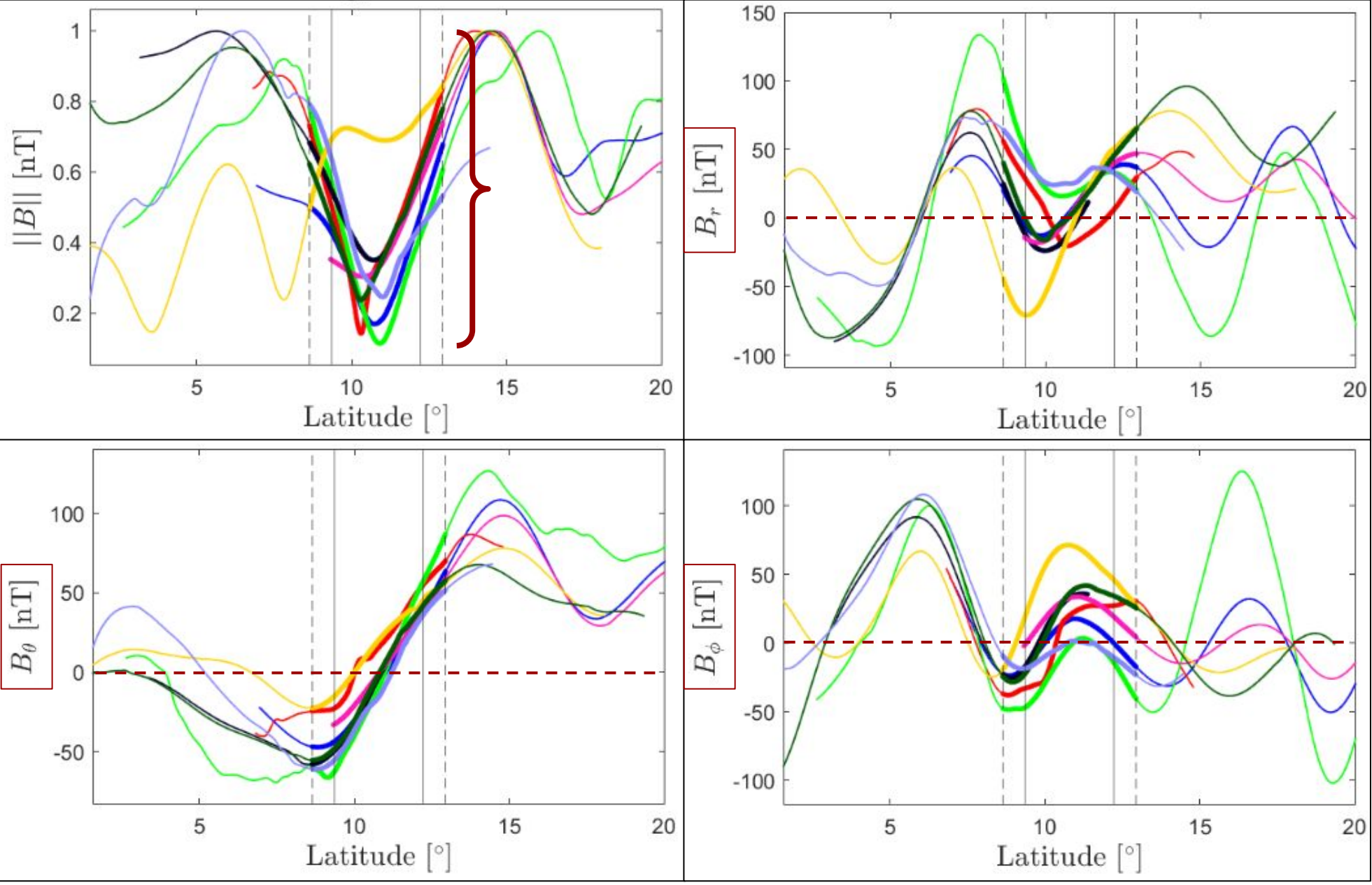


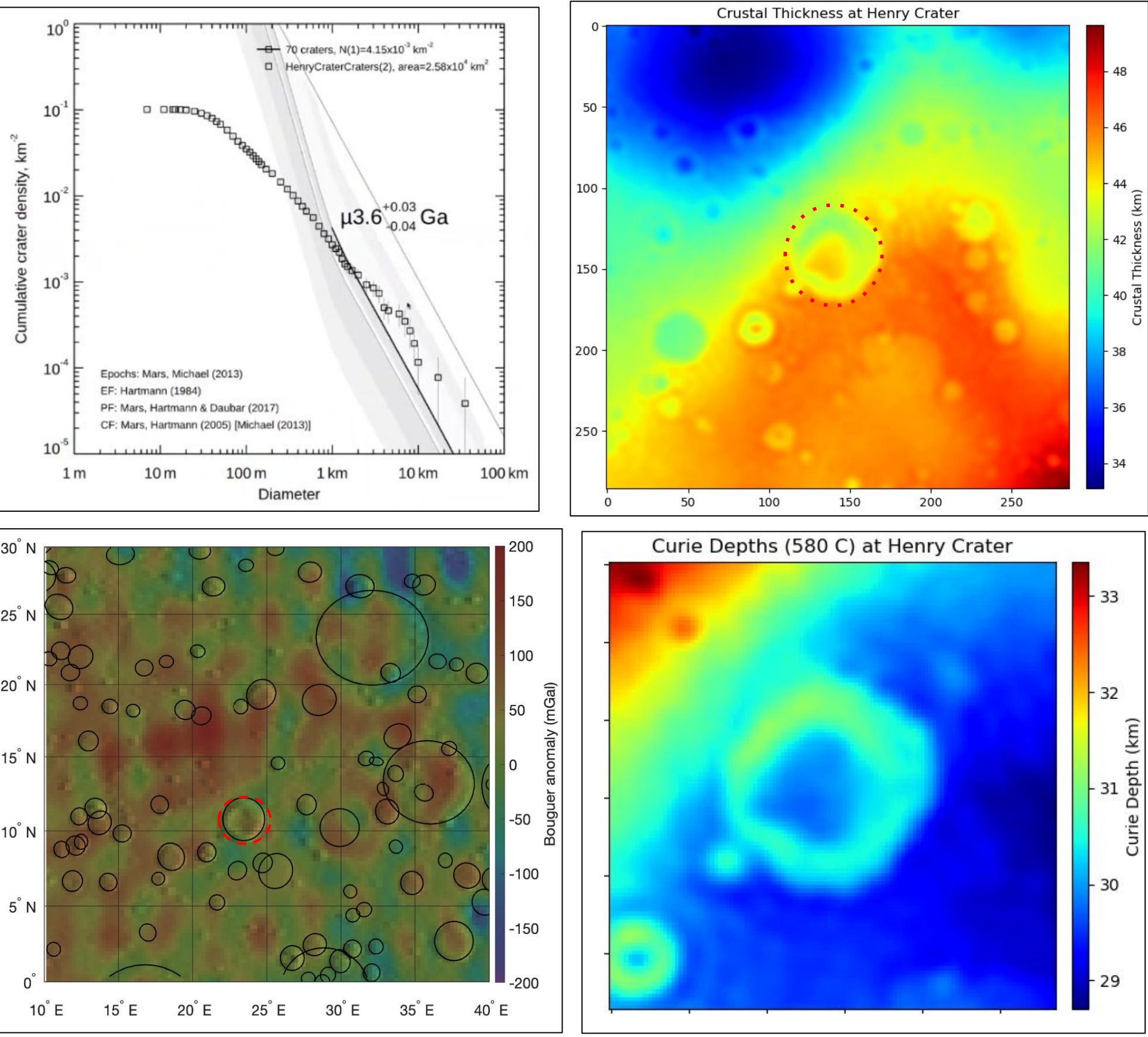
[Fig 1] Newer craters are less magnetized than older ones.



