Science Opportunities offered by Mercury's Ice-Bearing Polar Deposits

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and

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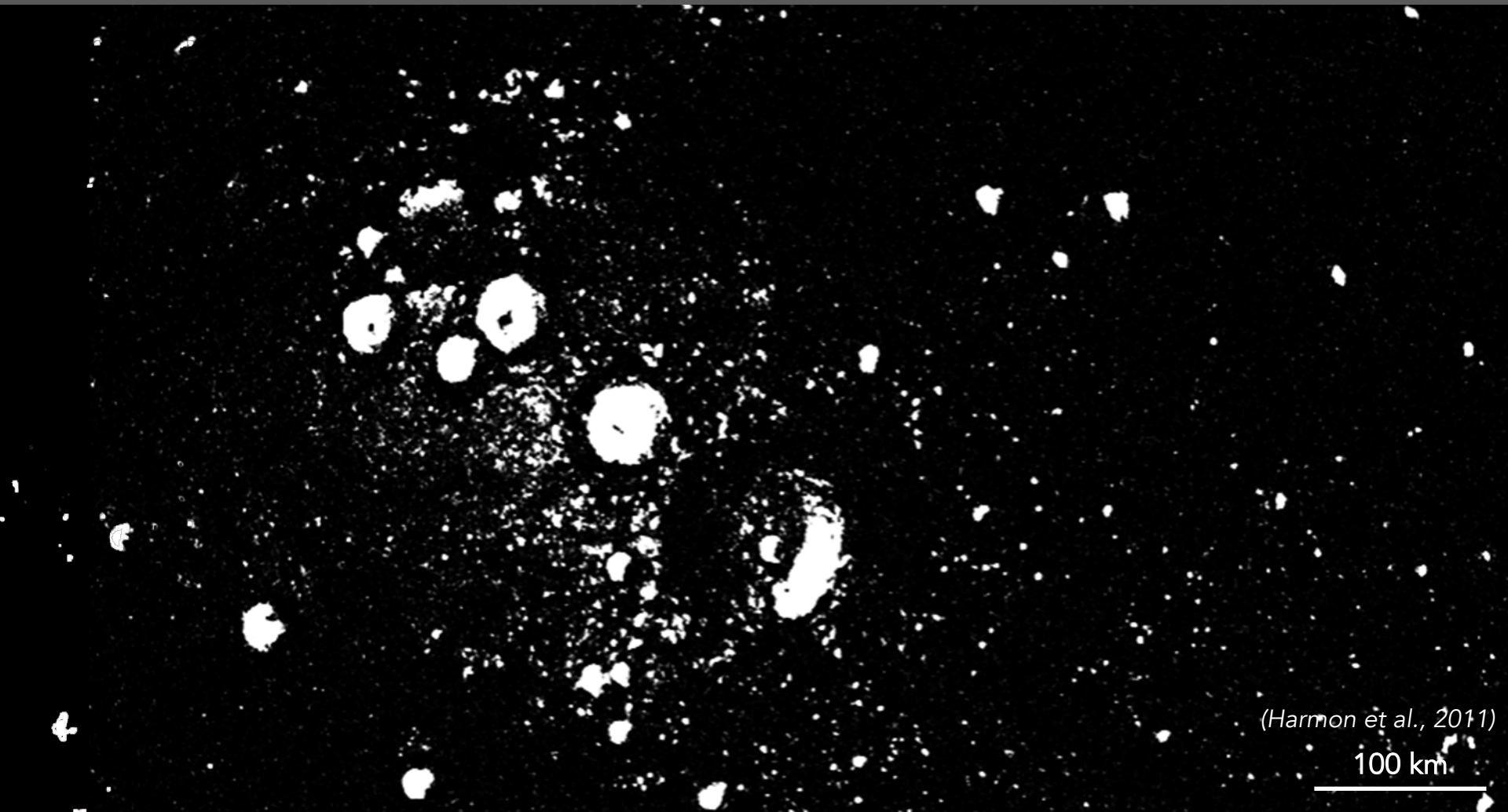
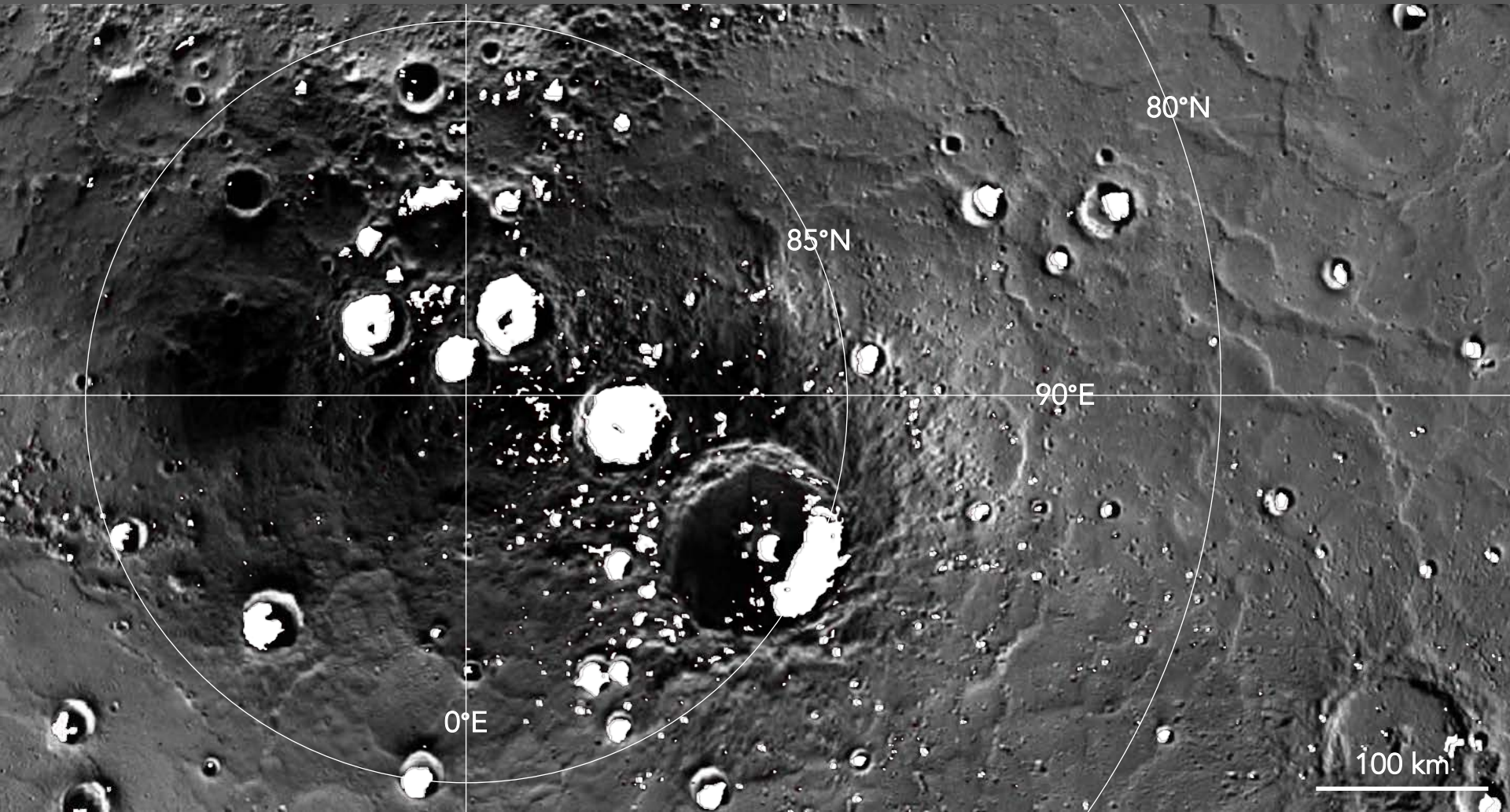
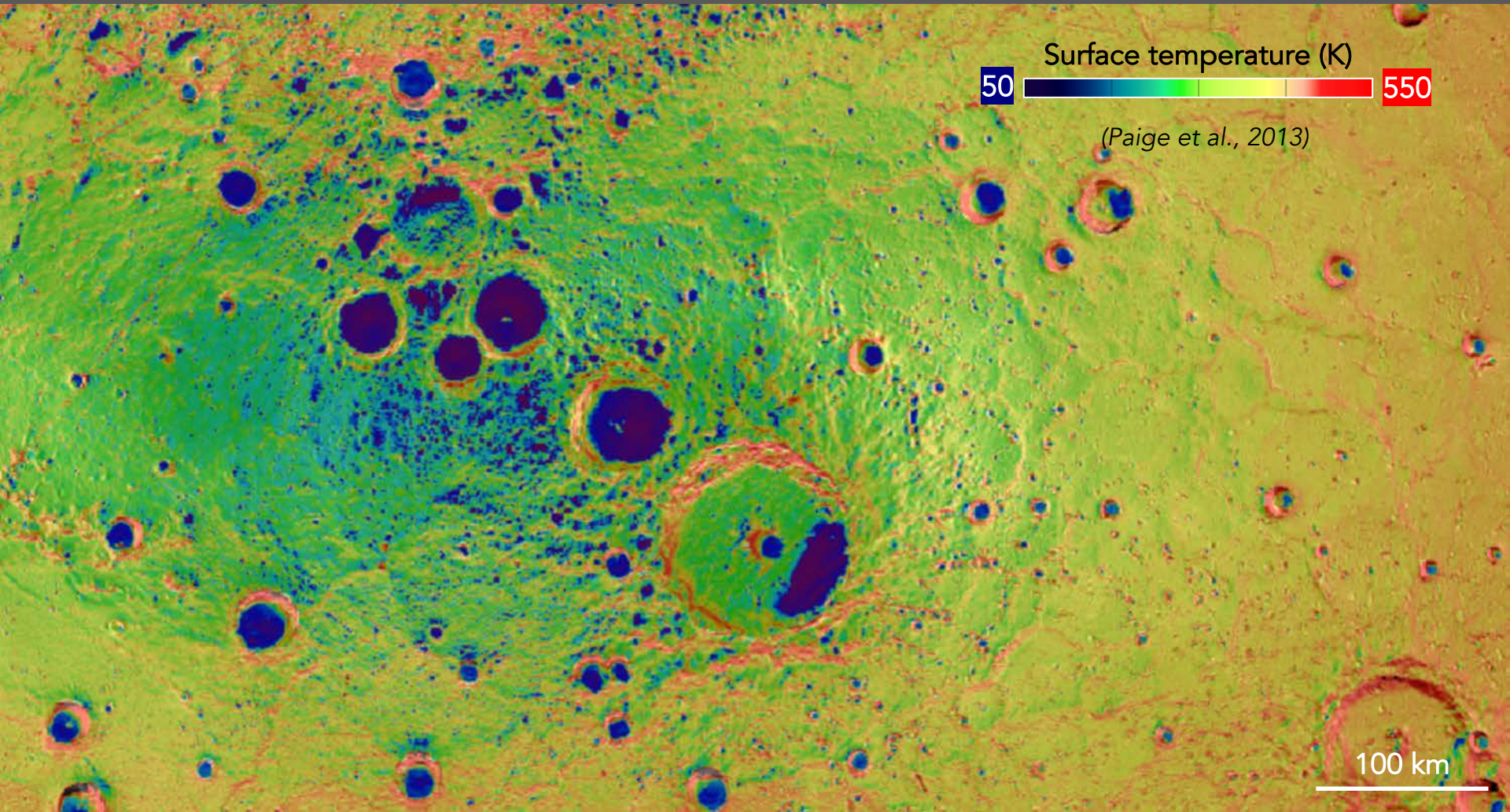
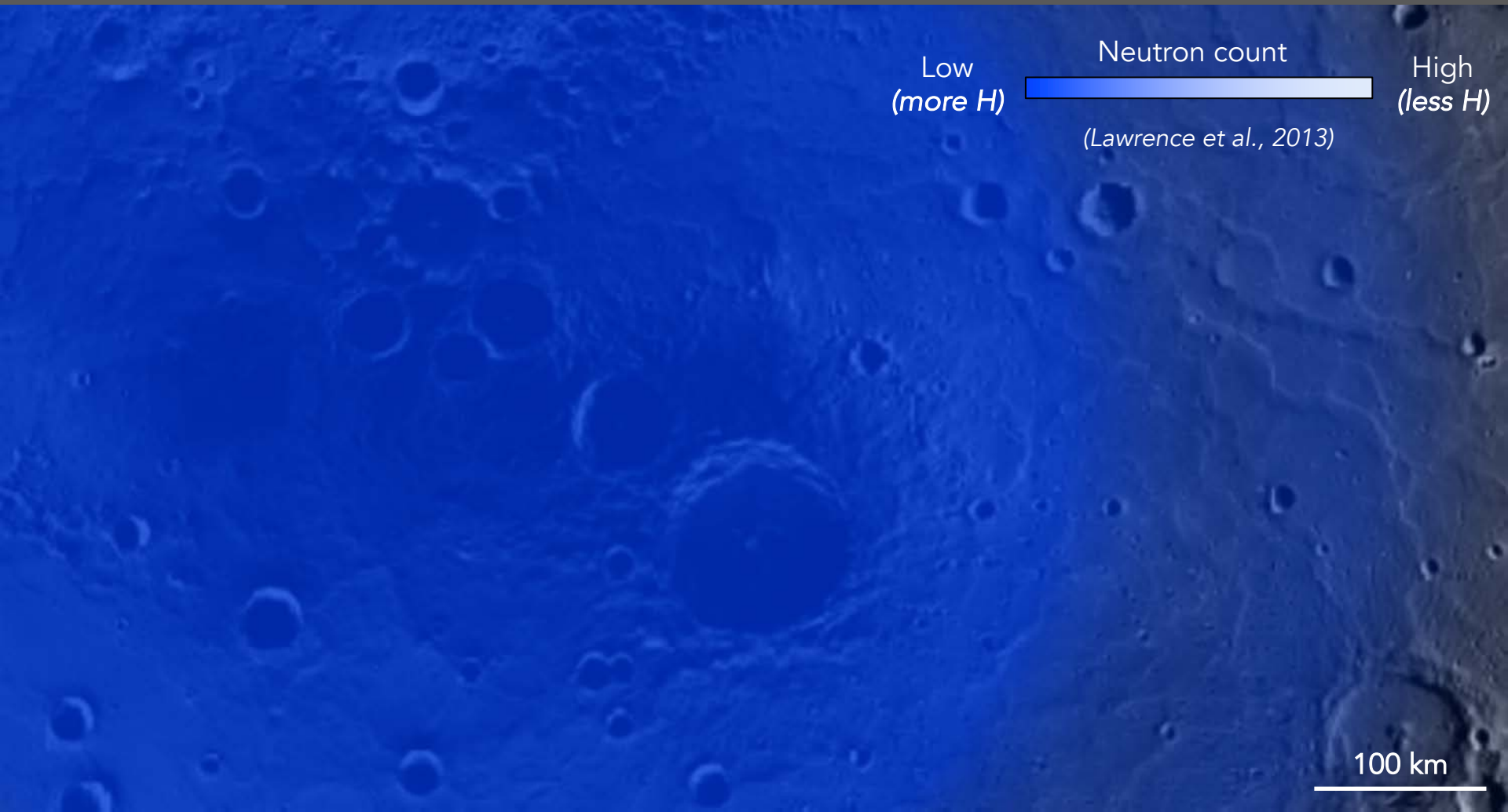
With support from 70 community members: Abhisek Maiti (Twente), Adrienn Luspay-Kuti (JHU APL), Akos Kereszturi (CSFK), Alice Lucchetti (INAF-OAPD), Anne Virkki (AO), Anthony Colaprete (NASA Ames), Audrey Vorburger (Bern), Ben Byron (SwRI), Brant Jones (GT), Brendan Anzures (Brown), Bryan Butler (NRAO), Carl Schmidt (BU), Carolyn Ernst (JHU APL), Cesare Grava (SwRI), Christian Klimczak (UGA), Chuanfei Dong (Princeton), Colin Hamill (JHU APL), Craig Hardgrove (ASU), David Blewett (JHU APL), David Lawrence (JHU APL), Dylan Hickson (AO, UCF), Edgard Rivera-Valentin (LPI, USRA), Emily Costello (UH Manoa), Erwan Mazarico (NASA GSFC), Gianrico Filacchione (INAF), Giovanni Bacon (Embry-Riddle Aeronautical), Gregory Neumann (NASA GSFC), Hannah Susorney (Bristol), Holly Brown (ASU), Indhu Varatharajan (DLR), Jack Wilson (JHU APL), Jacob Kloos (York), James Head (Brown), Jamey Szalay (Princeton), Jordan Steckloff (PSI), Kelly Miller (SwRI), Kevin Cannon (UCF), Kristen Luchsinger (NMSU), Lior Rubanenko (Stanford), Lizeth Magana (UTSA, SwRI), Margaret Landis (CU Boulder), Maria Gritsevich (FGI), Mark Schneegurt (WSU), Martin Slade (JPL/Caltech), Matthew Siegler (PSI), Maurizio Pajola (INAF-OAPD), Menelaos Sarantos (NASA GSFC), Michael Poston (SwRI), Michael Sori (Purdue), Mona Delitsky (CA Specialty Engineering), Noemi Pinilla-Alonso (FSI, AO, UCF), Norbert Schorghofer (PSI), Parvathy Prem (JHU APL), Paul Byrne (NC State), Paul Hayne (CU Boulder), Paul Lucey (UH Manoa), Peter James (Baylor), Petr Pokorný (CUA, NASA GSFC), Ronald Vervak, Jr. (JHU APL), Rosemary Killen (NASA GSFC), Ross Potter (Brown), Sean Solomon (Columbia), Shashwat Shukla (Twente), Sriram Bhiravarasu (ISRO), Steven Hauck (CWRU), Thomas Orlando (GT), Timothy Stubbs (NASA GSFC), Valentin Bickel (ETH Zurich, MPS Goettingen), Vincent Eke (Durham), William Farrell (NASA GSFC)

