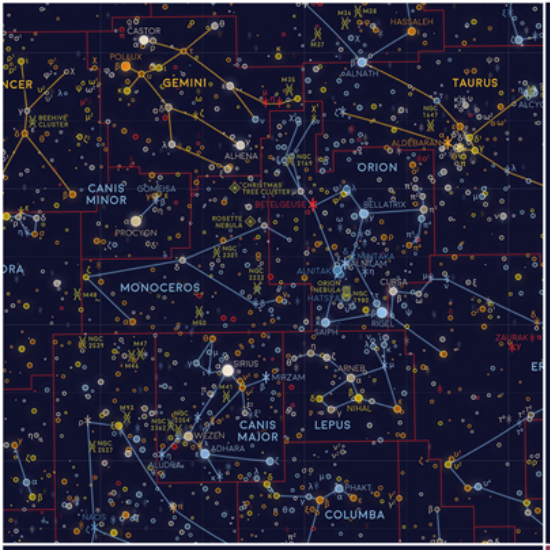
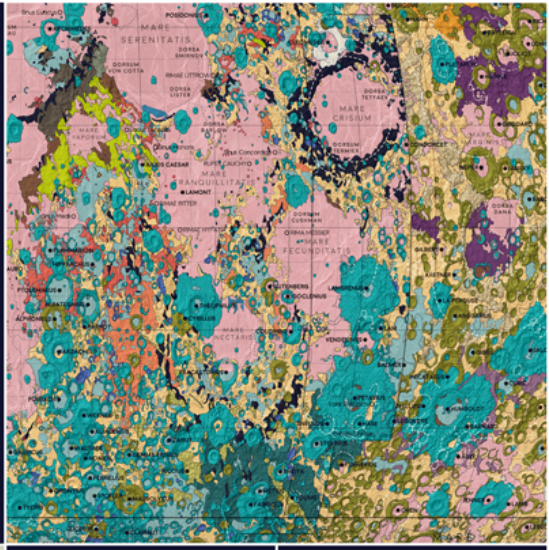
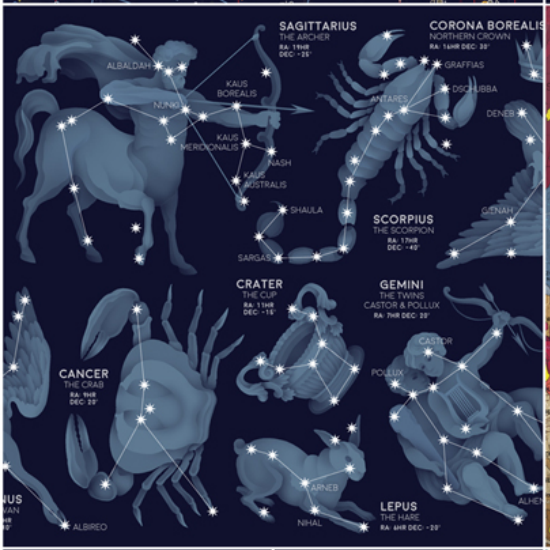
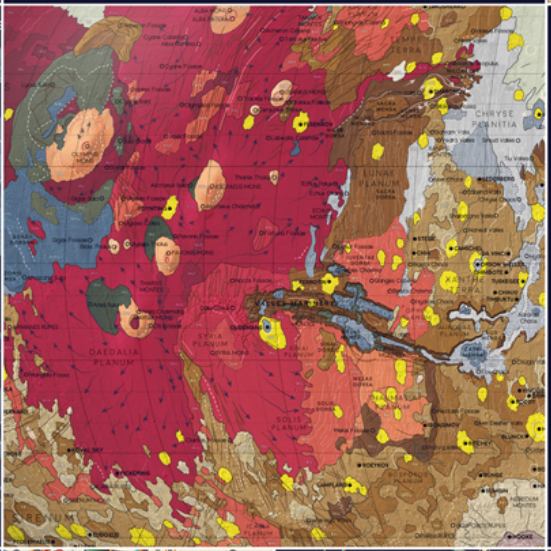
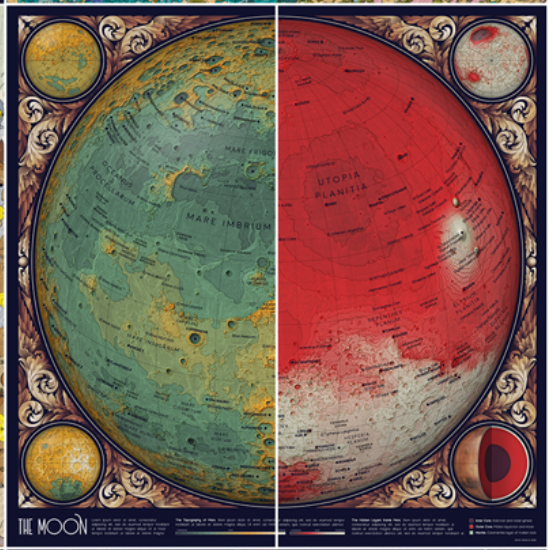

GEMINI
TAURUS
ORION
CANIS MINOR
MONOCEROS
CANIS MAJOR
LEPUS
COLUMBA

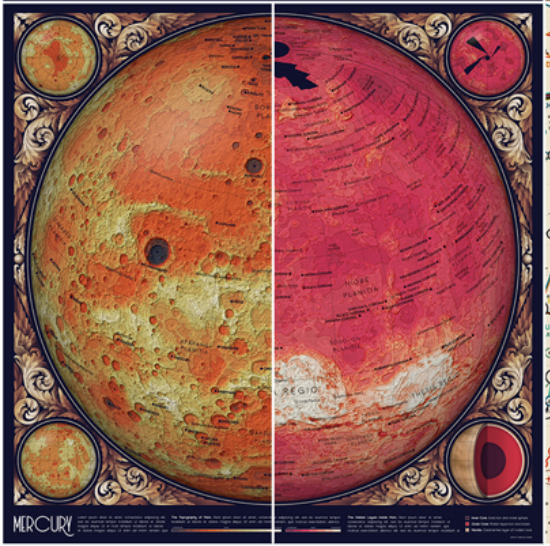
THE EARTH

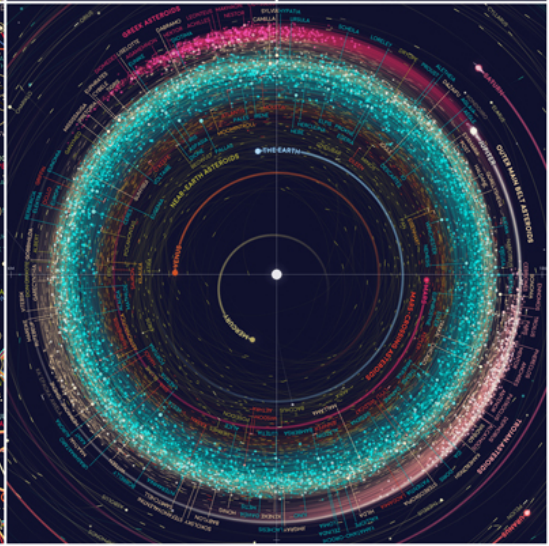


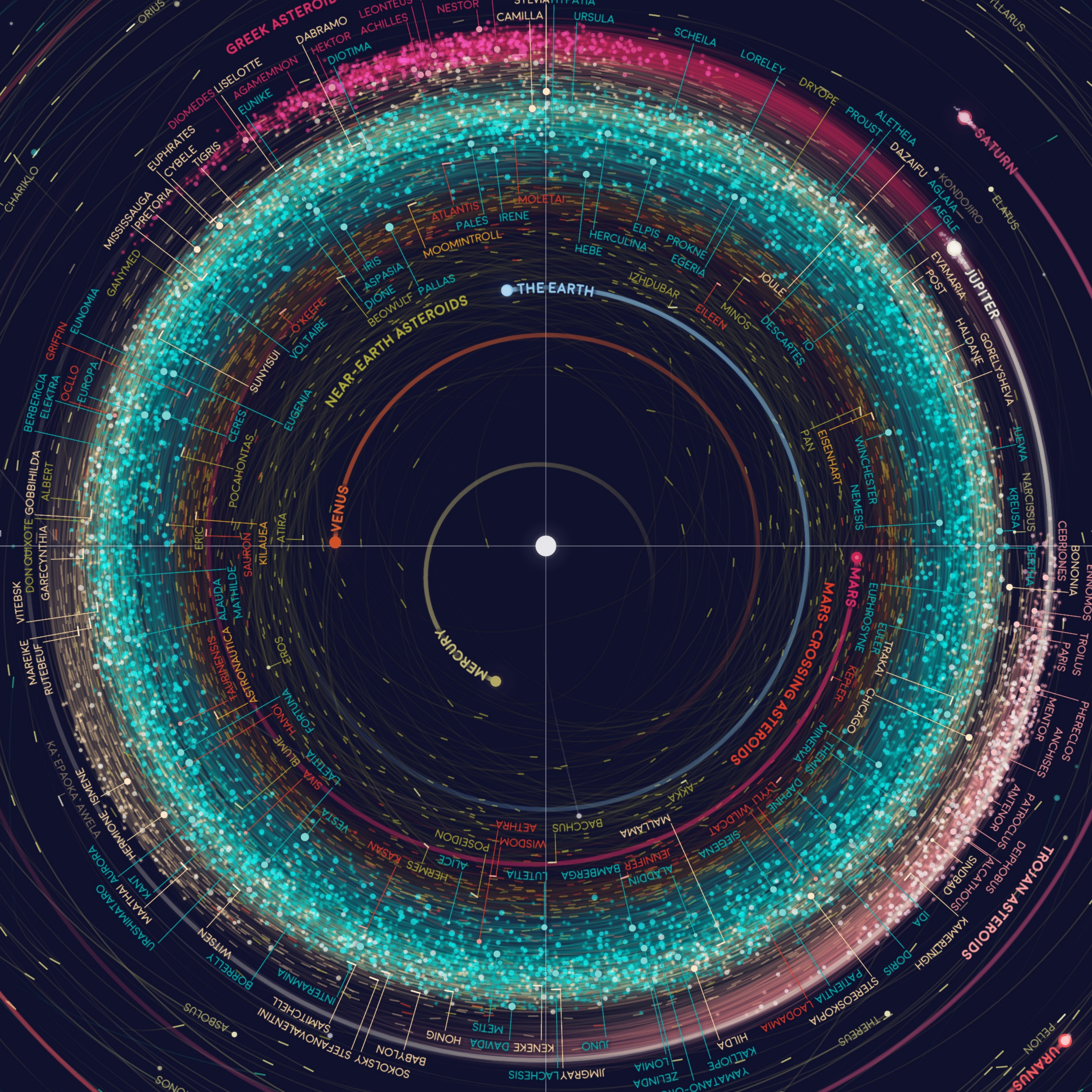

SAGITTARIUS
THE ARCHER
RA: 19HR
DEC: -28°
CORONA BOREALIS
NORTHERN CROWN
RA: 16HR DEC: 30°
SCORPIUS
THE SCORPION
RA: 17HR
DEC: -40°
CRATER
THE CUP
RA: 11HR
DEC: -15°
GEMINI
THE TWINS
CASTOR & POLLUX
RA: 7HR DEC: 20°
CANCER
THE CRAB
RA: 9HR
DEC: 20°
LEPUS
THE HARE
RA: 6HR DEC: -20°

