2022-10-25 Update

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Outline

I. New project summary
II. Radiogenic HPE demagnetization
    - Goals
    - Crustal heating
    - Temp / depth profile
    - Issues
III. Impact demagnetization

(I) New Project Summary

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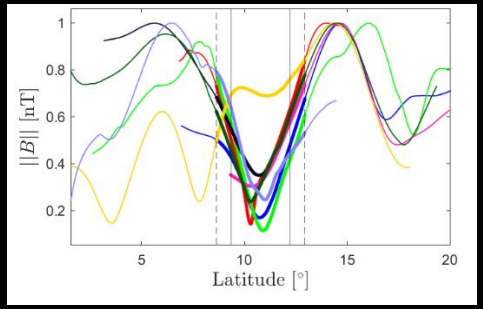
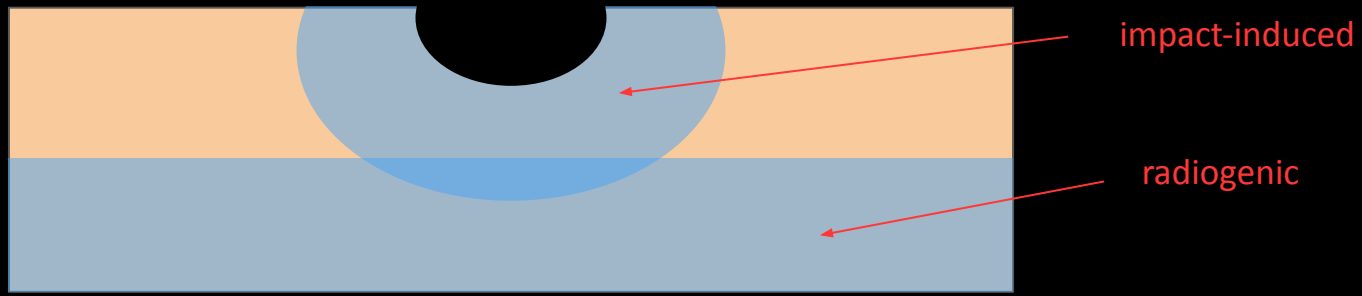


- Motivation:
  - Null result in search for impact-induced demagnetization
  - Compelling examples such as Henry Crater
- Goal:
  1. Constrain expected demagnetization as a function of depth
  2. Compare expected demagnetization to spherical harmonic models of MAVEN magnetometer data



(II) Radiogenic Heating

Overview

1. Calculate heat production in crust due to radioactive elements

2. Model temperature as a function of depth

3. Find depths where ambient temperature is below the curie point of iron – if we both calculate and observe demagnetization here, it's due to the impact

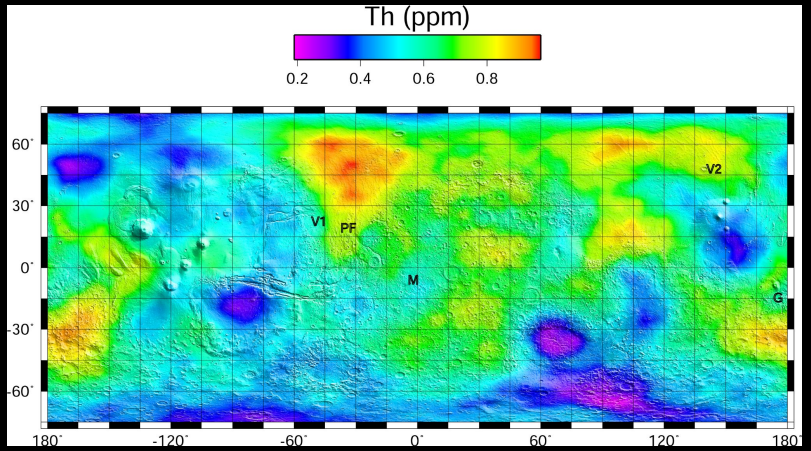
Crustal Heating

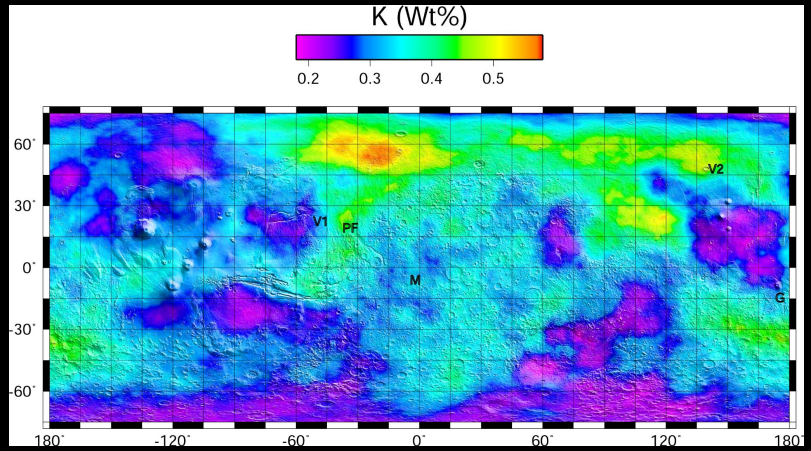
- Main HPEs (heat-producing elements):
  - ^{238}U, ^{235}U, ^{232}Th, ^{40}K
- Calculate crustal heat production with:

$$Q_R = \Sigma H_{A_M} f_{A_M} [M] \exp\left(\frac{0.693\ \Delta\ t}{t_{1/2}^{A_M}}\right)$$

  - isotopic fraction * heat production constant (net energy released per unit mass) * concentration * exponential of time

Concentration of HPEs From GRS maps





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=> Q_c(x,y,t)

Question (if there’s time)

if our time coordinate is 3.6 Ga ago (for Henry crater), wouldn't we have to significantly alter our model to account for heating from the mantle? or is crustal heat production independent of mantle heating? bc i know that currently the mantle is thought to be depleted of HPEs

Overview

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Temperature as a Function of Depth

$$T = T_0 + \frac{q_0}{k}y - \frac{\rho H}{2k}y^2.$$

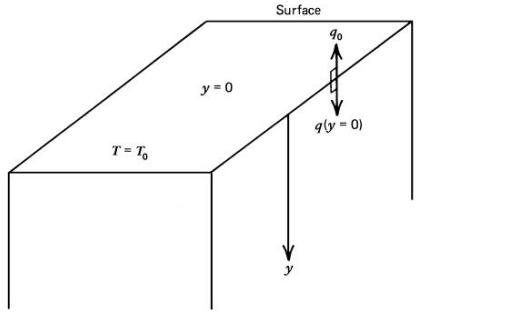

Figure 4.6 Geometry and boundary conditions for integration of Equation (4–12).

$$T = T_0 + \frac{\rho H}{6k}(a^2 - r^2).$$

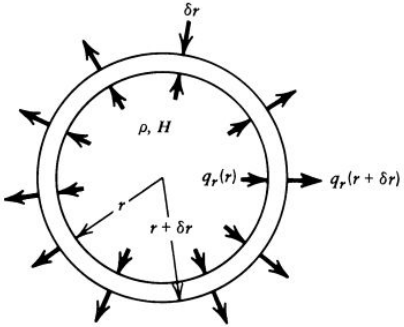

Figure 4.13 Heat flow into and out of a thin spherical shell with internal heat generation.