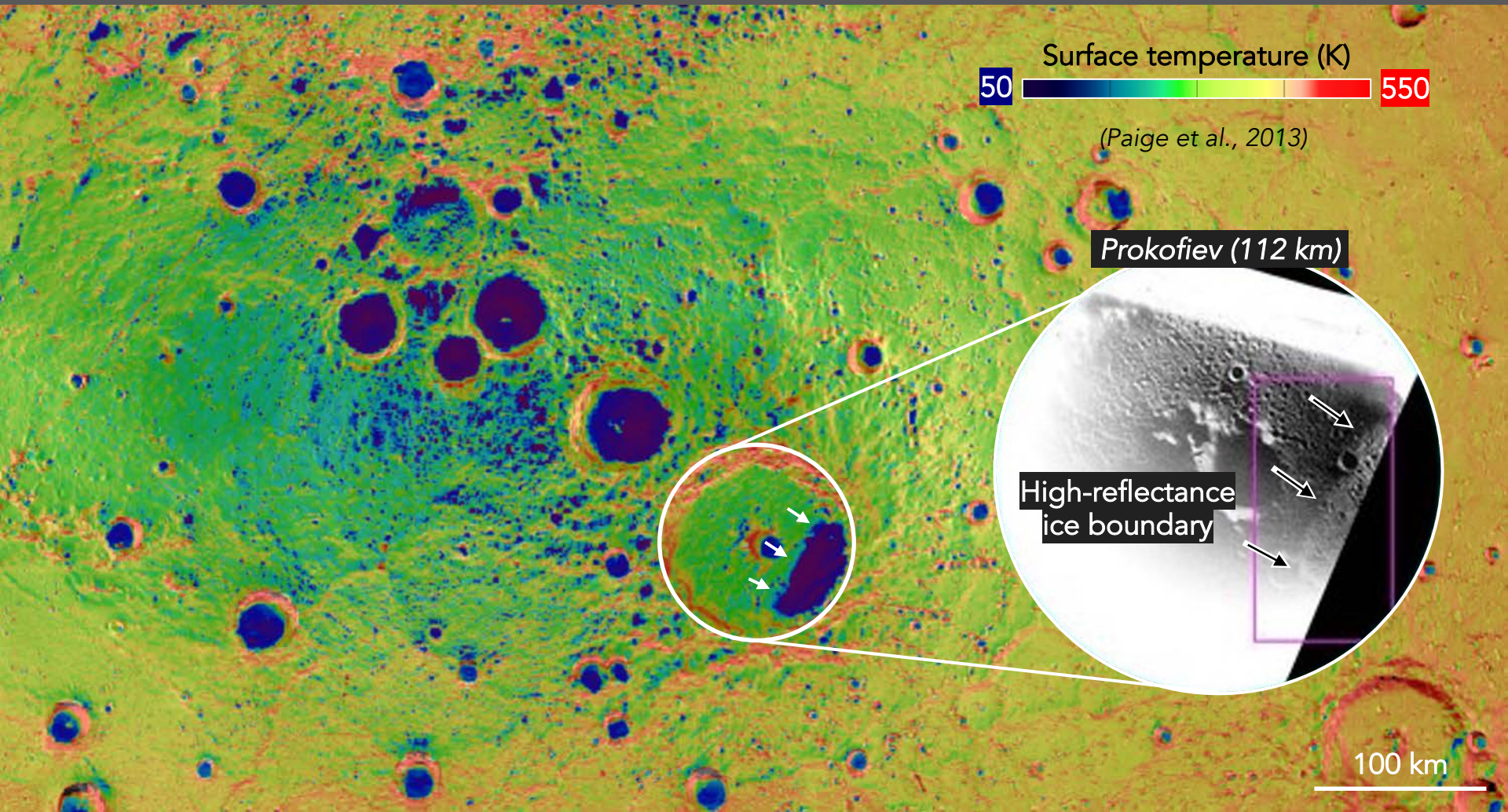
PSDS 2020 Panel on Mercury and the Moon – 3 November 2020