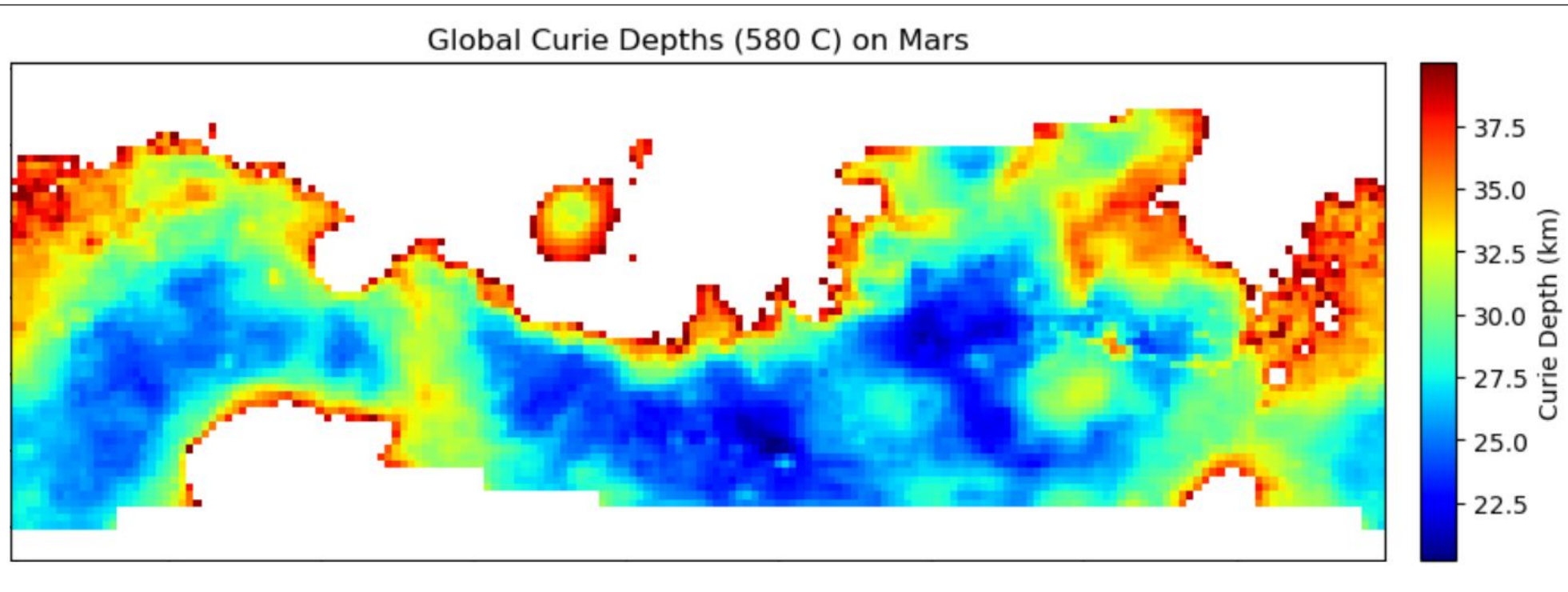
[Fig 2] MAVEN vector magnetic field components around Henry crater.



[Fig 3] Henry crater: age, crustal thickness, Bouguer, and Curie depths.



[Fig 4] Lower bound for magnetic sources on Mars due to Curie depths.



Constraining the Formation Time and Depth of Magnetic Sources within the Martian Crust