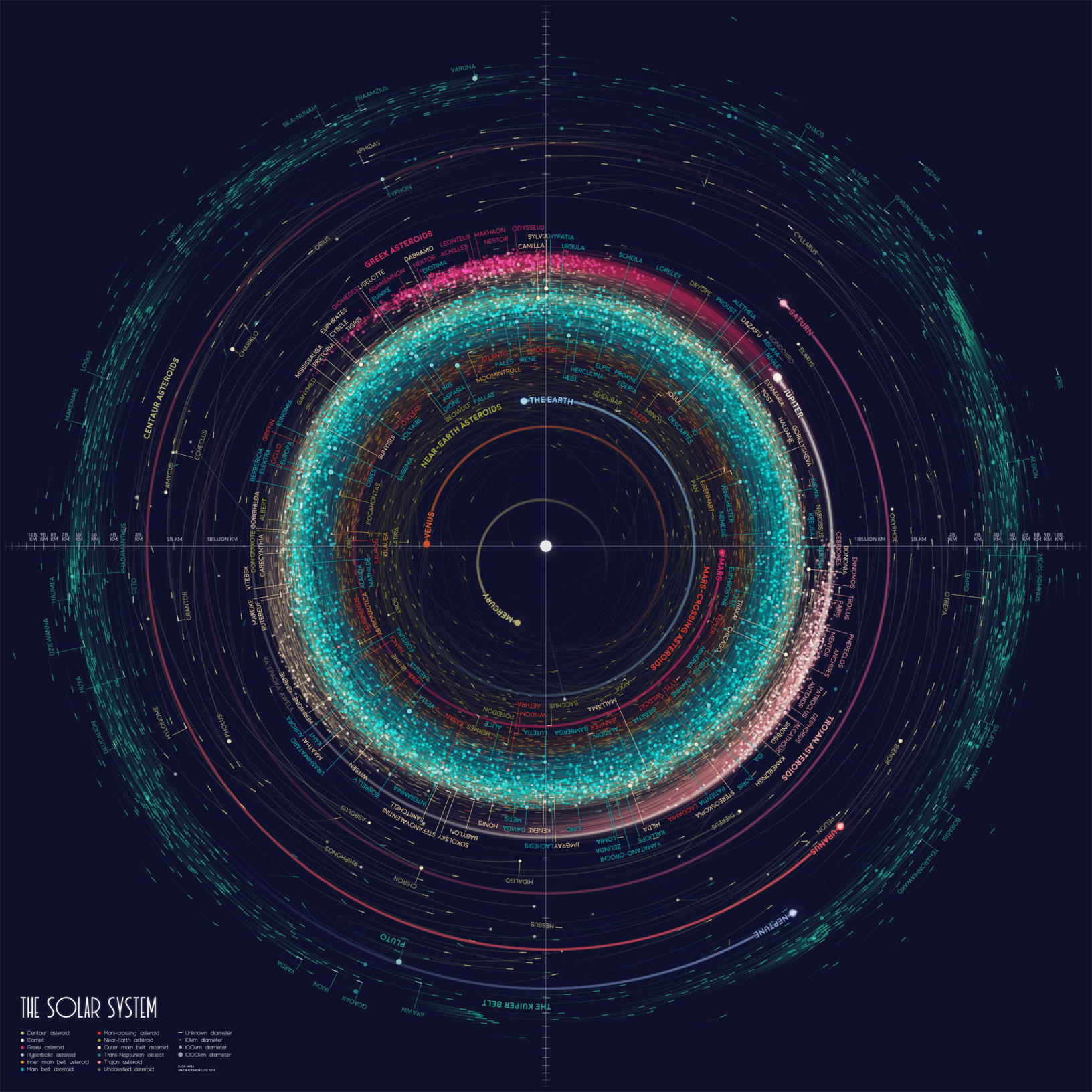


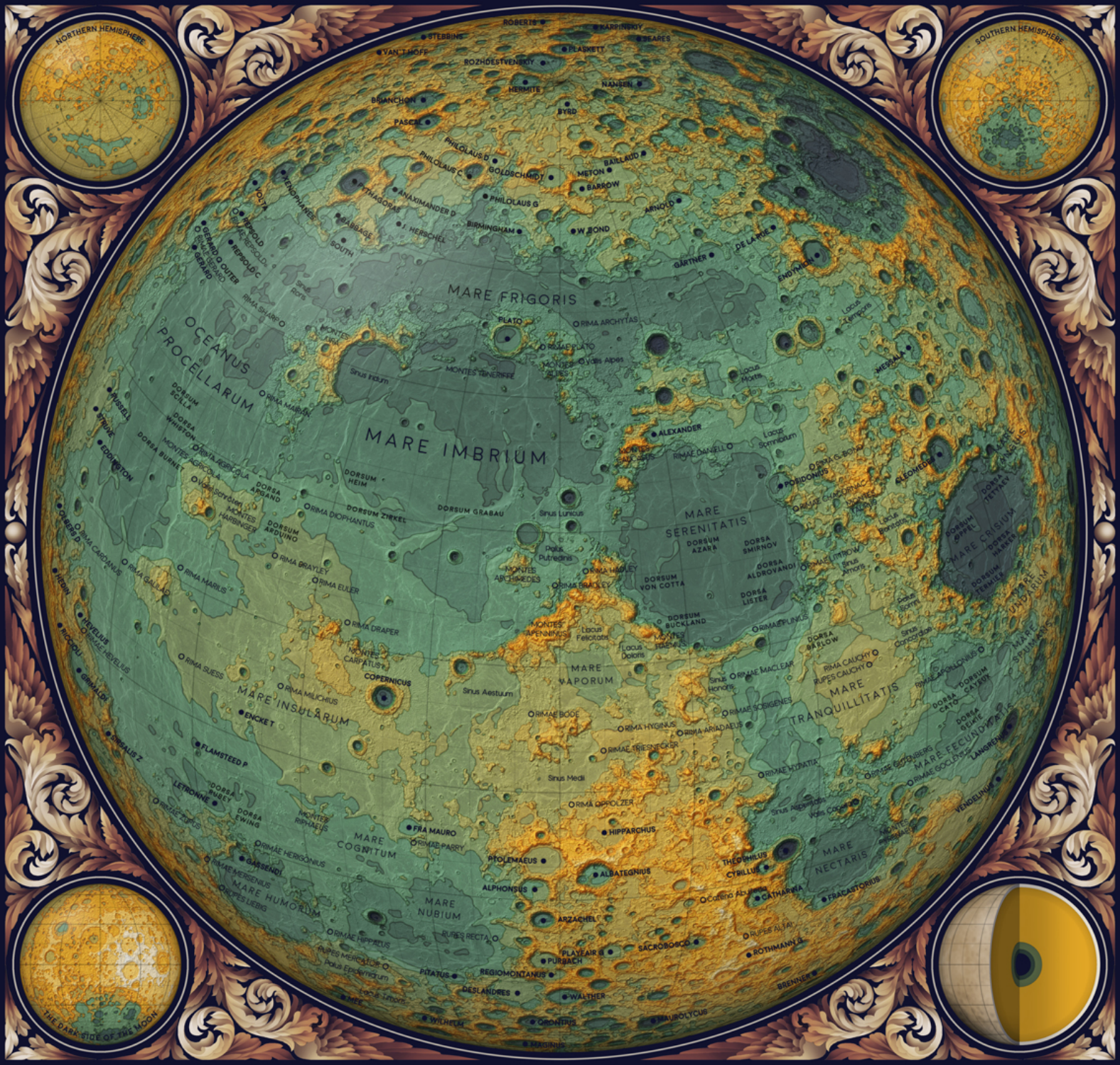

THE MOON


MERCURY




GREEK ASTEROIDS
NEAR-EARTH ASTEROIDS
MARS-CROSSING ASTEROIDS
TROJAN ASTEROIDS
THE EARTH
VENUS
MERCURY
MARS
JUPITER
SATURN
URANUS
LEONTEUS
NESTOR
CAMILLA
URSULA
DABRAMO
HEKTOR
ACHILLES
DIOTIMA
LISELOTTE
AGAMEMNON
EUNIKE
DIOMEDES
EUPHRATES
CYBELE
TIGRIS
CHARIKLO
MISSISSAUGA
PRETORIA
GANYMED
EUNOMIA
GRIFFIN
BERBERICIA
ELEKTRA
OCLLO
EUROPA
GOBBIHILDA
ALBERT
DON QUIXOTE
GARECYNTHIA
VITEBSK
MAREIKE
RUTEBEUF
SCHEILA
LORELEY
DRYOPE
PROUST
ALETHEIA
DAZAIFU
KONDOJIRO
ELATUS
AGLAJA
AEGLE
EVAMARIA
POST
HALDANE
GORELYSHEVA
IUEWA
NARCISSUS
KREUSA
CEBRIONES
BONONIA
ENNOMOS
BERTHA
TROILUS
PARIS
PHERECLOS
MENTOR
ANCHISES
ANTENOR
PATROCLUS
DEIPHOBUS
ALCATHOUS
SINDBAD
KAMERLINGH
IDA
DORIS
PELION
ATLANTIS
MOLETAI
PALES
IRENE
MOOMINTROLL
HERCULINA
ELPIS
PROKNE
HEBE
EGERIA
IRIS
ASPASIA
DIONE
PALLAS
BEOWULF
IZHDUBAR
JOULE
MINOS
EILEEN
DESCARTES
IO
O'KEEFE
VOLTAIRE
SUNYISUI
EUGENIA
CERES
POCAHONTAS
ERIC
SAURON
KILAUEA
ATIRA
ALAUDA
MATHILDE
TAURINENSIS
ASTRONAUTICA
EROS
PAN
EISENHART
WINCHESTER
NEMESIS
EUPHROSYNE
EULER
TRAKAI
KEPLER
CHICAGO
MINERVA
THEMIS
DAPHNE
LYLI
WILDCAT
SIEGENA
MALLAMA
AKKA
BACCHUS
WISDOM
AETHRA
POSEIDON
ALICE
HERMES
KASAN
LUTETIA
BAMBERGA
JENNIFER
ALADDIN
FORTUNA
IONIA
HANDA
BLUME
LAETITIA
SIVA
VESTA
HERMIONE
ISMENE
KANT
AURORA
MATHAI
URASHIMATARO
WITSEN
BORRELLY
INTERAMNIA
SAMITCHELL
IIVALENTINI
STEFANOVALENTINI
SOKOLSKY
BABYLON
HONIG
METIS
DAVIDA
KENEKE
LACHESIS
JIMGRAY
JUNO
LOMIA
ZELINDA
HILDA
KALLIOPE
YAMATANO-OROCHI
LAODAMIA
PATIENTIA
STEREOSKOPIA
THEREUS
ASBOLUS
ORIUS
SYLVIA
HYPATIA
CYLLARUS
KA'EPAOKA'AWELA

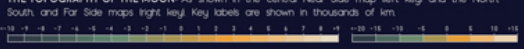

THE SOLAR SYSTEM
Centaur asteroid
Comet
Greek asteroid
Hyperbolic asteroid
Inner main belt asteroid
Main belt asteroid
Mars-crossing asteroid
Near-Earth asteroid
Outer main belt asteroid
Trans-Neptunian object
Trojan asteroid
Unclassified asteroid
Unknown diameter
10km diameter
100km diameter
1000km diameter
DATA: NASA
MAP: @LEANDR LUTZ 2019
THE EARTH
MERCURY
VENUS
MARS
JUPITER
SATURN
URANUS
NEPTUNE
PLUTO
GREEK ASTEROIDS
CENTAUR ASTEROIDS
NEAR-EARTH ASTEROIDS
MARS CROSSING ASTEROIDS
TROJAN ASTEROIDS
THE KUIPER BELT
1BILLION KM
2B. KM
3B KM
4B KM
5B KM
6B KM
7B KM
8B KM
9B KM
10B KM



THE MOON

The Moon probably formed about 4.5 billion years ago when a Mars-sized object impacted the Earth. The Moon is tidally locked to the Earth, so the near side always faces the Earth.

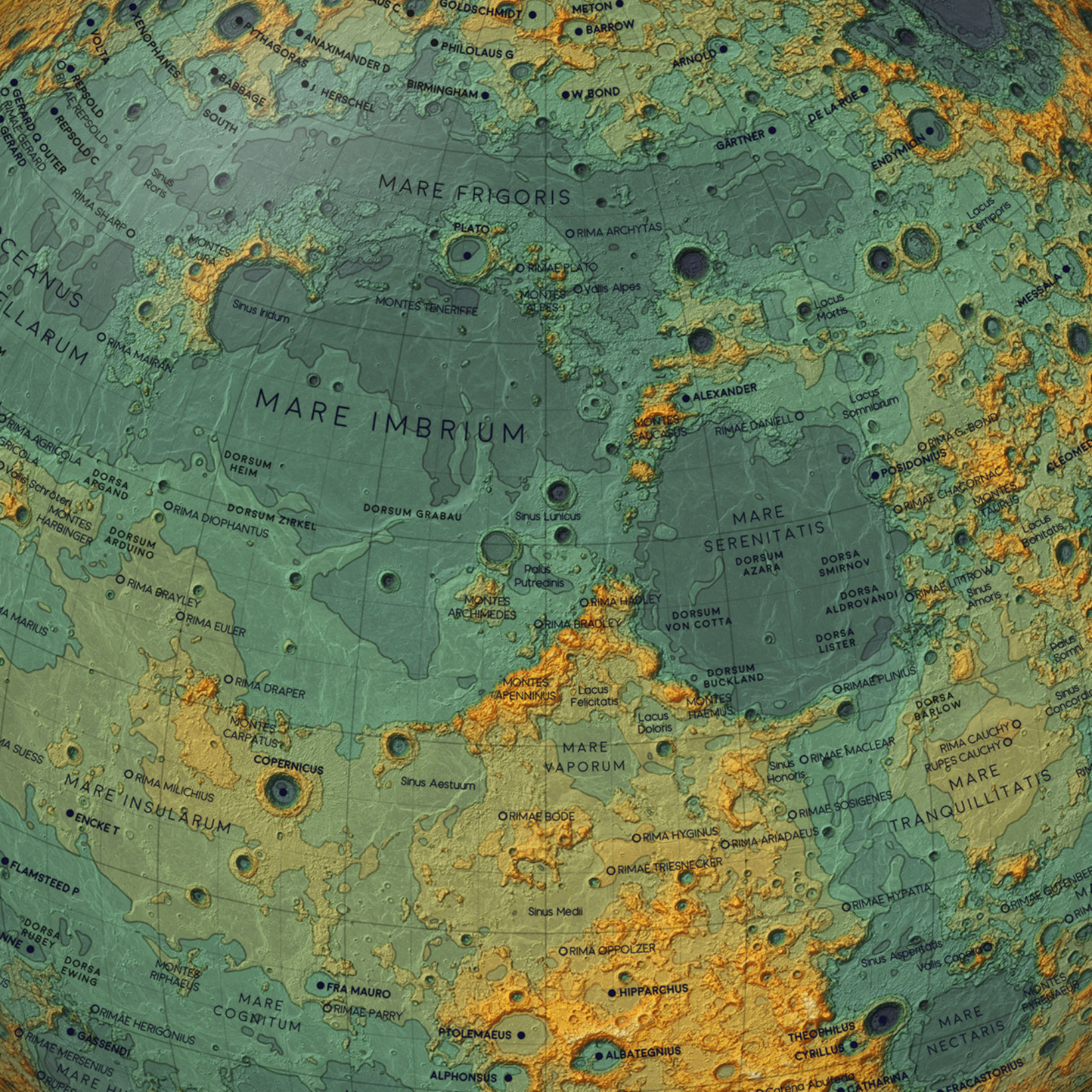
THE TOPOGRAPHY OF THE MOON: As shown in the central Near Side map (left key) and the North, South, and Far Side maps (right key). Key labels are shown in thousands of km.