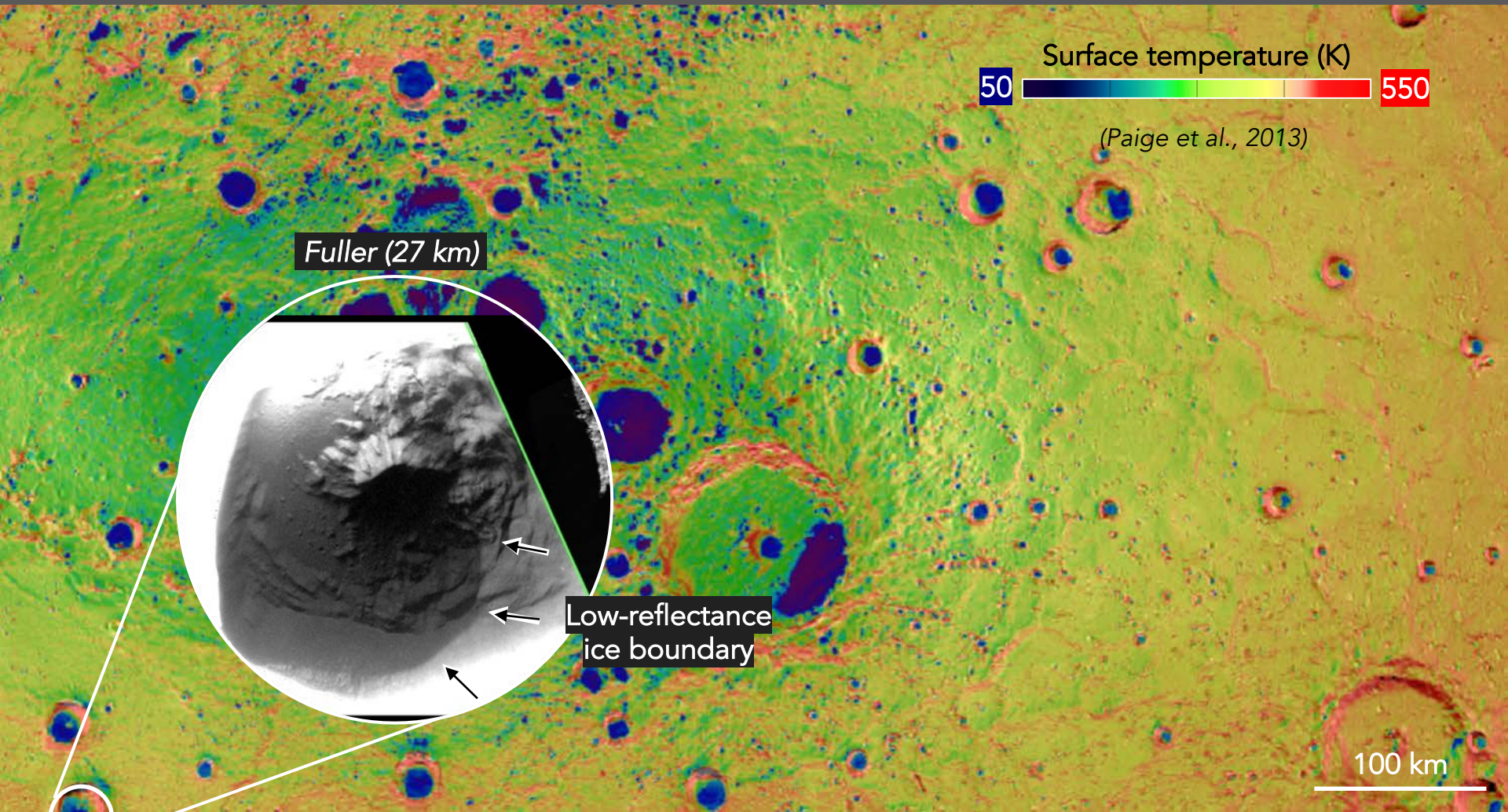

(Harmon et al., 2011)
100 km

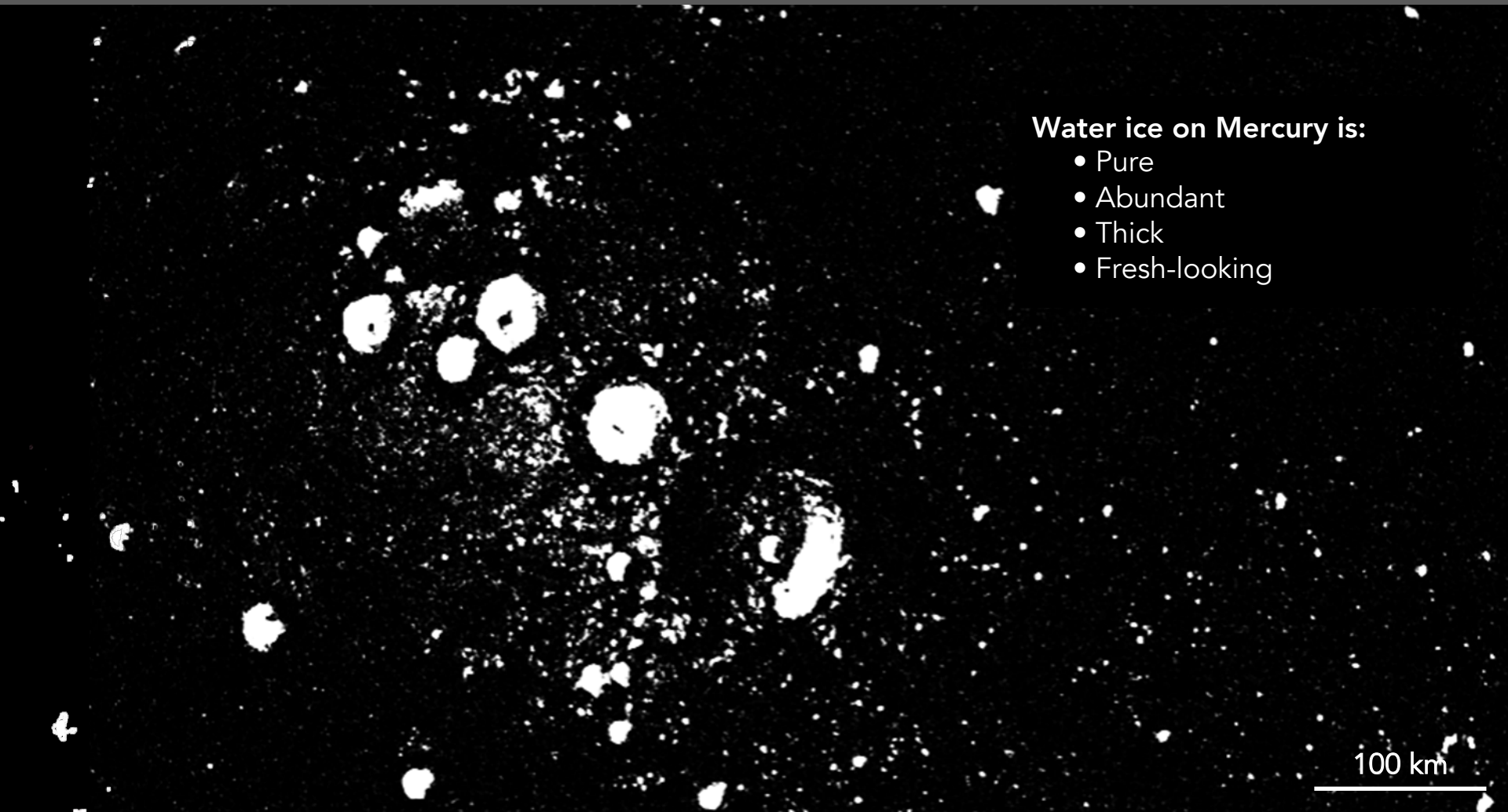

80°N
85°N
90°E
0°E
100 km


Surface temperature (K)
50
550
(Paige et al., 2013)
100 km

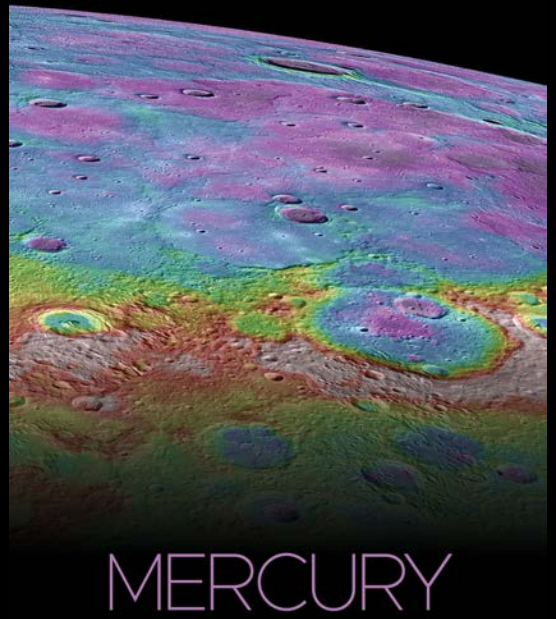

Low
(more H)
Neutron count
High
(less H)
(Lawrence et al., 2013)
100 km


Surface temperature (K)
50
550
(Paige et al., 2013)
Prokofiev (112 km)
High-reflectance ice boundary
100 km