Zain Eris Kamal, Lujendra Ojha — Rutgers University, New Brunswick

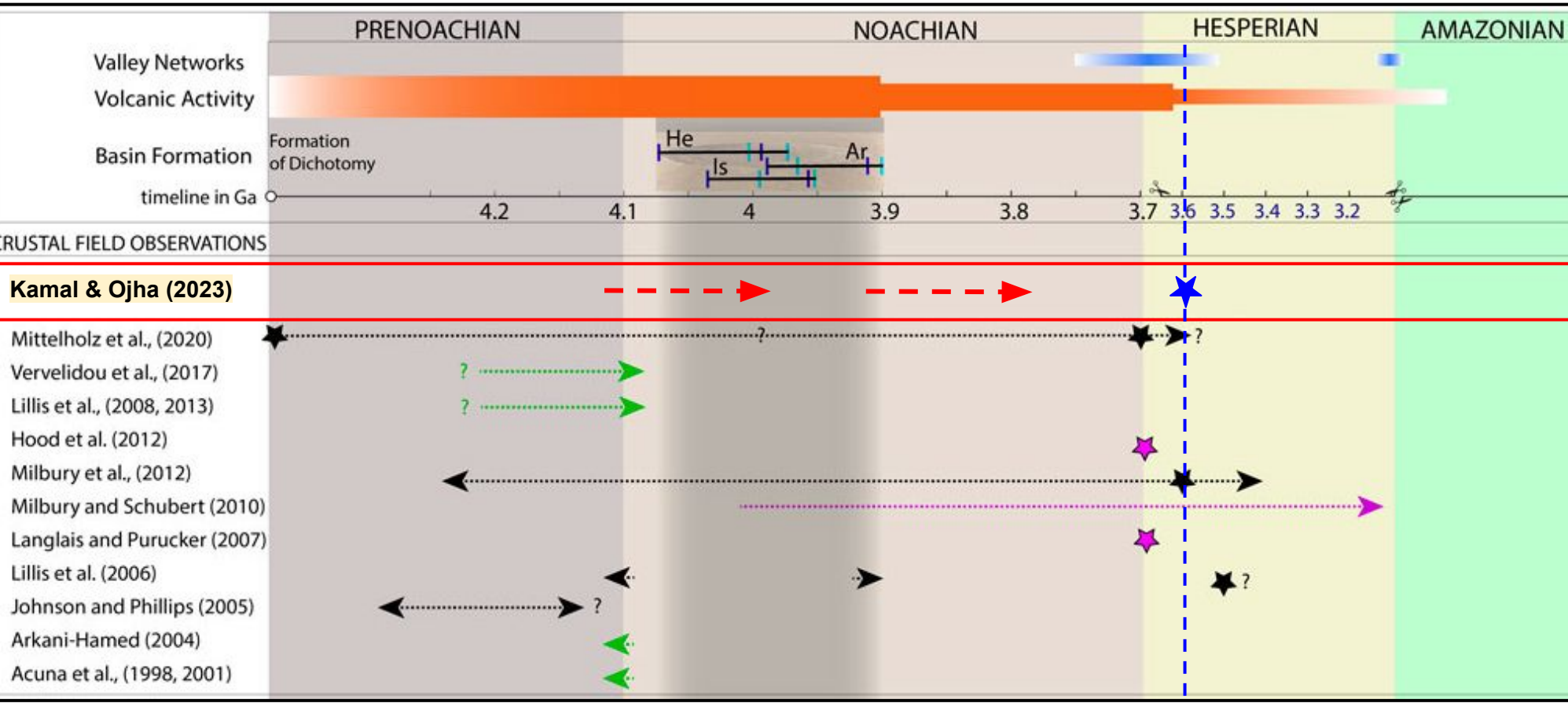
1. DYNAMO CESSATION ESTIMATES

Previous crustal magnetic field studies disagree on dynamo cessation age —

Our approach is the first to combine:

- (1) Systematically searching **all resolvable craters** (Diam>70km, n=855),
- (2) Analyzing high-res (low-altitude, nighttime) **MAVEN** track data.

By correlating crater magnetization with their ages [fig 1], we conclude the dynamo **likely persisted through 4.0 Ga, and certainly shut down by 3.6 Ga**:



[Figure adapted from Mittelholz & Johnson 2022 “The Martian Crustal Magnetic Field”]

2. THE CURIOUS CASE OF HENRY CRATER

Our conclusions seemed **contradictory** with past works::