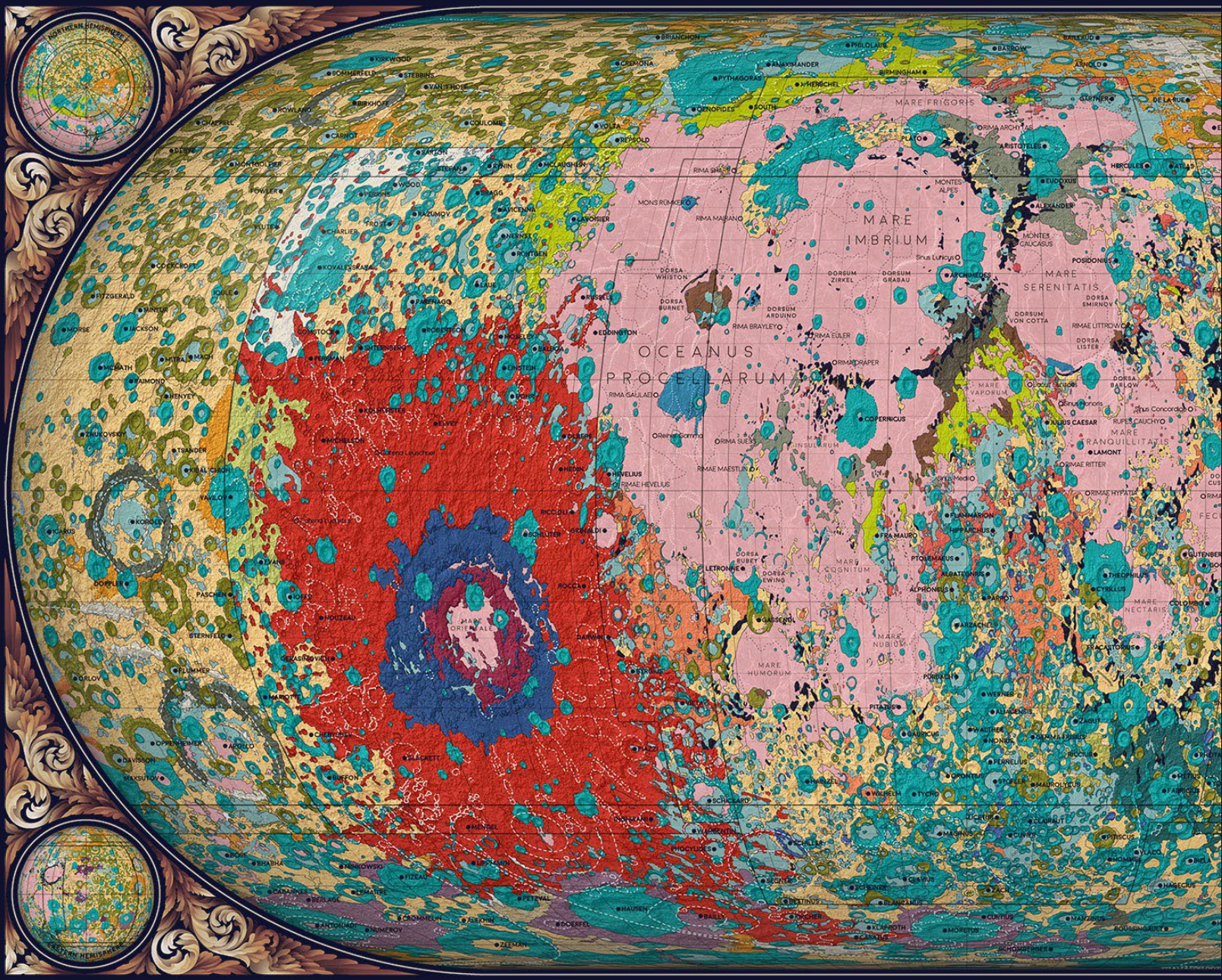
THE SURFACE OF THE MOON: The near and far sides of the moon are dramatically different, featuring dark plains and maria on the near side and highlands on the far side.

- **Solid Inner Core:** Iron-rich
- **Liquid Iron Shell:** 90km thick
- **Partially Molten Layer**
- **Mantle:** Olivine and pyroxene
- **Crust:** ~70km (near side) to ~150km (far side) thick

DATA: NASA & USGS. MAP: ©ELEANOR LUTZ 2019


GOLDSCHMIDT
METON
BARROW
VOLTA
XENOPHANES
PYTHAGORAS
ANAXIMANDER D
PHILOLAUS G
ARNOLD
REPSOLD
RIMAE REPSOLD
BABBAGE
J. HERSCHEL
BIRMINGHAM
W. BOND
DE LA RUE
GERARD Q OUTER
RIMAE GERARD
REPSOLD C
GERARD
SOUTH
GÄRTNER
ENDYMION
Sinus Roris
MARE FRIGORIS
RIMA SHARP O
PLATO
RIMA ARCHYTAS
Lacus Temporis
MONTES JURA
RIMAE PLATO
Vallis Alpes
MONTES ALPES
MESSALA
MONTES TENERIFFE
Sinus Iridum
Lacus Mortis
RIMA MAIRAN
MARE IMBRIUM
ALEXANDER
Lacus Somniorum
MONTES CAUCASUS
RIMAE DANIELL
RIMA G. BOND
POSIDONIUS
RIMA AGRICOLA
DORSUM HEIM
DORSA ARGAND
Vallis Schröteri
MONTES HARBINGER
DORSUM ZIRKEL
DORSUM GRABAU
RIMAE CHACORNAC
MONTES TAURUS
RIMA DIOPHANTUS
Sinus Lunicus
MARE SERENITATIS
Lacus Bonitatis
DORSUM ARDUINO
DORSUM AZARA
DORSA SMIRNOV
Palus Putredinis
RIMA BRAYLEY
RIMA LITTROW
DORSA ALDROVANDI
Sinus Amoris
MONTES ARCHIMEDES
RIMA HADLEY
RIMA EULER
RIMA BRADLEY
DORSUM VON COTTA
DORSA LISTER
Palus Somni
RIMA DRAPER
DORSUM BUCKLAND
RIMAE PLINIUS
MONTES APENNINUS
Lacus Felicitatis
MONTES HAEMUS
DORSA BARLOW
Sinus Concordiae
MONTES CARPATUS
Lacus Doloris
MARE VAPORUM
RIMAE MACLEAR
RIMA CAUCHY O
RUPES CAUCHY O
COPERNICUS
Sinus Honoris
MARE TRANQUILLITATIS
RIMA MILICHIUS
Sinus Aestuum
MARE INSULARUM
RIMAE SOSIGENES
ENCKE T
RIMAE BODE
RIMA HYGINUS
RIMA ARIADAEUS
RIMAE TRIESNECKER
FLAMSTEED P
RIMAE HYPATIA
RIMAE GUTENBERG
Sinus Medii
DORSA RUBEY
DORSA EWING
RIMA OPPOLZER
Sinus Asperitatis
Vallis Capella
MONTES RIPHAEUS
FRA MAURO
HIPPARCHUS
MARE COGNITUM
RIMAE PARRY
RIMAE HERIGONIUS
PTOLEMAEUS
THEOPHILUS
CYRILLUS
MARE NECTARIS
GASSENDI
ALBATEGNIUS
RIMAE MERSENIUS
ALPHONSUS
CATHARINA
FRACASTORIUS

BRIANCHON
PHILOLAUS
BAILLAUD
KIRKWOOD
CREMONA
BARROW
STEBBINS
ANAXIMANDER
BIRMINGHAM
ARNOLD
PYTHAGORAS
VAN'T HOFF
J. HERSCHEL
BIRKHOFF
MARE FRIGORIS
GÄRTNER
DE LA RUE
OENOPIDES
SOUTH
COULOMB
VOLTA
RIMA ARCHYTAS
ENDYMION
PLATO
REPSOLD
ARISTOTELES
SARTON
STEFAN
RYNIN
MCLAUGHLIN
HERCULES
ATLAS
RIMA SHARP
EUDOXUS
WOOD
MONTES ALPES
PERRINE
BRAGG
MONS RÜMKER
ALEXANDER
RAZUMOV
AVICENNA
MARE IMBRIUM
FROST
LAVOISIER
RIMA MAIRAN
MONTES CAUCASUS
NERNST
RÖNTGEN
Sinus Lunicus
POSIDONIUS
DORSA WHISTON
DORSUM ZIRKEL
DORSUM GRABAU
ARCHIMEDES
MARE SERENITATIS
LAUE
CLEOMEDES
RUSSELL
DORSA SMIRNOV
PARENAGO
DORSA BURNET
DORSUM ARDUINO
DORSUM VON COTTA
RIMA BRAYLEY
RIMAE LITTROW
ROBERTSON
EDDINGTON
RIMA EULER
DORSA LISTER
MOSELEY
BALBOA
OCEANUS PROCELLARUM
SHTERNBERG
RIMA DRAPER
EINSTEIN
MARE VAPORUM
DORSA BARLOW
RIMA GALILAEI
Lacus Felicitatis
BOHR
Sinus Honoris
Sinus Concordiae
KOHLSCHÜTTER
COPERNICUS
JULIUS CAESAR
RUPES CAUCHY
ELVEY
Reiner Gamma
OLBERS
RIMA SUESS
MARE INSULARUM
MARE TRANQUILLITATIS
LAMONT
Catena Leuschner
RIMAE MAESTLIN
RIMAE RITTER
HEDIN
HEVELIUS
RIMAE HEVELIUS
Sinus Medii
RIMAE HYPATIA
DORSUM CUSHMAN
RIMA MESSIER
MARE FECUNDITATIS
RICCIOLI
FLAMMARION
SCHLÜTER
GRIMALDI
HIPPARCHUS
FRA MAURO
DORSA RUBEY
PTOLEMAEUS
GUTENBERG
LANGRENUS
MARE COGNITUM
GOCLENIUS
LETRONNE
ALBATEGNIUS
THEOPHILUS
DORSA EWING
CYRILLUS
ROCCA
ALPHONSUS
PARROT
MARE NECTARIS
COLOMBO
MARE ORIENTALE
VENDELINUS
GASSENDI
ARZACHEL
DARWIN
MARE NUBIUM
FRACASTORIUS
MARE HUMORUM
PURBACH
BYRGIUS
WERNER
SNELLIUS
VIETA
PITATUS
ALIACENSIS
STEVINUS
ZAGUT
WALTHER
GAURICUS
NONIUS
GEMMA FRISIUS
PIAZZI
RICCIUS
RHEITA
BLACKETT
FERNELIUS
OPONTIUS
STÖFLER
MAUROLYCUS
METIUS
HAINZEL
FABRICIUS
YOUNG
WILHELM
TYCHO
SCHICKARD
LICETUS
CLAIRAUT
MENDEL
INGHIRAMI
WARGENTIN
MAGINUS
CUVIER
PITISCUS
PHOCYLIDES
SCHILLER
VLACQ
HOMMEL
BIELA
LIPPMANN
FIZEAU
SEGNER
CLAVIUS
HAGECIUS
PONTÉCOULANT
SCHEINER
PETZVAL
ZACH
DEFINUS
BLANCANUS
HAUSEN
CROMMELIN
ALEKHIN
BAILLY
KIRCHER
CURTIUS
MANZINUS
HELMHOLTZ
NUMEROV
DOERFEL
KLAPROTH
MORETUS
BOUSSINGAULT
NEUMAYER
CASATUS
ZEEMAN



THE MOON

Glowing with reflected sunlight, the Moon is our nearest celestial neighbor and the brightest object in the night sky. The Moon always faces its Near Side towards the Earth, and the center of the Near Side is shown at the center of this geologic map.