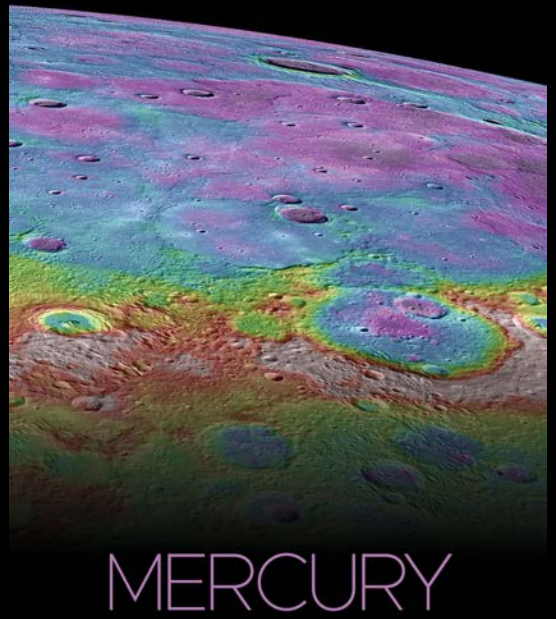

Surface temperature (K)
50
550
(Paige et al., 2013)
Fuller (27 km)
Low-reflectance
ice boundary
100 km

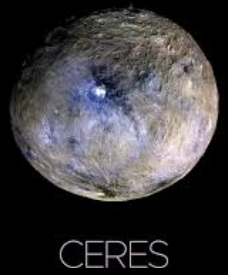

Water ice on Mercury is:
• Pure
• Abundant
• Thick
• Fresh-looking
100 km

Understanding the nature and extent of polar deposits on Mercury has important and wide-reaching implications for planetary science.

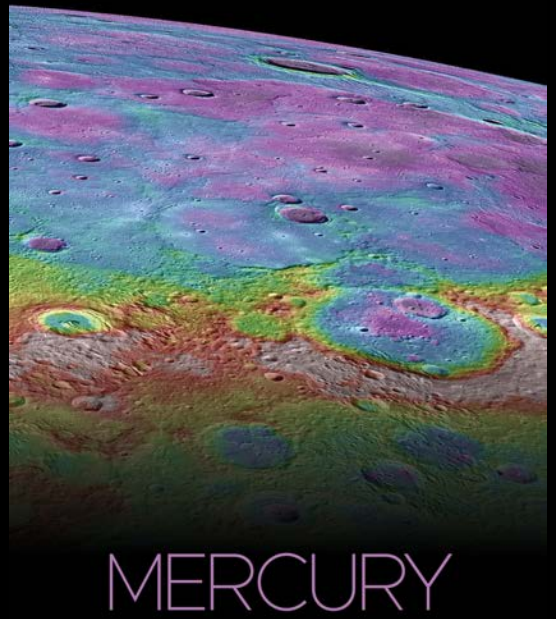


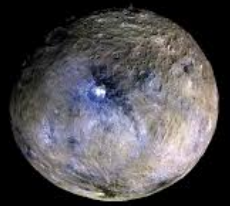
Understanding the nature and extent of polar deposits on Mercury has important and wide-reaching implications for planetary science, including the origin and inventory of lunar volatiles.



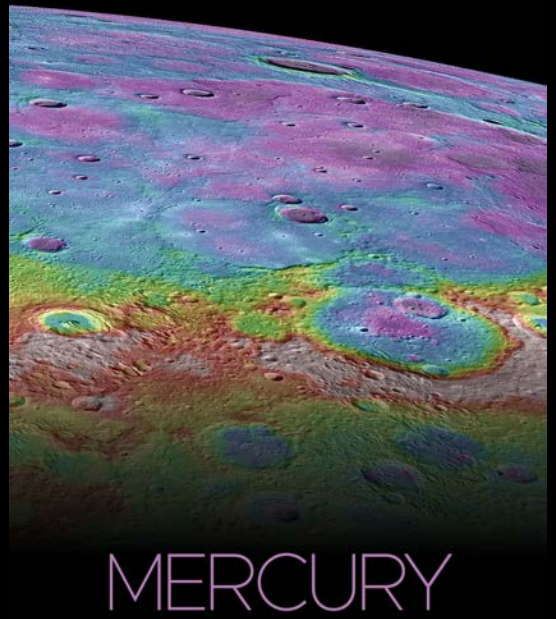


Understanding the nature and extent of polar deposits on Mercury has important and wide-reaching implications for planetary science, including the delivery of water and organics to early Earth and Mars.





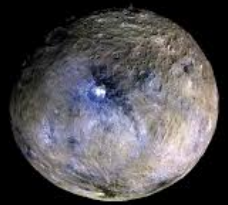
Understanding the nature and extent of polar deposits on Mercury has important and wide-reaching implications for planetary science, including the nature of outer solar system volatiles and organics.