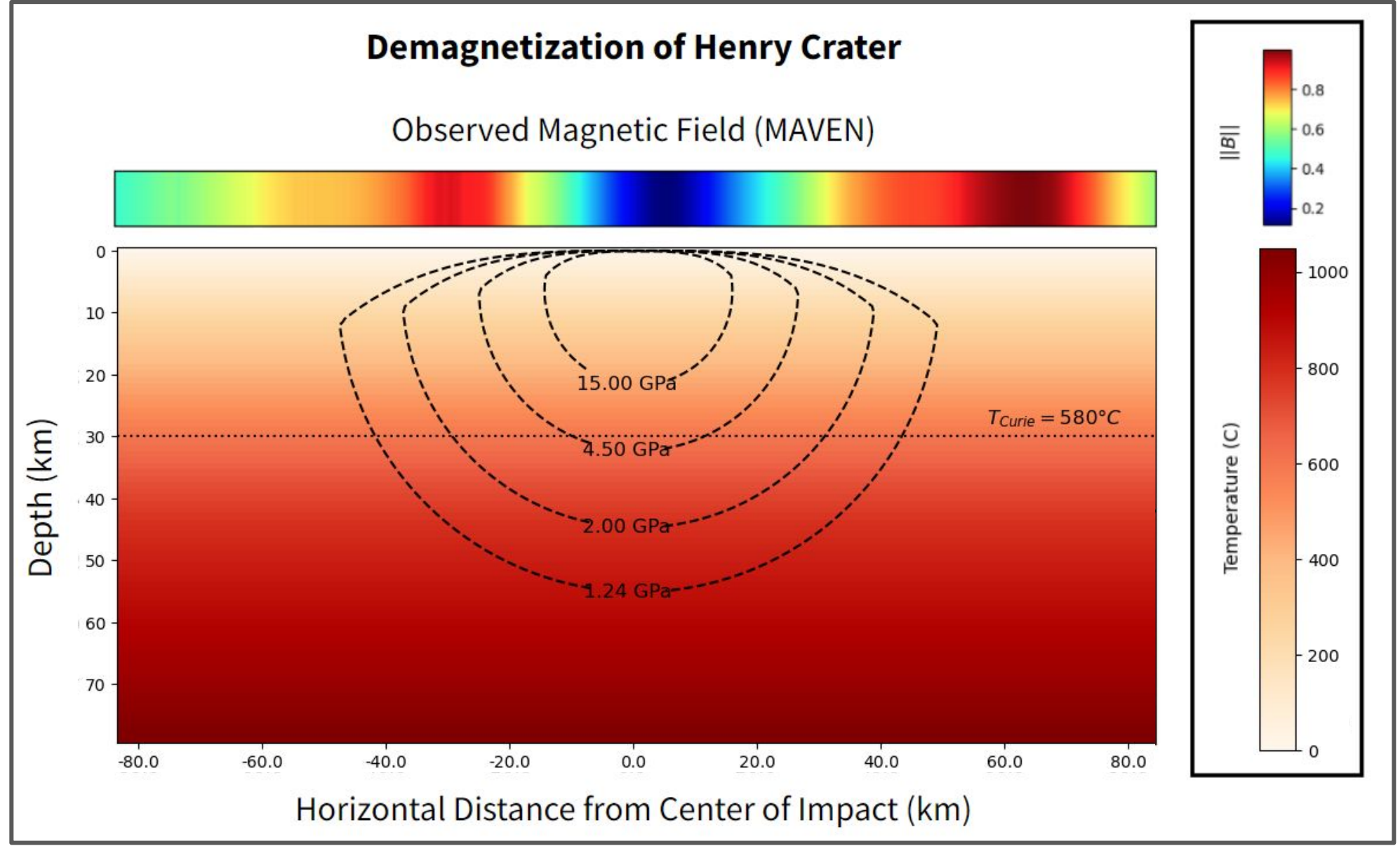
- We predict craters >300 km diameter should be demagnetized, **but this is only observed in 25% of cases.**
- Despite its size, **Henry crater (167 km) is one of the most demagnetized (non-major) craters on Mars** (~90% reduction in ||B||).

Henry formed at 3.6 ± 0.03 Ga, and shows no clear crustal/gravity anomalies.

3. CONSTRAINING THE MAGNETIZED LAYER

Can our observations be explained by basic processes? We consider demagnetization from:

- (**Contour lines**) Impact **shock wave** demagnetization.
- (**Red gradient**) **Curie depths** due to radiogenic HPE decay.