The Moon is covered with hundreds of craters formed by meteorites impacting the surface. Because the Moon has no significant atmosphere, there is little wind erosion to obscure the craters once they form. Several huge impacts have created large geologic features still visible today, including the Australe basin on the Southern hemisphere, the Orientale basin on the Southern Far Side, and the Nectaris basin on the Southern Near Side.

From the Apollo missions carrying people to the Moon, we know that the lunar surface is covered by a layer of fine dust. This dust was formed over billions of years by repeated meteorite impacts breaking up the surface rock into tiny particles. When a projectile strikes the Moon, it impacts at a tremendously high speed that vaporizes the meteorite and sends a shock wave through the Moon that fractures the ground. The explosion can be similar to a nuclear bomb detonated at ground level.

GEOLOGIC UNITS

TYPES OF ROCK AND SURFACE DEPOSITS

The majority of the Moon is densely covered with craters, including several huge impact sites. Note that geologic units on this map have been grouped together into similar types of rock, for continuity across the six different geology datasets incorporated into the map.

- **Craters:** Craters formed by meteorites impacting the surface of the Moon.
- **Crater Chains:** Closely spaced clusters of craters that appear chained together.
- **Irregular Craters:** May include clustered impact craters or craters formed by tectonic forces.
- **Secondary Craters:** Smaller craters formed from rocks ejected from a larger impact crater.
- **Furrowed Craters:** Ridged or textured crater floors. Probably filled with lava post-impact.
- **Subdued Craters:** Older craters that are worn, eroded, or covered by newer impact craters.
- **Orientale Basin:** Terrain features surrounding the Orientale basin impact crater.
- **Basins:** Miscellaneous basin features or unspecified basin geology.
- **Rugged Basins:** Small peaks and ridges, mostly found in and around older basins.
- **Hertzsprung Basin:** Partially buried secondary craters from Hertzsprung impact.
- **Basin Walls:** Mountainous rims and walls that form rings surrounding basins.
- **Lineated Basins:** Basins marked with straight lines of small ridges or channels.
- **Mares:** Large, dark basalt plains with a smooth surface.
- **Plains:** Flat ground with overlying impact craters, probably volcanic in origin.
- **Terrain:** Gently rolling terrain of lighter color. Smooth and level with some hills.
- **Hilly and Furrowed Ground:** Closely spaced hills about 3-5km long and 2-6km wide.
- **Lineated Material:** Terrain marked with straight lines of small ridges or channels.
- **Domes:** Domes of smooth, elevated terrain. Most have no craters or furrows.
- **Alpine Formation:** Closely spaced hills 2-5km in diameter, blocky but smooth-surfaced.
- **Mountains:** Rugged mountain ranges and segments of mountains.
- **Dark Ground:** Patches of dark material, possibly volcanic in origin.
- **Hills:** Numerous small hills clustered closely together.
- **Hilly Plateau:** Plateau featuring smooth, low domes and hills.
- **Montes Rook:** Large ring of mountains marking the impact site of Orientale basin.
- **Janssen Formation:** Ridged and grooved terrain found nearby Mare Nectaris.
- **Maunder Formation:** Smooth to intensely fractured plains surrounding Mare Orientale.
- **Fra Mauro Highlands:** Named for the Fra Mauro Crater. Landing site of Apollo 14.
- **Furrowed and Pitted Ground:** Other types of unspecified furrowed or ridged terrain.
- **Unknown:** Missing or incomplete data from original geologic maps.

GEOLOGIC STRUCTURES

FRACTURES AND FOLDS IN THE GROUND

By studying the physical structures on the surface of the Moon, scientists can understand the geologic history of events such as past volcanic eruptions or meteorite impacts.

GEOLOGIC CONTACT: Black line on map!

A boundary separating one rock type from its neighboring rock. Dashed contacts are inferred, approximate, concealed, or gradated.

BASIN RING CREST

The outer edge of large basin depressions. Some basins are multi-ringed like a bull's-eye.

BURIED CRATER RIM CREST

The outer edge of craters hidden or covered by newer geologic formations.

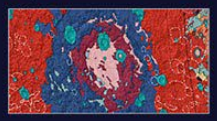
RIDGE

A continuous elevated crest caused by erosion or volcanic activity.

MARE ORIENTALE

THE BULLS-EYE ON THE FAR SIDE OF THE MOON

The Orientale basin is a giant, multi-ringed crater formed by a meteorite impact. Although the entire area is about 1000km across, it is difficult to see from Earth because it lies on the very edge of the far side of the Moon. The area consists of extremely rugged ground near the center, fading into smoother terrain further from the impact site. A basalt mare fills the center of the basin. The smooth terrain directly surrounding the mare is probably made of rock that instantaneously melted at the site of impact.



LANDING SI

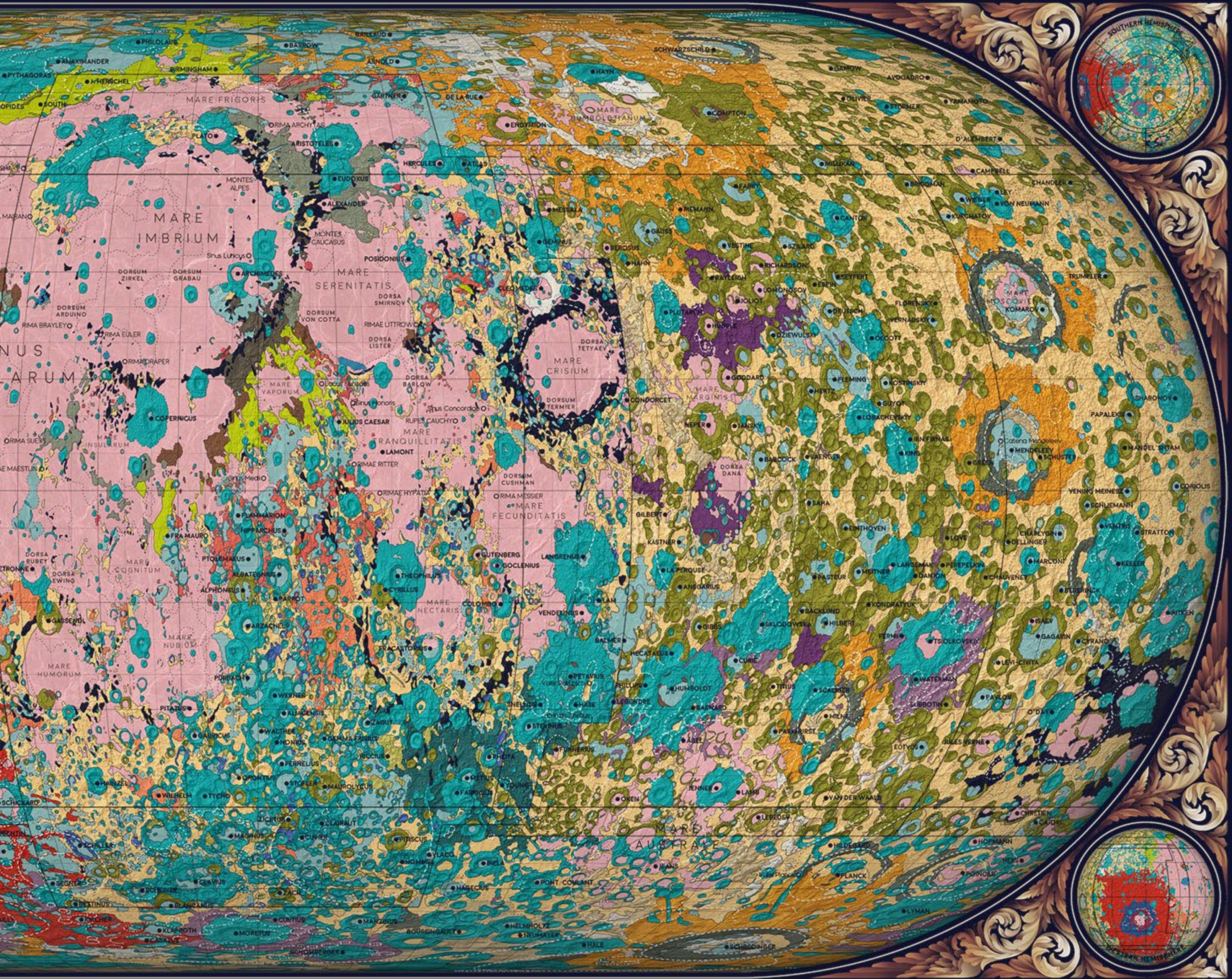
SPACECRAFT ON

THE SPACE RACE

Of the many m
the majority exp
there are many
Moon, and this
or failed missio
landings. Notably
landed on the
from the Apollo

KEY & EXAMPLE

- 1958-1960: spacecraft
- 1960-1970: humans to
- 1970-1980: returned co
- 1990-2000: crashed into
- 2000-2010: crashed into
- 2010-2020: soft landing



Closely spaced hills 2-5km … but smooth-surfaced.

… mountain ranges and …tains.

…hes of dark material … origin.

…all hills clustered closely

…au featuring smooth, low

…e ring of mountains …t site of Orientale basin.

… Ridged and grooved …by Mare Nectaris.

…: Smooth to intensely …rounding Mare Orientale.

…de: Named for the Fra …ing site of Apollo 14.

…d Ground: Other types …owed or ridged terrain.

…r incomplete data from …maps.

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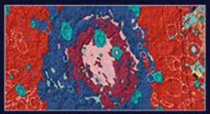


LANDING SITES

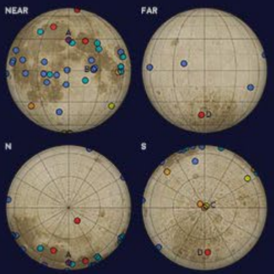
SPACECRAFT ON THE LUNAR SURFACE

THE SPACE RACE

Of the many missions that landed on the Moon, the majority explored the near side. By now there are many man-made objects on the Moon, and this map includes several crash-landed or failed missions in addition to successful landings. Notably, only twelve people have ever landed on the Moon - all of them astronauts from the Apollo space program.

KEY & EXAMPLE SPACECRAFT

- **1950-1960:** Luna 2 (A) was the first spacecraft to land on the Moon in 1959.
- **1960-1970:** Apollo 11 (B) carried the first humans to set foot on the Moon.
- **1970-1980:** The 70's Apollo missions returned over 200kg of samples to Earth.
- **1990-2000:** The Lunar Prospector (C) crashed into the South Pole in 1999.
- **2000-2010:** Several probes intentionally crashed into the Moon to detect water.
- **2010-2020:** Chang'e 4 (D) achieved the first soft landing on the first side of the Moon.