EARTH'S MOON


EARTH

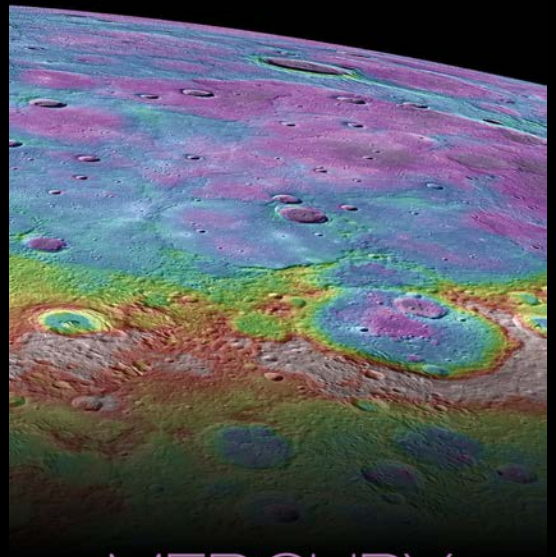

COMETS

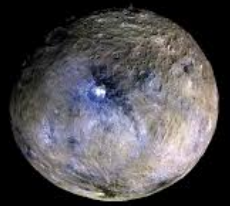

CERES


MARS

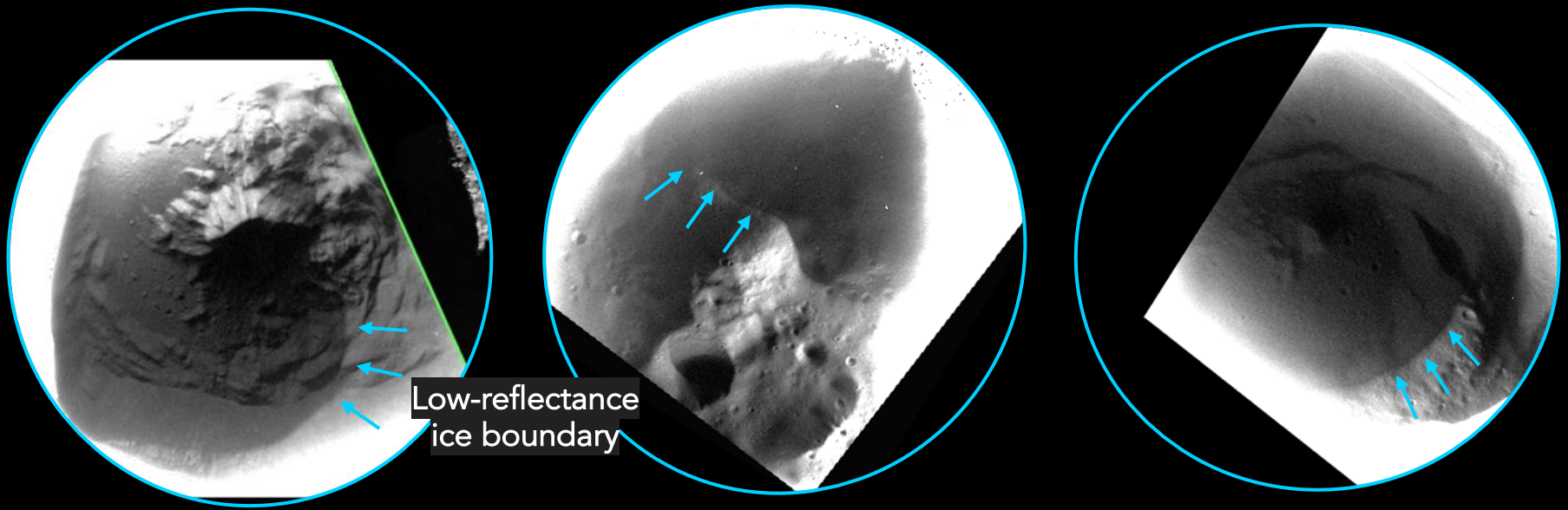

ASTEROIDS

Understanding the nature and extent of polar deposits on Mercury has important and wide-reaching implications for planetary science, including very cold chemistry occurring between volatiles, organics, minerals, and high-energy particles.



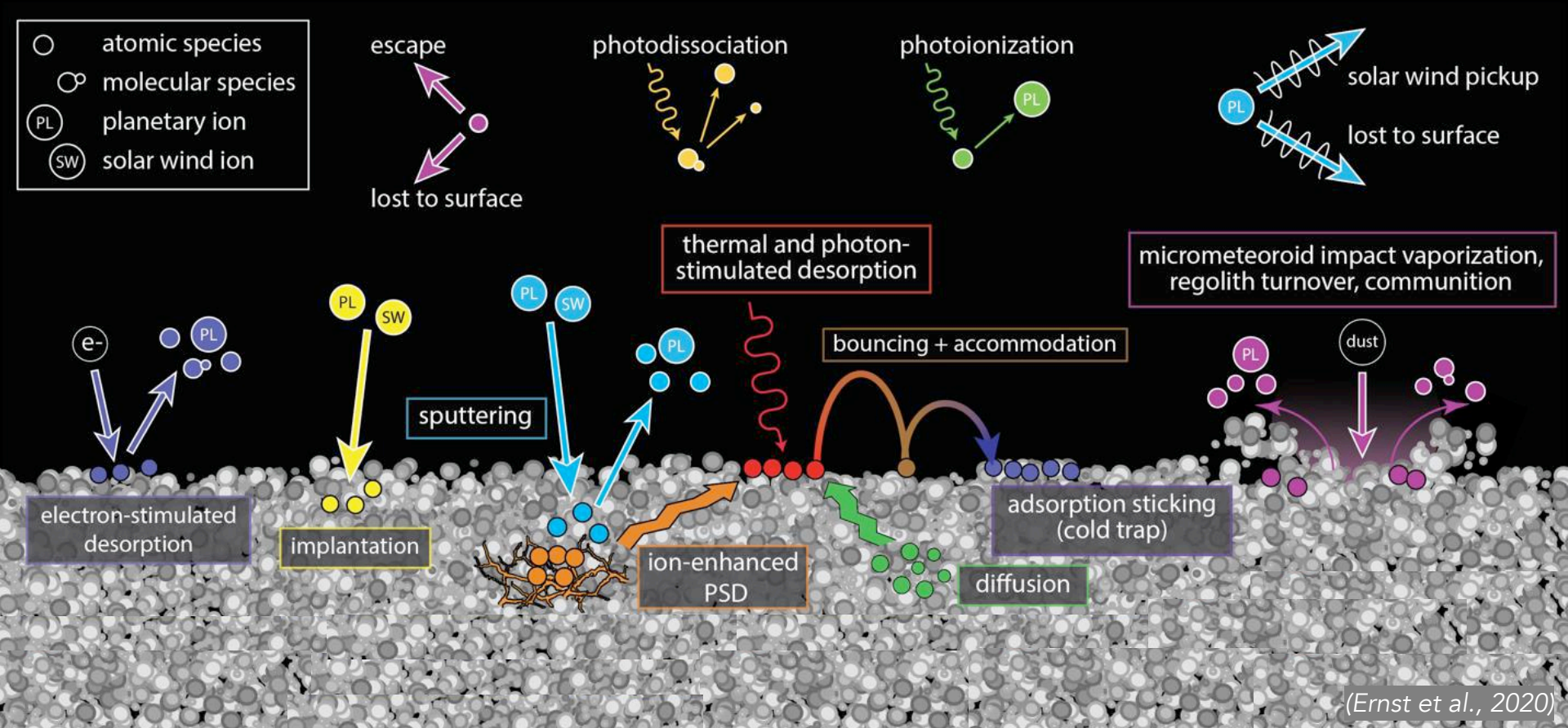


1. What are the origin and age of polar deposits on Mercury, and the relative contributions of impacts, solar wind, and outgassing?



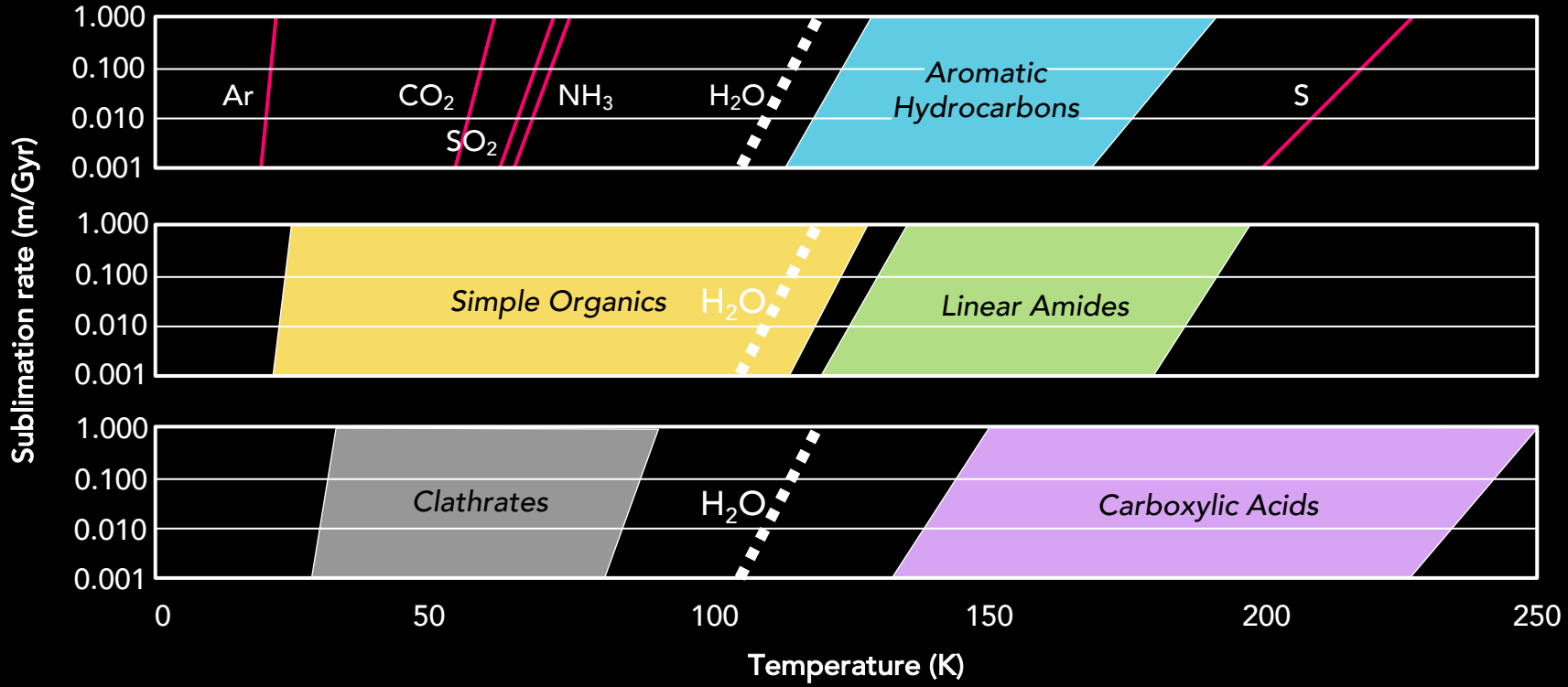
Fuller (27 km diameter) *Anyte (19 km)* *Burke (29 km)*