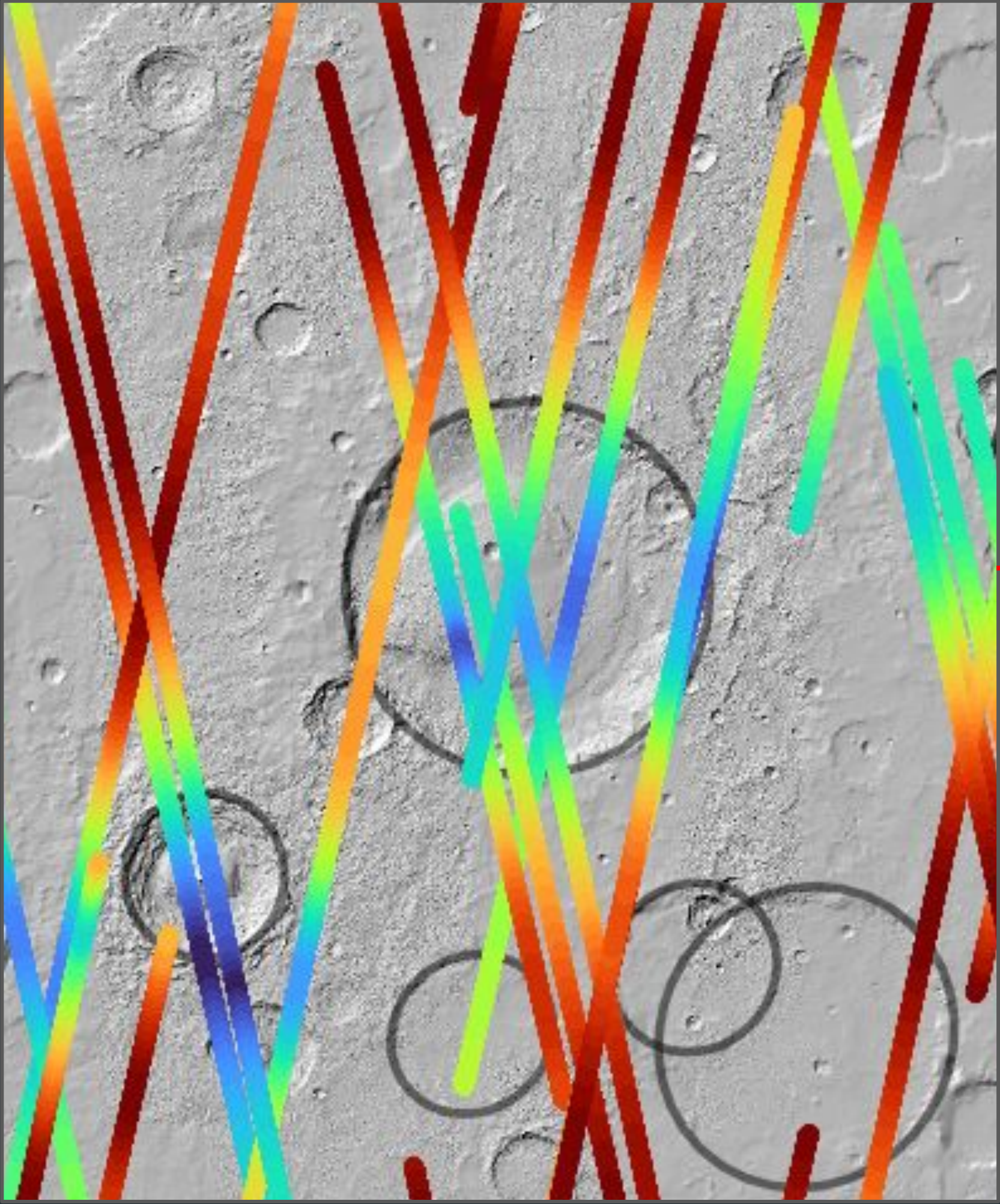
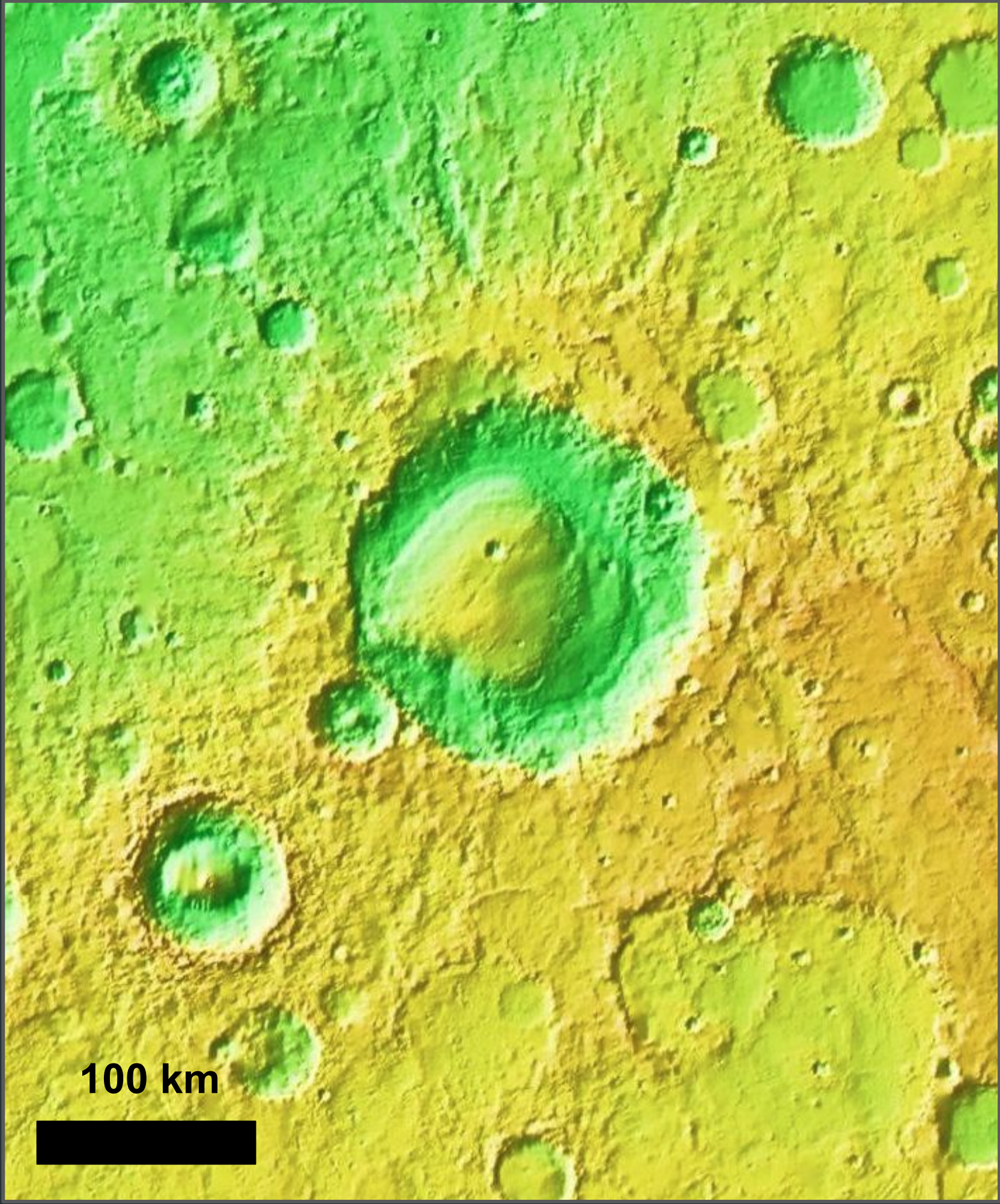
4. FUTURE WORK

- Repeating this for all >70km craters on Mars allows us to **constrain magnetic source depths globally.**
- Comparing the above results to source depth models would let us constrain:
 - Crustal formation mechanisms,
 - Early basal heating / heat flow rates,
 - Threshold demagnetization pressures/temperatures,
 - Crustal thickness/density quantities,
 - GRS elemental concentration uncertainties, etc.

Small crater demagnetization lets us constrain:

- (1) **Dynamo** cessation age (**3.6 Ga**), and
- (2) **Depth** of magnetic sources (**20-50 km**).

But causal factors remain an **unsolved puzzle**.



Take a picture for more information, or visit:

<https://bit.ly/CuriousCaseOfHenry>