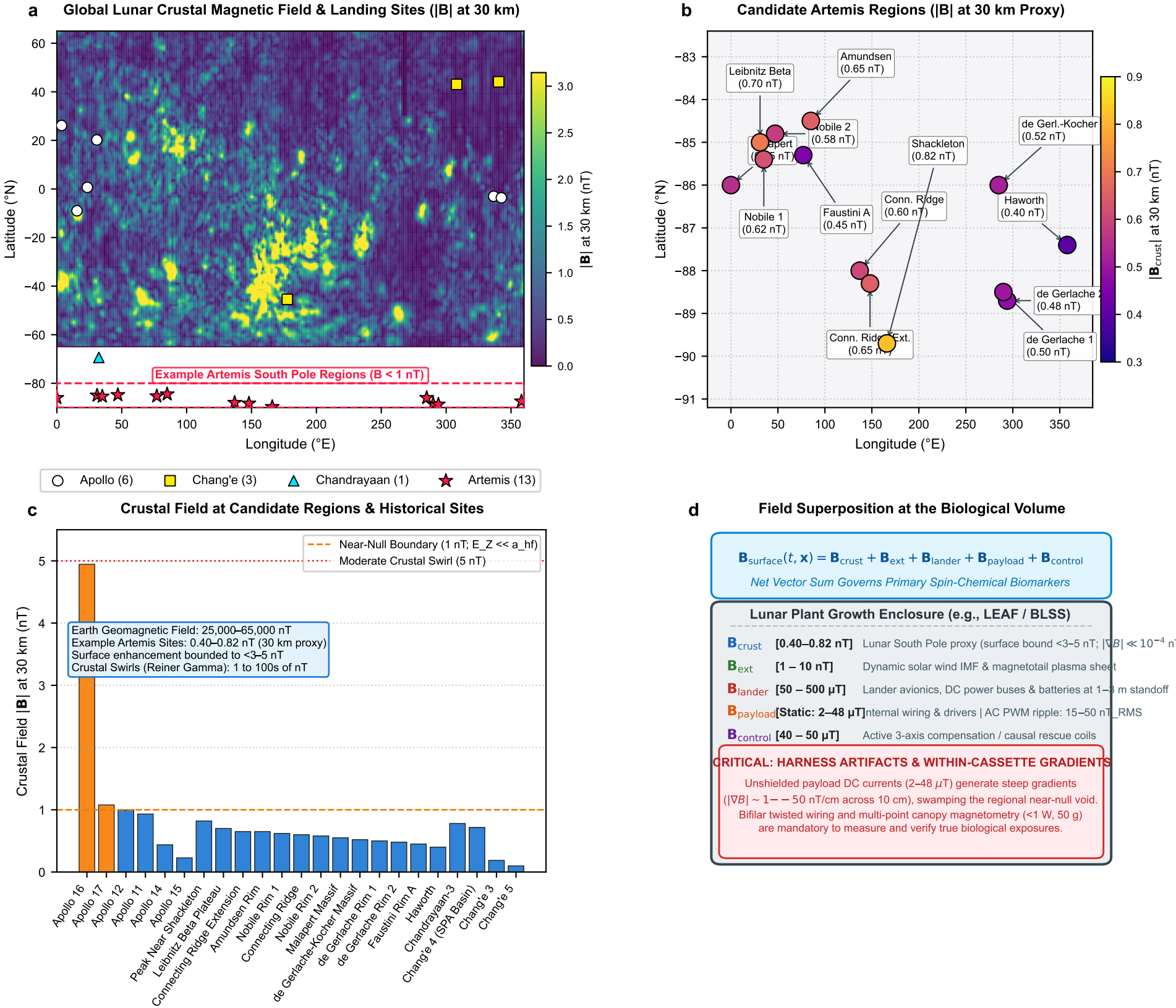

a
Global Lunar Crustal Magnetic Field & Landing Sites (|B| at 30 km)
Latitude (°N)
Longitude (°E)
|B| at 30 km (nT)
Example Artemis South Pole Regions (B < 1 nT)
Apollo (6)
Chang'e (3)
Chandrayaan (1)
Artemis (13)
b
Candidate Artemis Regions (|B| at 30 km Proxy)
Leibnitz Beta (0.70 nT)
Amundsen (0.65 nT)
Nobile 2 (0.58 nT)
Shackleton (0.82 nT)
de Gerl.-Kocher (0.52 nT)
Nobile 1 (0.62 nT)
Faustini A (0.45 nT)
Conn. Ridge (0.60 nT)
Haworth (0.40 nT)
de Gerlache 1 (0.50 nT)
|Bcrust| at 30 km (nT)
c
Crustal Field at Candidate Regions & Historical Sites
Near-Null Boundary (1 nT; E_Z << a_hf)
Moderate Crustal Swirl (5 nT)
Earth Geomagnetic Field: 25,000–65,000 nT
Example Artemis Sites: 0.40–0.82 nT (30 km proxy)
Surface enhancement bounded to <3–5 nT
Crustal Swirls (Reiner Gamma): 1 to 100s of nT
Crustal Field |B| at 30 km (nT)
Apollo 16
Apollo 17
Apollo 12
Apollo 11
Apollo 14
Apollo 15
Peak Near Shackleton
Leibnitz Beta Plateau
Connecting Ridge Extension
Amundsen Rim
Nobile Rim 1
Connecting Ridge
Nobile Rim 2
Malapert Massif
de Gerlache-Kocher Massif
de Gerlache Rim 1
de Gerlache Rim 2
Faustini Rim A
Haworth
Chandrayaan-3
Chang'e 3 (SPA Basin)
Chang'e 3
Chang'e 5
d
Field Superposition at the Biological Volume
$\mathbf{B}_{surface}(t, \mathbf{x}) = \mathbf{B}_{crust} + \mathbf{B}_{ext} + \mathbf{B}_{lander} + \mathbf{B}_{payload} + \mathbf{B}_{control}$
Net Vector Sum Governs Primary Spin-Chemical Biomarkers
Lunar Plant Growth Enclosure (e.g., LEAF / BLSS)
$\mathbf{B}_{crust}$ [0.40–0.82 nT] Lunar South Pole proxy (surface bound <3–5 nT; $|\nabla B| \ll 10^{-4}$ nT/cm)
$\mathbf{B}_{ext}$ [1 – 10 nT] Dynamic solar wind IMF & magnetotail plasma sheet
$\mathbf{B}_{lander}$ [50 – 500 μT] Lander avionics, DC power buses & batteries at 1–3 m standoff
$\mathbf{B}_{payload}$ [Static: 2–48 μT] Internal wiring & drivers | AC PWM ripple: 15–50 nT_RMS
$\mathbf{B}_{control}$ [40 – 50 μT] Active 3-axis compensation / causal rescue coils
CRITICAL: HARNESS ARTIFACTS & WITHIN-CASSETTE GRADIENTS
Unshielded payload DC currents (2–48 μT) generate steep gradients
($|\nabla B| \sim 1 - - 50$ nT/cm across 10 cm), swamping the regional near-null void.
Bifilar twisted wiring and multi-point canopy magnetometry (<1 W, 50 g)
are mandatory to measure and verify true biological exposures.