2. What are the processes modulating the retention, modification, and loss of cold volatile-rich surfaces?



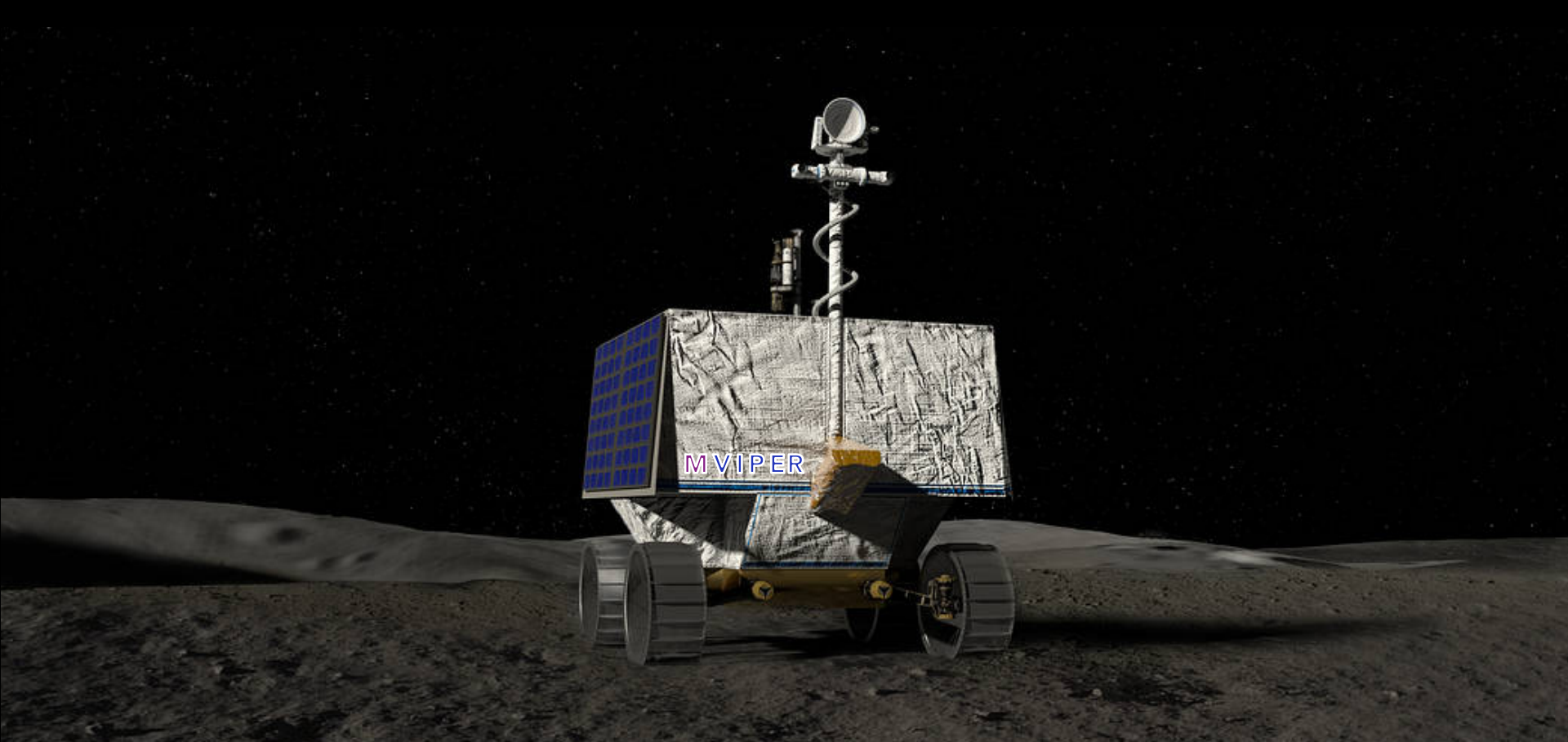
(Ernst et al., 2020)

3. What chemical reactions are occurring between organic compounds, water ice, and other frozen volatiles at very low temperatures?

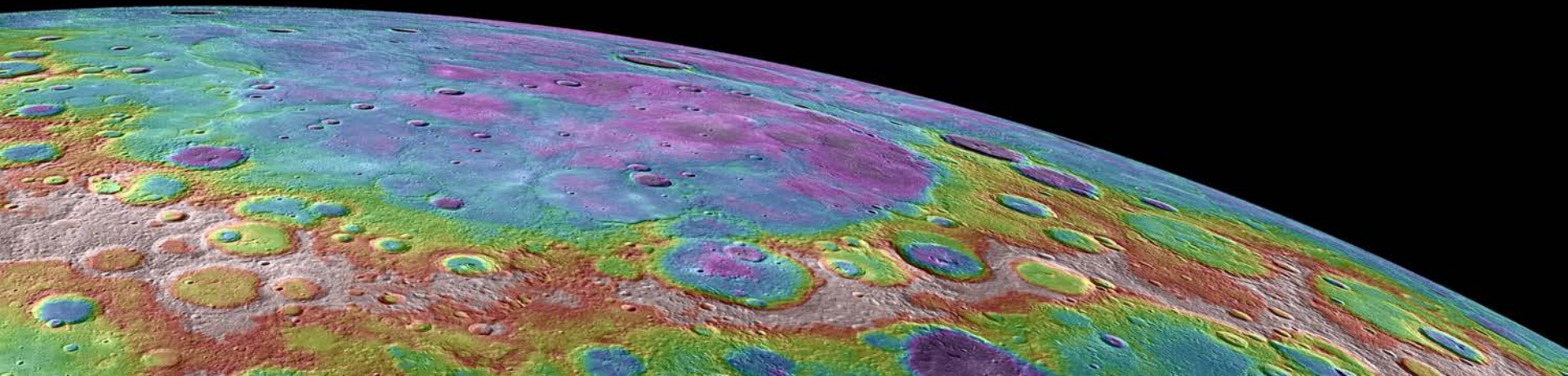


(Zhang and Paige, 2010)

4. What are the physical and geomechanical properties of cold polar regolith and volatiles?



- Support research and analysis of Mercury's polar deposits.
- Support the continued investigation of Mercury with the ESA/JAXA BepiColombo mission.
- Expand Earth-based radar campaigns.
- Develop the concept for and fly one or more missions to explore Mercury's polar deposits.
- In the longer term, develop cryogenic sample analysis, storage, and return capabilities.