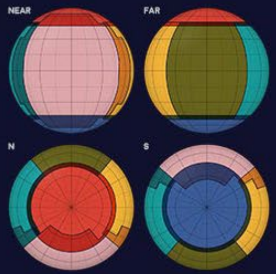
MAPPING THE MOON

PIECING TOGETHER THE DATA SOURCES

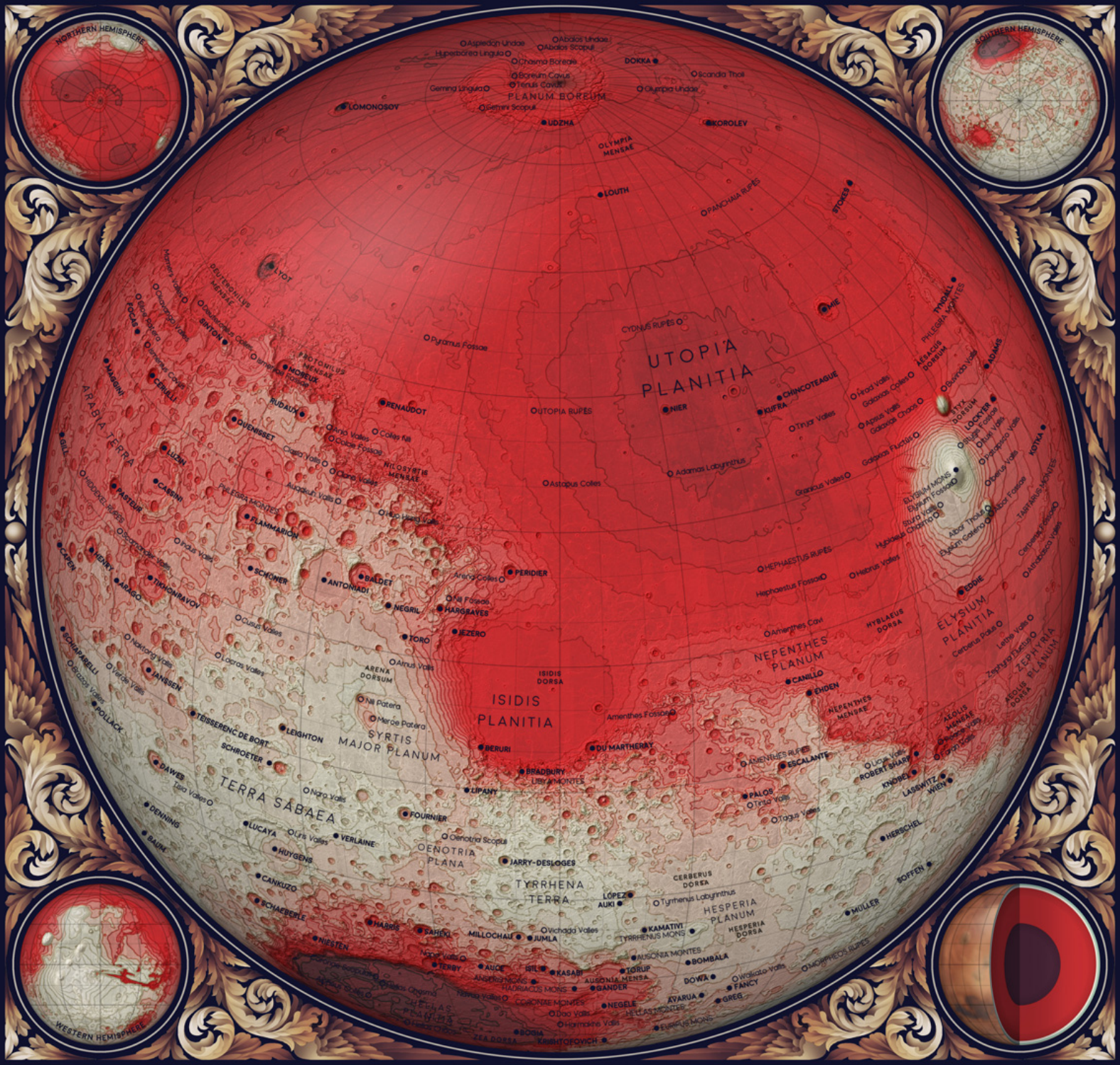
The geology of the Moon was first mapped in the 1970s using data from the Lunar Orbiter, Zond 7, Zond 8, Mariner 10, Apollo 15-17, and telescope photographs. In 2013 all six maps were compiled into one digital version by the US Geologic Survey. Some geologic features differ by map, so individual map borders are shown here and also overlaid on the map above.

DATA SOURCES AND DATES

- 1971: Don Wilhelms & John McCauley. I-703: Near Side Map.
- 1977: Don Wilhelms & Farouk El-Baz. I-948: East Side Map.
- 1977: David Scott, John McCauley, & Mareta West. I-1034: West Side Map.
- 1978: Desiree Stuart-Alexander. I-1047: Central Far Side Map.
- 1978: Baerbel Lucchitta. I-1062: North Side of the Moon.
- 1979: D.E. Wilhelms & H.G. Wilshire. I-1162: South Side of the Moon.



DATA: IAU, USGS, NASA PDS, LOLA SCIENCE TEAM. MAP: @ELEANOR LUTZ 2019



MARS

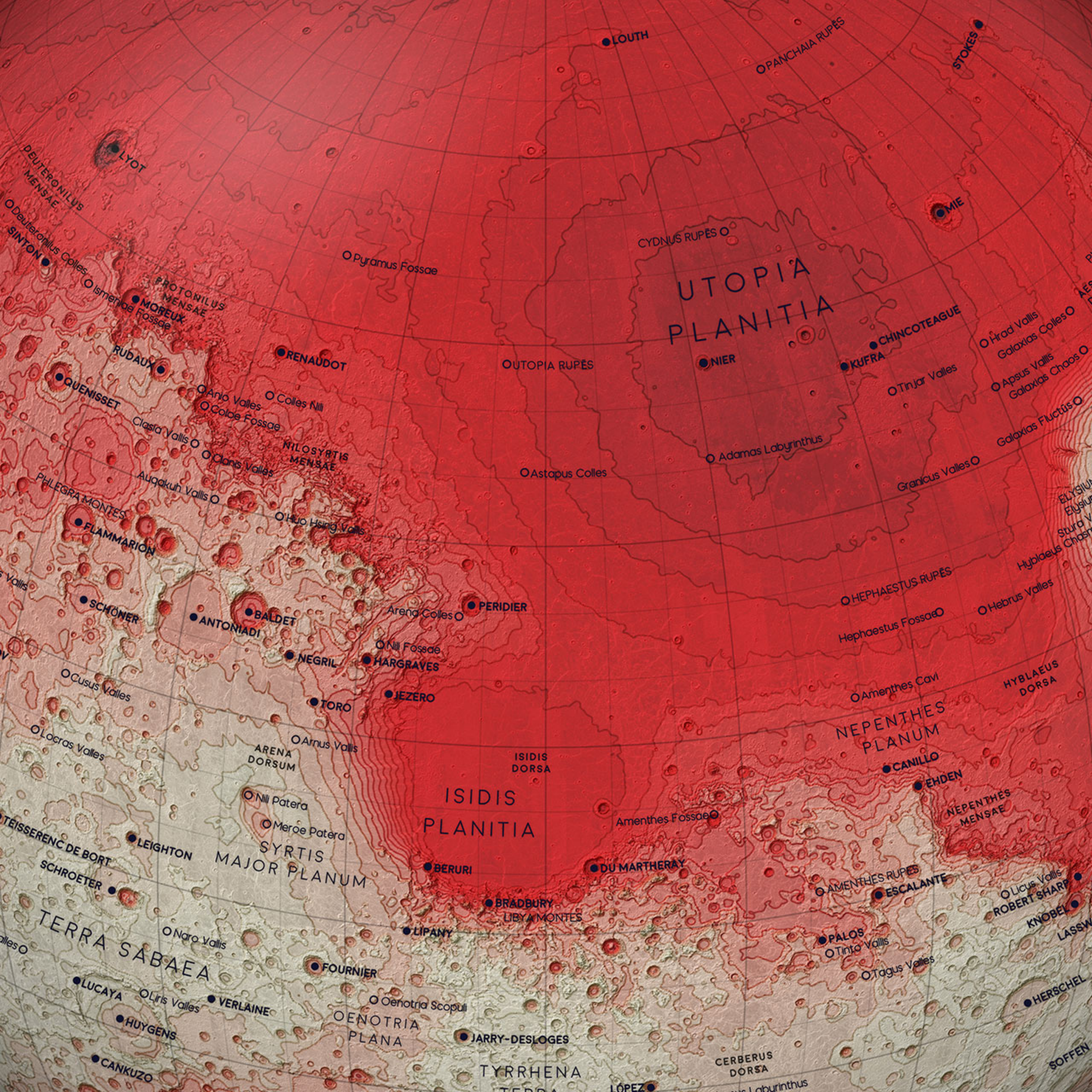
Mars is home to a huge canyon system called the Valles Marineris, as well as the largest volcano in the solar system, Olympus Mons. The surface of Olympus Mons is geologically very young, and the volcano may still be active. Mars likely had rivers and lakes in the ancient past.

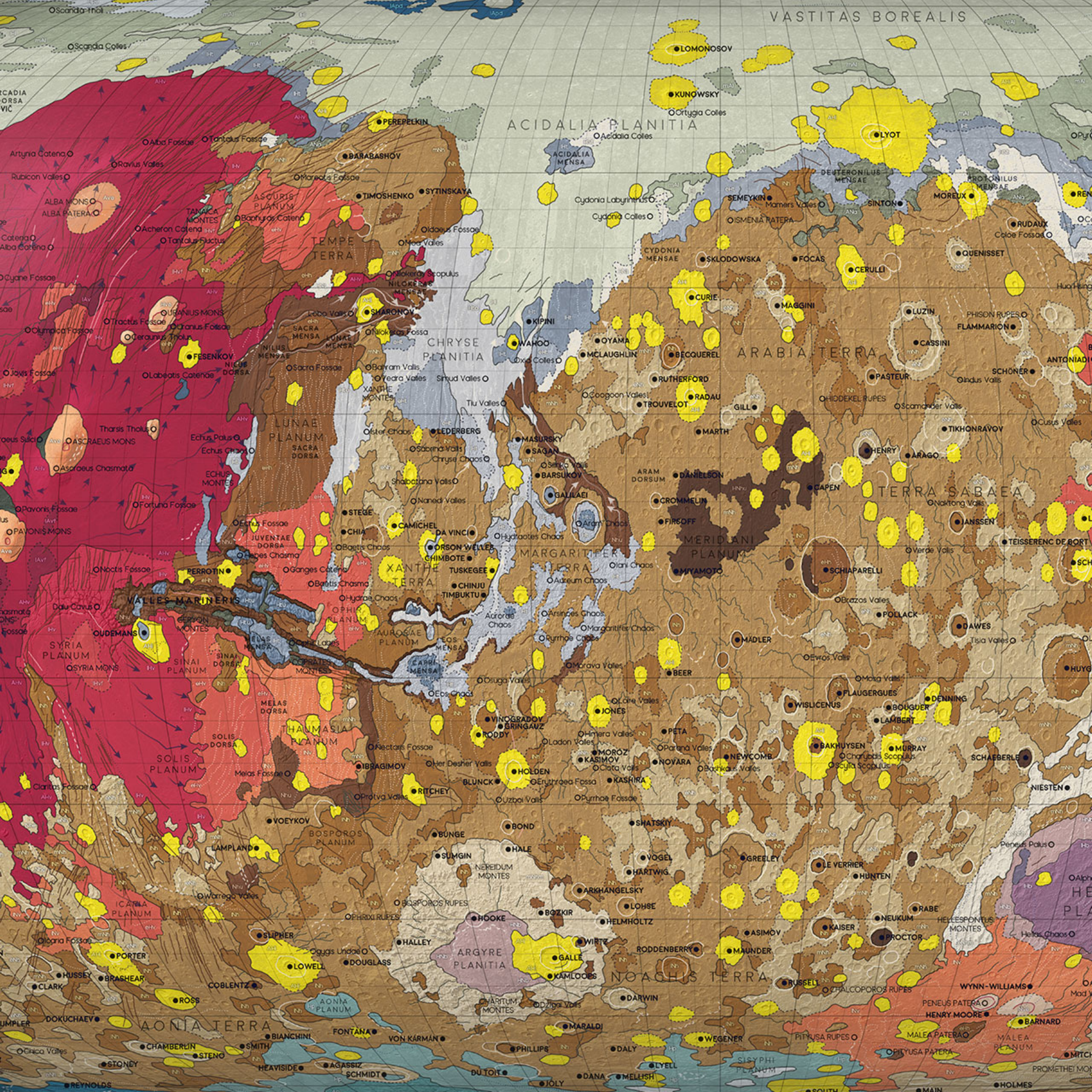
THE TOPOGRAPHY OF MARS: As shown in the central Eastern Hemisphere map (left key) and the Northern, Southern, and Western Hemispheres (right key). Key labels are shown in hundreds of km.

THE ATMOSPHERE OF MARS: The distinctive red color of the Martian surface is due to fine dust particles that coat the ground. Planet-wide dust storms can occur when high winds blow the dust into the air. Note that layers in the core diagram are not to scale.

- **Core:** Dense core of iron, nickel, & sulfur
- **Mantle:** Rocky mantle (1240–1880km thick)
- **Crust** and **Thin Atmosphere**

DATA: NASA & USGS. MAP: ©ELEANOR LUTZ 2019


LOUTH
PANCHAIA RUPES
STOKES
LYOT
DEUTERONILUS MENSAE
Deuteronilus Colles
SINTON
Ismeniae Fossae
PROTONILUS MENSAE
MOREUX
Pyramus Fossae
MIE
CYDNUS RUPES
UTOPIA PLANITIA
CHINCOTEAGUE
Hrad Vallis
Galaxias Colles
NIER
KUFRA
UTOPIA RUPES
RENAUDOT
RUDAUX
QUENISSET
Apsus Vallis
Galaxias Chaos
Tinjar Valles
Anio Valles
Colles Nili
Coloe Fossae
Clasia Vallis
Galaxias Fluctus
NILOSYRTIS MENSAE
Oeanus Valles
Adamas Labyrinthus
Astapus Colles
Auqakuh Vallis
PHLEGRA MONTES
Granicus Valles
Huo Hsing Vallis
FLAMMARION
Hyblaeus Chasma
HEPHAESTUS RUPES
SCHÖNER
PERIDIER
Arena Colles
BALDET
ANTONIADI
Hephaestus Fossae
Hebrus Valles
Nili Fossae
NEGRIL
HARGRAVES
Cusus Valles
JEZERO
TORO
Amenthes Cavi
HYBLAEUS DORSA
NEPENTHES PLANUM
Locras Valles
Arnus Vallis
ARENA DORSUM
ISIDIS DORSA
CANILLO
EHDEN
NEPENTHES MENSAE
ISIDIS PLANITIA
Nili Patera
Amenthes Fossae
Meroe Patera
TEISSERENC DE BORT
LEIGHTON
SYRTIS MAJOR PLANUM
SCHROETER
BERURI
DU MARTHERAY
AMENTHES RUPES
ESCALANTE
Licus Vallis
ROBERT SHARP
BRADBURY
LIBYA MONTES
KNOBEL
TERRA SABAEA
Naro Vallis
LIPANY
PALOS
Tinto Vallis
Tagus Valles
FOURNIER
LUCAYA
Liris Valles
VERLAINE
Oenotria Scopuli
HERSCHEL
OENOTRIA PLANA
HUYGENS
JARRY-DESLOGES
CERBERUS DORSA
CANKUZO
TYRRHENA TERRA
LÓPEZ
SOFFEN



VASTITAS BOREALIS
Scandia Tholi
Scandia Colles
LOMONOSOV
KUNOWSKY
Ortygia Colles
ACIDALIA PLANITIA
Acidalia Colles
ACIDALIA MENSA
LYOT
PEREPELKIN
Alba Fossae
Tantalus Fossae
Artynia Catena
Ravius Valles
Rubicon Valles
ALBA MONS
ALBA PATERA
BARABASHOV
Mareotis Fossae
TIMOSHENKO
SYTINSKAYA
ASCURIS PLANUM
TANTALUS MONTES
Baphyras Catena
Acheron Catena
Tantalus Fluctus
Alba Catena
TEMPE TERRA
Idaeus Fossae
Mosa Valles
DEUTERONILUS MENSAE
PROTONILUS MENSAE
SEMEYKIN
Mamers Valles
SINTON
MOREUX
Cydonia Labyrinthus
Cydonia Colles
ISMENIA PATERA
RUDAUX
Coloe Fossae
CYDONIA MENSAE
SKLODOWSKA
FOCAS
QUENISSET
CERULLI
Cyane Fossae
Nilokeras Scopulus
NILOKERAS FOSSA
CURIE
MAGGINI
LUZIN
PHISON RUPES
FLAMMARION
Olympica Fossae
Tractus Fossae
URANIUS MONS
Uranius Fossae
Ceraunius Tholus
Lobo Vallis
SHARONOV
Nilokeras Fossa
SACRA MENSA
LUNAE MENSA
NILUS MENSAE
KIPINI
WAHOO
CHRYSE PLANITIA
OYAMA
MCLAUGHLIN
BECQUEREL
ARABIA TERRA
CASSINI
ANTONIADI
FESENKOV
NILUS DORSA
Sacra Fossae
Jovis Fossae
Labeatis Catenae
Bahram Vallis
Vedra Valles
Simud Valles
Oxia Colles
RUTHERFORD
PASTEUR
Indus Valles
SCHÖNER
XANTHE MONTES
Tiu Valles
Coogoon Valles
RADAU
TROUVELOT
GILL
HIDDEKEL RUPES
Scamander Vallis
Cusus Valles
LUNAE PLANUM
Tharsis Tholus
ASCRAEUS MONS
Echus Palus
Echus Chaos
Ascraeus Chasmata
SACRA DORSA
Ister Chaos
LEDERBERG
MASURSKY
SAGAN
MARTH
TIKHONRAVOV
HENRY
ARAGO
Sacrra Valles
Chryse Chaos
Shalbatana Vallis
Simud Valles
BARSUKOV
ARAM DORSUM
DANIELSON
CAPEN
TERRA SABAEA
Naktong Vallis
ECHUS MONTES
Pavonis Fossae
PAVONIS MONS
Fortuna Fossae
Nanedi Valles
GALILAEI
CROMMELIN
JANSSEN
Aram Chaos
FIRSOFF
TEISSERENC DE BORT
STEGE
CAMICHEL
CHIA
Echus Fossae
JUVENTAE DORSA
Hebes Chasma
DA VINCI
ORSON WELLES
Hydraotes Chaos
MERIDIANI PLANUM
MARGARITIFER TERRA
Iani Chaos
CHIMBOTE
TUSKEGEE
Baetis Chaos
XANTHE TERRA
CHINJU
TIMBUKTU
Aureum Chaos
MIYAMOTO
SCHIAPARELLI
Verde Vallis
Noctis Fossae
PERROTIN
Ganges Catena
Baetis Chasma
Hydrae Chaos
VALLES MARINERIS
OPHIR PLANUM
Daly Cavus
Brazos Valles
POLLACK
DAWES
Arsinoes Chaos
Aurorae Chaos
OUDEMANS
GERYON MONTES
AURORAE PLANUM
EOS MENSA
Margaritifer Chaos
Pyrrhae Chaos
MÄDLER
Tisia Valles
SYRIA PLANUM
SYRIA MONS
SINAI PLANUM
SINAI DORSA
MELAS MENSA
CAPRI MENSA
Evros Valles
Morava Valles
BEER
HUYGENS
Osuga Valles
Eos Chaos
Mosa Valles
FLAUGERGUES
DENNING
WISLICENUS
BOUGUER
LAMBERT
MELAS DORSA
Loire Valles
JONES
VINOGRADOV
ERINGAUZ
RODDY
THAUMASIA PLANUM
Himera Valles
PETA
Ladon Valles
MOROZ
KASIMOV
Parana Valles
NOVARA
NEWCOMB
BAKHUYSEN
MURRAY
Charybdis Scopulus
Scylla Scopulus
SCHAEBERLE
SOLIS DORSA
SOLIS PLANUM
Nectaris Fossae
Melas Fossae
IBRAGIMOV
Her Desher Vallis
HOLDEN
Clota Vallis
KASHIRA
Bashkaus Valles
Claritas Fossae
Protva Valles
RITCHEY
BLUNCK
Erythraea Fossa
Uzboi Vallis
Pyrrhae Fossae
NIESTEN
VOEYKOV
BOSPOROS PLANUM
BOND
SHATSKIY
BUNGE
LAMPLAND
SUMGIN
HALE
NEREIDUM MONTES
VOGEL
GREELEY
LE VERRIER
HUNTEN
Peneus Palus
HARTWIG
Warrego Valles
ICARIA PLANUM
Phrixi Rupes
Bosporos Rupes
ARKHANGELSKY
LOHSE
RABE
BOZKIR
HOOKE
HELMHOLTZ
KAISER
NEUKUM
HELLESPONTUS MONTES
Hellas Chaos
SLIPHER
Icaria Fossae
PORTER
Ogygis Undae
HALLEY
ARGYRE PLANITIA
WIRTZ
ASIMOV
PROCTOR
RODDENBERRY
MAUNDER
LOWELL
DOUGLASS
GALLE
HUSSEY
BRASHEAR
KAMLOOPS
NOACHIS TERRA
RUSSELL
CHALCOPOROS RUPES
WYNN-WILLIAMS
CLARK
COBLENTZ
ROSS
AONIA PLANUM
CHARITUM MONTES
Dzigai Vallis
DARWIN
PENEUS PATERA
HENRY MOORE
BARNARD
DOKUCHAEV
AONIA TERRA
FONTANA
MARALDI
BIANCHINI
VON KÁRMÁN
WEGENER
PITYUSA RUPES
MALEA PATERA
MALEA PLANUM
CHAMBERLIN
SMITH
Chico Valles
STENO
PHILLIPS
DALY
PITYUSA PATERA
STONEY
HEAVISIDE
AGASSIZ
SCHMIDT
DU TOIT
DANA
LYELL
SISYPHI PLANUM
PROMETHEI MONS
REYNOLDS
JOLY
MELLISH
SOUTH
HOLMES

THE PLANET MARS

Named after the Roman god of war, Mars is also called the Red Planet due to its distinctive color. The red surface is caused by red dust that covers almost the entire surface of the planet. At times, planet-wide dust storms envelop the world and redistribute the red dust into giant sand dunes.

Mars is home to dizzyingly tall mountains and deep canyons. Olympus Mons, the tallest mountain in the solar system, is about two and a half times taller than Mount Everest. The Martian canyons called the Valles Mariners is approximately the length of the entire continental United States and more than three times as deep as the Grand Canyon. Like Venus and Mercury, Mars has impact craters all over the planet, where meteors have fallen through the thin atmosphere to strike the surface.

Billions of years ago, the surface of Mars and Earth looked very similar. Although the Martian surface no longer holds any liquid water, Mars probably once had lakes and rivers, as well as a thick atmosphere like Earth. Why did Mars become a cold, waterless desert while life flourished on Earth? Knowing more about the history of Mars might also help us understand more about the past and future of Earth.

GEOLOGIC UNITS

TYPES OF ROCK AND SURFACE DEPOSITS

VOLCANIC UNITS: Volcanoes, lava flows, lava plains, and rock expelled from volcanic vents.

- **Nve:** Volcanic cones from the Noachian time period very early on in Mars history.
- **Hve:** Volcanic cones from the Hesperian time period of widespread volcanic activity.
- **Ave:** Volcanic cones from the Amazonian time period, which continues today.
- **lNv:** Old and degraded volcanic flows and lava from the Noachian time period.
- **eHv:** Large stretches of ground flooded by lava from the early Hesperian period.
- **lHvf:** Large areas of clustered volcanoes and lava flows from the late Hesperian era.
- **lHv:** Plains of flooded lava originating from nearby volcanic vents and fissures.
- **AHv:** Stacked, gently sloping layers of volcanic lava flows of variable age.
- **Av:** Rugged lava flows from Elysium Mons and a source northwest of Olympus Mons.
- **lAvf:** Youngest fields of clustered volcanoes and lava flows.
- **lAv:** Recent areas of flooded lava, often including many ridges and troughs.

HIGHLAND UNITS: Densely cratered midlands and highlands, -3 to 5km in elevation.

- **eNhm:** Primitive rocks of the Martian crust lifted into mountains by large impacts.
- **mNhm:** Ancient, degraded rocks of the Martian crust uplifted into mountains.
- **Nhe:** Irregularly shaped and degraded volcanic cones of the southern highlands.
- **eNh:** Old, heavily degraded and cratered outcrops extending hundreds of kilometers.
- **mNh:** Heavily cratered ground forming rolling highlands and high-relief outcrops.
- **lNh:** Rocks of highland plains, sometimes also found in high-elevation lowlands.
- **eHh:** Deformed or degraded rocks forming high plains and smooth outcrops.
- **Nhu:** Layered rocks forming canyon walls, high plains, and channel floors.
- **HNhu:** Lighter-colored layers of weathered sedimentary, volcanic, and impact rocks.

LOWLAND UNITS: Geologic materials of the Northern lowlands, -5 to -4km in elevation.

- **lHl:** Loose sediment deposited by runoff from flowing streams or lakes and oceans.
- **mAl:** Fields of knobbly ground shaped by repeated freezing and thawing.

BASIN UNITS: Geologic deposits in and around the Hellas, Argyre, and Utopia Planitiae.

- **HNb:** Ancient basin floors overlaid with ridges. At least hundreds of meters thick.
- **eHb:** Older basin floors crisscrossed by channels formed by flowing streams.
- **lHb:** Rugged basin floor surface surrounded by steep cliffs.
- **eAb:** Sedimentary rock formed by ancient lakes or flooding events.

POLAR UNITS: Ice, dust, and mixtures of ice and rock found at the North and South poles.

- **Hpe:** Polar volcanoes, including ice volcanoes that erupt water or other liquids.
- **Hpu:** Roughly equal proportions of water ice mixed with sand-sized eroded rocks.
- **Hp:** Sheets of water ice marked with narrow ridges and depressions.
- **Ap:** Deeply pitted plains of ice. Pits possibly formed by selective melting by magma.
- **Apu:** Plateaus several meters thick made of water ice mixed with dust.
- **lApd:** Wind-blown sand organized into dunes tens of hundreds of meters across.
- **lApc:** Seasonally fluctuating ice caps made of H_2O in the north and CO_2 in the south.

TRANSITION UNITS: Geologic features of marginal zones between lowlands and highlands.

- **HNt:** High mesas, knobs, and plains adjacent to the highland-lowland boundary.
- **Hto:** Debris deposits with exposed islands of underlying bedrock.
- **Ht:** Broken-up blocks of collapsed ground mixed together with sediment materials.
- **eHt:** Undulating to rugged plains with low knobs and high mesas.
- **lHt:** Relatively smooth, undulating plateaus of sedimentary rock.
- **Htu:** Layered, irregular plateaus of sediment with channels formed by flowing streams.
- **AHtu:** Irregular plateaus of fine sediment transported by wind or a volcano eruption.

OTHER UNITS: Impact units and apron units (piles of rock debris below cliffs).

- **ANa:** Ice-rich rocky material transported by debris flows moving under gravity.
- **Aa:** Rocky deposits from the flanks of Olympus Mons and Valles Mariners.
- **lAa:** Ridges of rock and sediment deposited by ancient glaciers.
- **AHi:** Craters formed by meteorites impacting the Martian surface.

GEOLOGIC STRUCTURES

FRACTURES, FAULTS AND FOLDS IN THE GROUND

By studying the physical structures on the Martian surface, scientists can understand the geologic history of the planet, including past volcanic eruptions or presence of flowing water.