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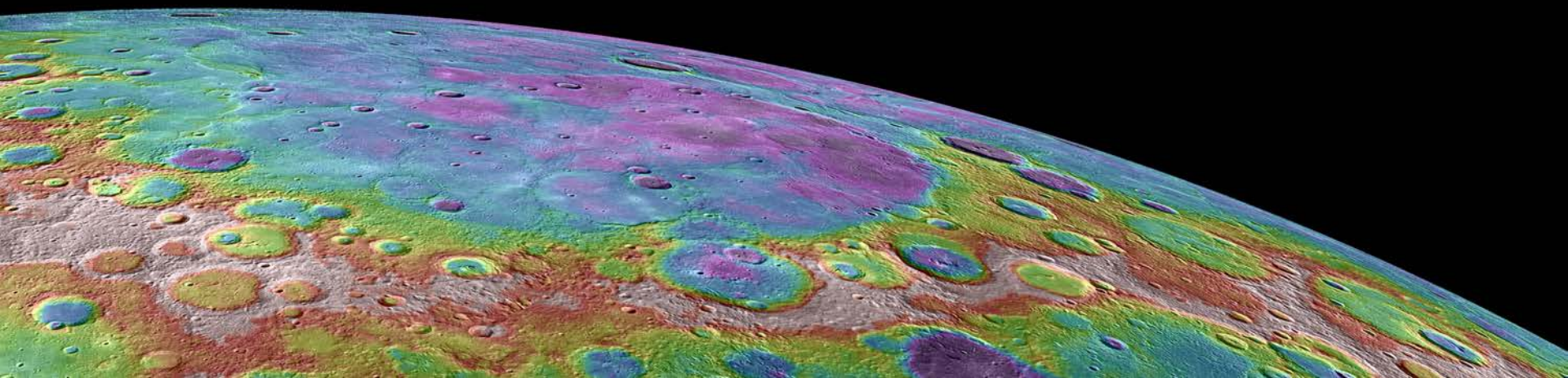

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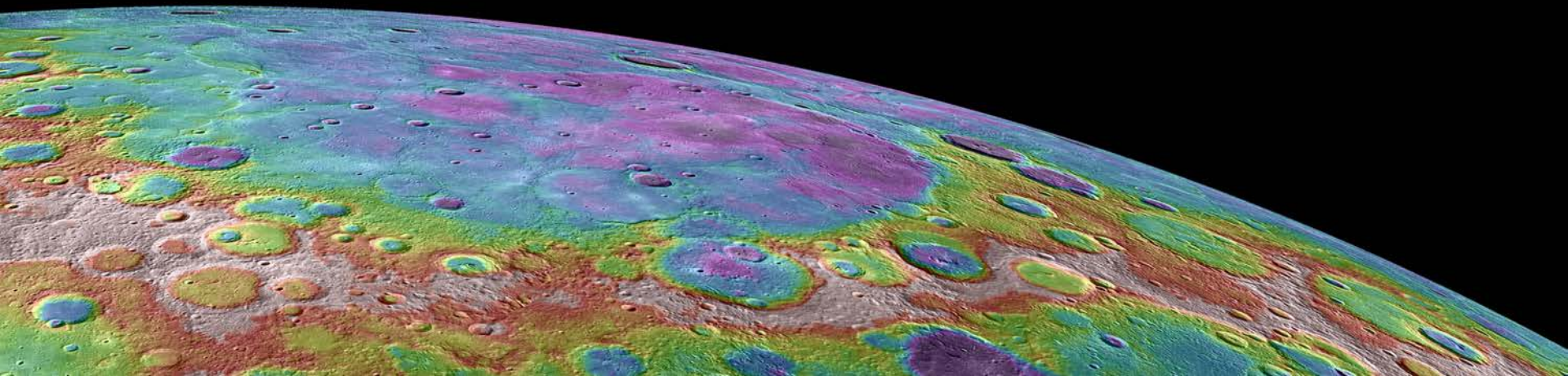

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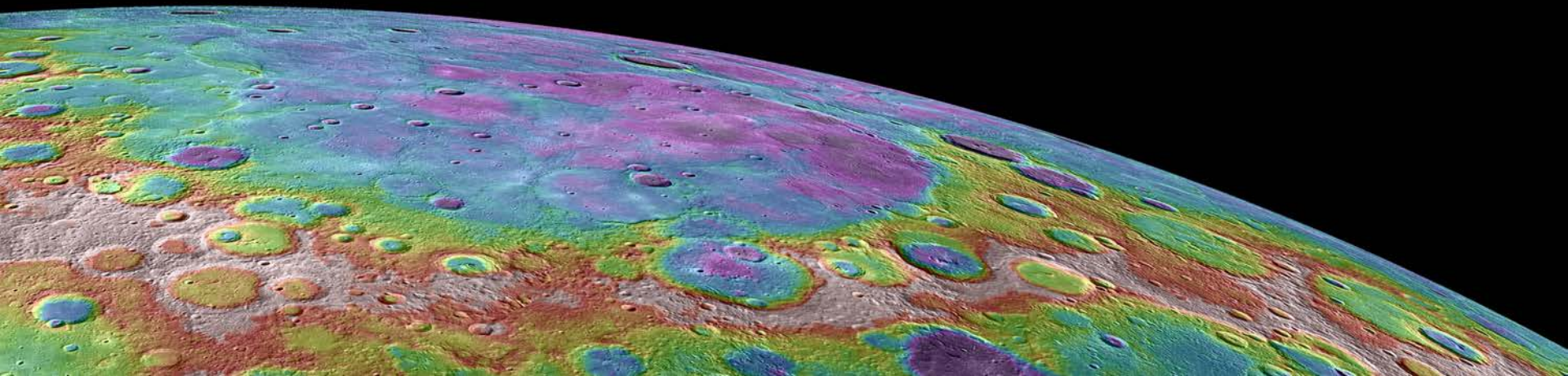

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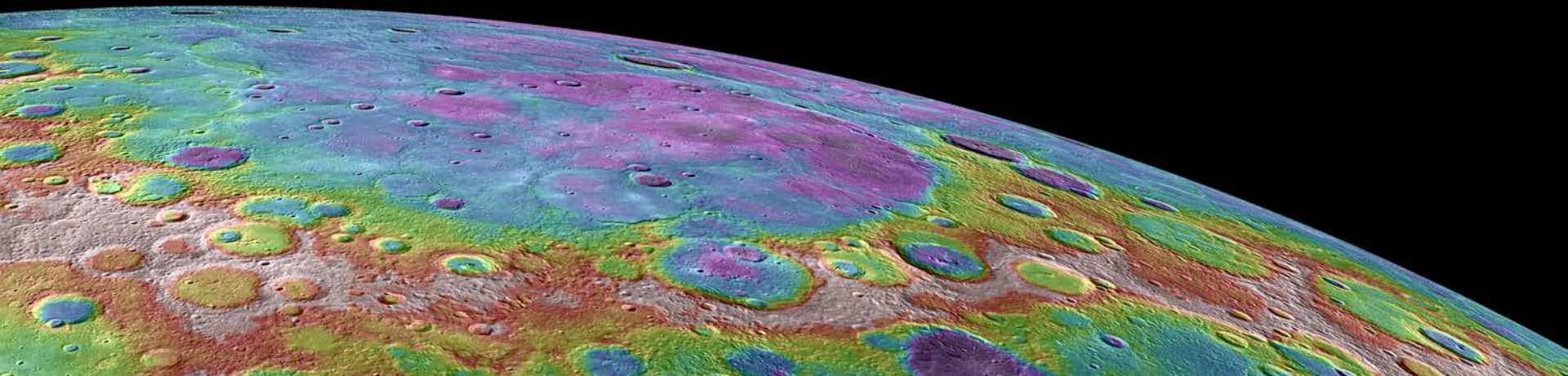

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This coming decade is the time to explore!