GEOLOGIC CONTACT (Black line on map)

A boundary that separates one rock type or rock body from its neighboring rock.

APPROXIMATE CONTACT (Black line on map)

Dashed lines represent geologic contacts that are approximate, inferred, concealed, or gradational.

INTERNAL CONTACT (Black line on map)

Boundaries between younger and older geologic layers.

YARDANG

Parallel, narrow ridges eroded by wind. Yardangs can be linear or curvilinear.

CHANNEL

A trough, branc
downhill, believe
from liquid strea

WRINKLE RIDGE

Low, sinuous, ve
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OUTFLOW CHA

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characterized b

PIT-CRATER CH

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RIDGE

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A very steep s
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deposits in and around
Utopia Planitiae.

floors overlaid with
hundreds of meters thick
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and organized into dunes
of meters across.
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Parallel, narrow ridges eroded by wind. Yardangs can be linear or curvilinear.

CHANNEL

A trough, branching system, or a floor sloping downhill, believed to be caused by erosion from liquid streams and rivers.

WRINKLE RIDGE

Low, sinuous, vein-like ridges formed by the compression of lava sheets.

OUTFLOW CHANNEL

Long channel floors caused by flooding, characterized by remains of islands and bars.

PIT-CRATER CHAIN

Craters formed from the collapse of surface material into an empty underground chamber.

RIDGE

A continuous elevated crest caused by erosion or volcanic activity.

SCARP

A very steep slope, can be caused by erosion, tectonic activity, or volcanic activity.

CRATER RIM

The outer edge of craters formed by impacts from falling meteorites. Impact craters typically have raised rims and are circular.

SPIRAL TROUGH

Spiral shaped depressions in the polar ice, caused by erosion from wind and sunlight.

LOBATE FLOW (Black line on map)

Flows of volcanic lava, gently sloping away from cliffs and escarpments.

GRABEN

A depression in the planet crust bordered by parallel fault lines.

RILLE

Long channels with many possible causes, such as collapsed lava tubes or contracted lava.

CALDERA RIM

The rim of an empty magma chamber left behind after a volcanic eruption.

LANDING SITES

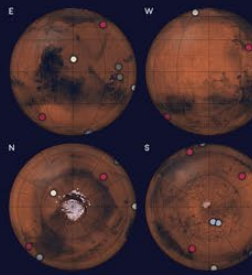
LANDERS AND ROVERS ON THE PLANET MARS

THE SPACE RACE

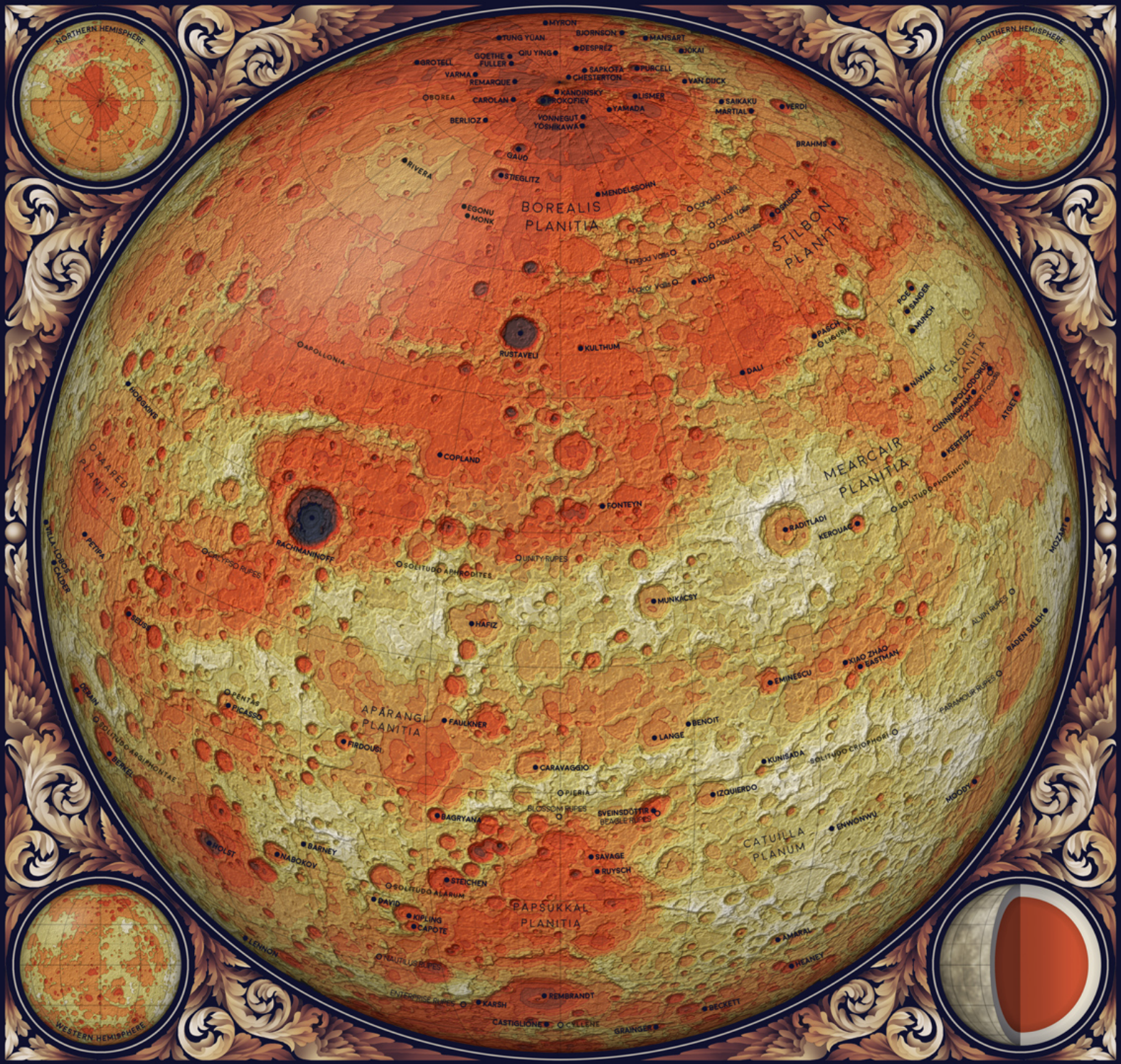
Spacecraft exploration of Mars began in earnest during the 20th century. Space Race, when the United States and the Soviet Union competed to explore the solar system with satellites and manned missions. Since then, more than 50 space missions have been launched toward Mars - about half of them successful. Some notable missions include the Mars Global Surveyor orbiter, which collected the data used to design this geologic map. The Curiosity Rover (A) a car-sized robot, is a recent addition to the planet. Curiosity is equipped with six independently controlled wheels, a robotic arm, and tools for analyzing Martian rocks.

KEY & EXAMPLE SPACECRAFT FROM TIME PERIOD

- **1970-1980**: Mars 2, was the first man-made object to reach Mars.
- **1990-2000**: The Sojourner Rover explored Mars for about three months before failure.
- **2000-2010**: The Opportunity Rover explored Mars for 14 years and traveled 45km.
- **2010-2020**: The Curiosity Rover, which landed in 2012, is still operational as of June 2019.



DATA: IAU, USGS, NASA PDS, LOLA SCIENCE TEAM. MAP: ©ELEANOR LUTZ 2019



MERCURY

Mercury is the smallest terrestrial planet in the solar system - less than half the diameter of the Earth. Mercury is also the closest planet to the sun, and completes a full orbit revolution in just 88 Earth days.

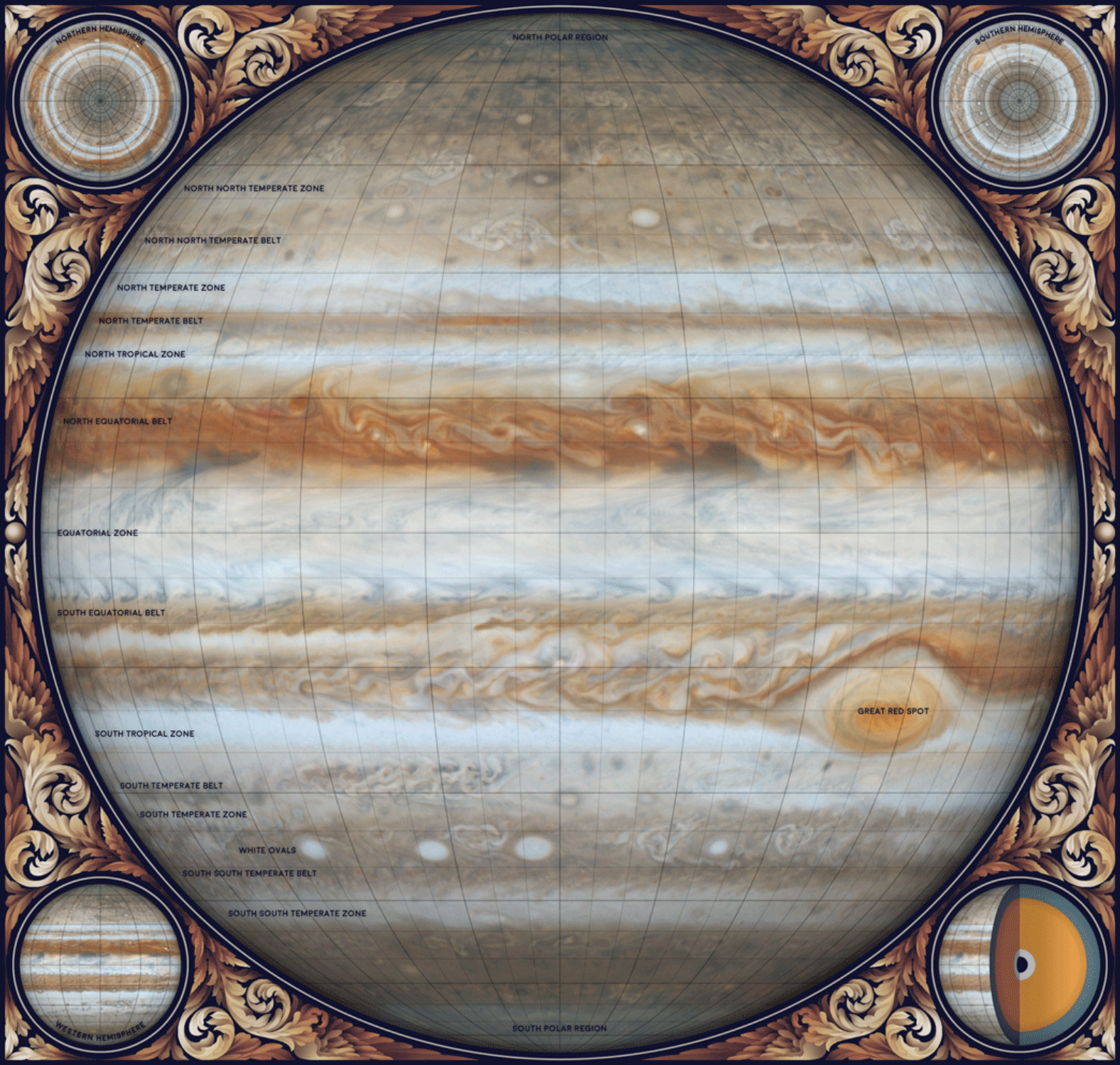
THE TOPOGRAPHY OF MERCURY: As shown in the central Eastern Hemisphere map (left key) and the Northern, Southern, and Western Hemispheres (right key). Key labels are shown in thousands of km.

INTERIOR STRUCTURE: Mercury is a heavily cratered planet, with no atmosphere and a surprisingly dense internal structure. At least part of Mercury's metallic core is probably liquid metal, and the size of this core is about the same size as Earth's moon.

Core: Metallic iron-nickel core

Rocky Crust: About 700km thick, the crust is made up primarily of silicates.

DATA: NASA & USGS. MAP: ©ELEANOR LUTZ 2019



JUPITER

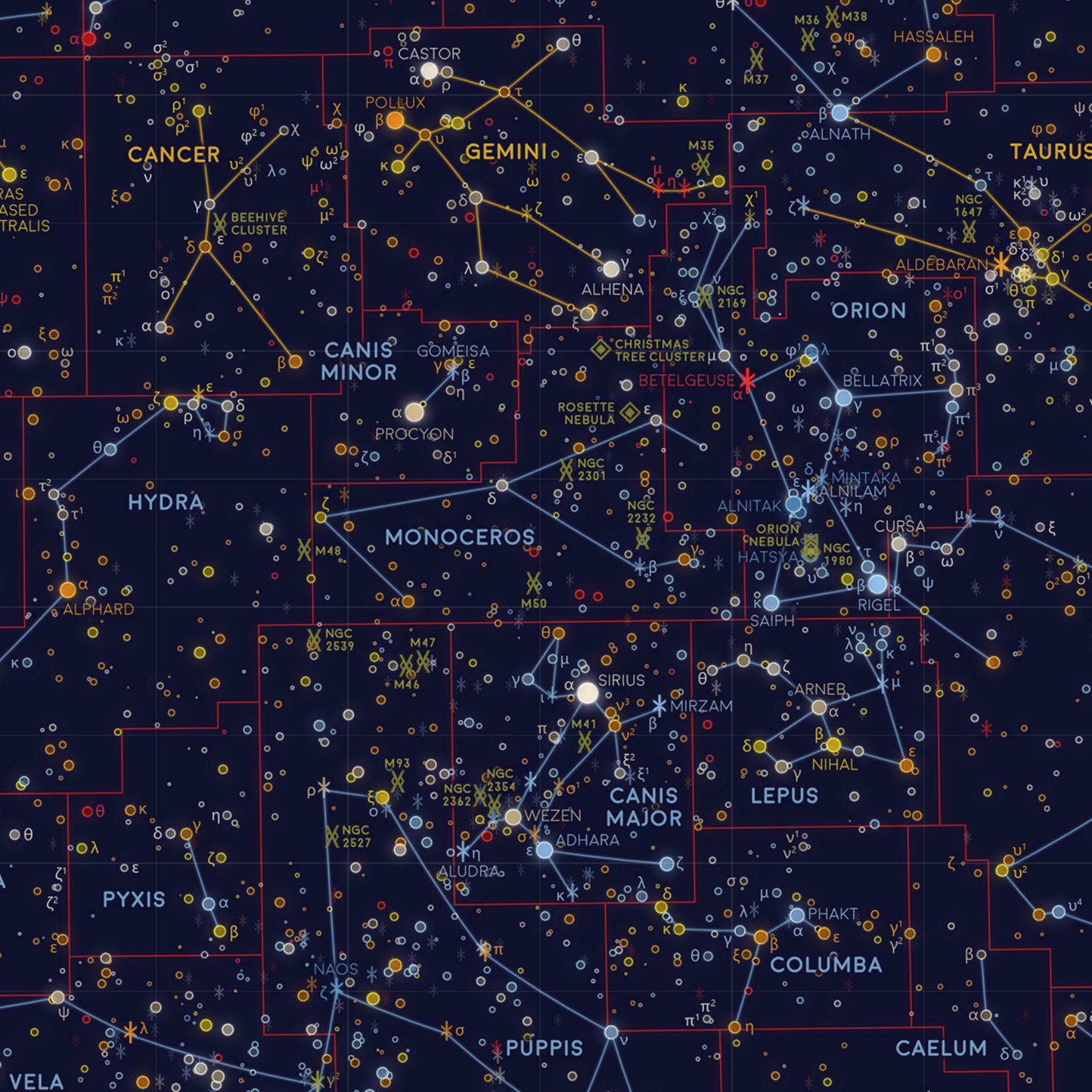
Jupiter is by far the largest planet in the solar system - about 318 times more massive than Earth. Jupiter has 79 confirmed moons, including Ganymede - which is larger than Mercury - and Io - the most volcanically active body in our Solar System.

THE BELTS OF JUPITER: The clouds of Jupiter range in color from white to red and brown. The dark and light bands across Jupiter are semi-permanent features that are constantly shifting in position and intensity. The Great Red Spot is a gigantic storm on Jupiter, visible on the lower right in this map. The storm has persisted for at least 300 years, but it is shrinking and may disappear within our lifetime.

THE INTERIOR OF JUPITER: Jupiter is a gas giant that is probably composed mostly of Hydrogen and Helium. The pressure within the planet is so high that Hydrogen is compressed into a liquid metal starting about 12000km from the edge of the atmosphere.

- **Rock:** Pressurized Iron, Silicon, & Oxygen
- **Ice:** Carbon, Nitrogen, Oxygen, Hydrogen
- **Metallic** and **Molecular** Hydrogen

DATA: NASA & USGS. MAP: ©ELEANOR LUTZ 2019


CANCER
BEEHIVE CLUSTER
GEMINI
CASTOR
POLLUX
ALHENA
M35
M36
M37
M38
HASSALEH
ALNATH
TAURUS
NGC 1647
ALDEBARAN
ORION
NGC 2169
CHRISTMAS TREE CLUSTER
BETELGEUSE
BELLATRIX
MINTAKA
ALNILAM
ALNITAK
ORION NEBULA
NGC 1980
HATSYA
CURSA
RIGEL
SAIPH
CANIS MINOR
GOMEISA
PROCYON
ROSETTE NEBULA
NGC 2301
NGC 2232
MONOCEROS
M48
M50
HYDRA
ALPHARD
NGC 2539
M47
M46
SIRIUS
MIRZAM
M41
ARNEB
NIHAL
LEPUS
M93
NGC 2354
NGC 2362
WEZEN
ADHARA
CANIS MAJOR
NGC 2527
ALUDRA
PYXIS
PHAKT
COLUMBA
NAOS
PUPPIS
CAELUM
VELA

THE NIGHT SKY

For thousands of years, humans have looked up at the stars in the night sky for navigation, divination, and storytelling. Before the invention of telescopes, ancient Egyptians used the bright star Sirius to predict the annual flooding of the Nile river. Ancient Polynesians navigated by the stars through the open ocean for hundreds of kilometers.

This map shows every star that might be visible to the human eye on the darkest night. It also includes many deep-sky objects such as galaxies, nebulae, and star clusters that are similarly visible from Earth.

Because the Earth wobbles slightly around its axis, the position of the stars appears to change over time when seen from Earth. This map shows the position of each star on New Year's Day of the year 2000. These star movements are large enough to see throughout human history. In the ancient divination tradition of astrology, a persons sun sign describes where the Sun was located when they were born. But because of the shifting stars, the sun signs of people born today are off by about one zodiac sign when using the traditional date calculations from 2000 years in the past.

MAGNITUDE

STARS VISIBLE TO THE NAKED EYE FROM EARTH

0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6

STAR MAGNITUDE
The magnitude of stars describes the relative brightness as seen from Earth. Closer, smaller stars may therefore have a bigger magnitude than extremely large stars that are far away.

VARIABLE STARS
Variable stars change in magnitude over time. Some variable stars appear to pulsate because another object periodically blocks its light, and others actually change in diameter over time.

τ θ ζ α β ε γ χ ι ο π ρ κ η λ δ μ ξ ν ω υ ψ

BAYER DESIGNATIONS
In the early 1600's Johann Bayer, a German astronomer, assigned Greek letters to the brightest stars in each constellation.

SPECTRAL CLASS

THE TEMPERATURE OF THE STARS

Note: Colors in this map are not true to life.

- **O**: Blue stars with an approximate temperature of ~30000 Kelvin
- **B**: Blue-white stars between 10000K and 30000K. Examples include Rigel and Spica.
- **A**: White stars between 7500K and 10000K. Examples include Sirius and Vega.
- **F**: Yellow-white stars 6000-7500K. Examples include Canopus and Procyon.
- **G**: Yellow stars 5200-6000K. Examples include Rigil Kentaurus and our own sun.
- **K**: Orange stars 3700-5200K. Examples include Arcturus and Aldebaran.
- **M**: Red stars between 2400 and 3700K. Examples are Betelgeuse and Antares.
- **OTHER**: Cool red and brown dwarfs and other rare stars (C, R, W, N, S, D, & P).
- Unknown spectral class or missing data.

DEEP SKY OBJECTS

GALAXIES, NEBULAE, AND CLUSTERS VISIBLE TO THE NAKED EYE

SPIRAL GALAXY
A rotating galaxy with spiral arms contained within a disk-shape. Made of young stars and interstellar material.

EMISSION NEBULA
Nebulae are giant clouds of interstellar material. Emission nebulae emit light from ionized interstellar gas.

GLOBULAR CLUSTER
Globe-shaped star clusters with hundreds of thousands of stars. Some of the oldest parts of our galaxy.

OPEN CLUSTER
Star clusters younger and smaller than globular clusters, with only dozens to hundreds of stars.

OPEN CLUSTER WITH EMISSION NEBULA
An open cluster embedded within an emission nebula. Examples on this map: Swan Nebula & Hercules Cluster.

STAR CLOUD
A bright group of stars that falsely looks like a cluster. The only one on this map is the Sagittarius star cloud.

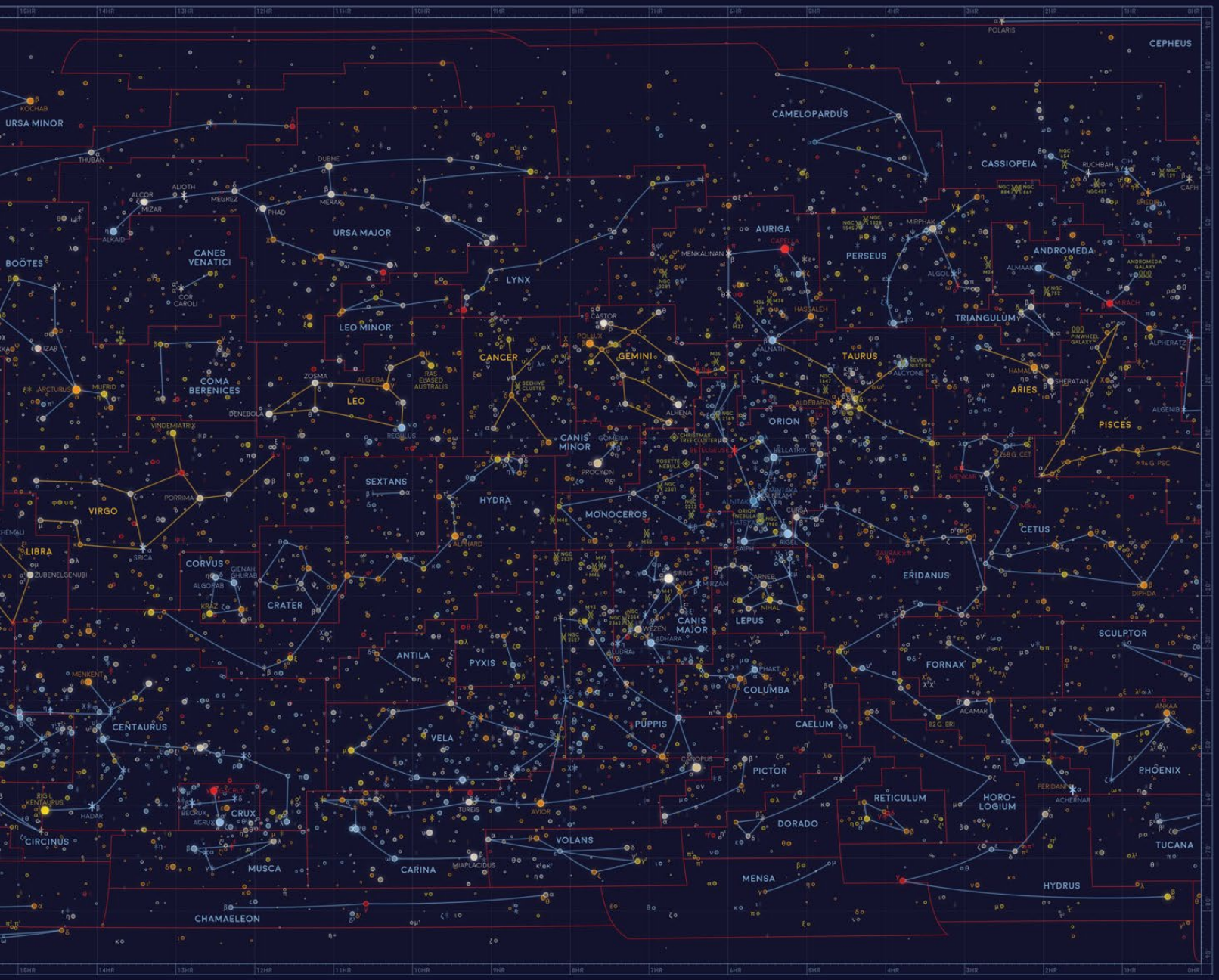
CONSTELLATIONS & ASTERISMS

THE SHAPES WE SEE IN THE STARS

IAU CONSTELLATION BOUNDARIES
The red lines on this map show the official constellation boundaries designated by the International Astronomical Union. Taken together, these 88 constellations cover the entire celestial sphere. The constellations depict 36 animals, 30 objects and 22 mythological or real characters.

TRADITIONAL WESTERN ASTERISMS
Many ancient civilizations created geometric patterns of stars to describe the night sky. These shapes are called asterisms. Today, many of the modern IAU constellations are named after the ancient Greek asterisms within each constellation.

ANCIENT GREEK ZODIAC ASTERISMS
Major objects in the sky such as the planets, Sun, and Moon, are all constrained to a narrow belt of sky called the zodiac. Astrology, a tradition of divination with no scientific validity, is based on planetary motion through the zodiac.



TS

CLUSTERS VISIBLE TO THE NAKED EYE

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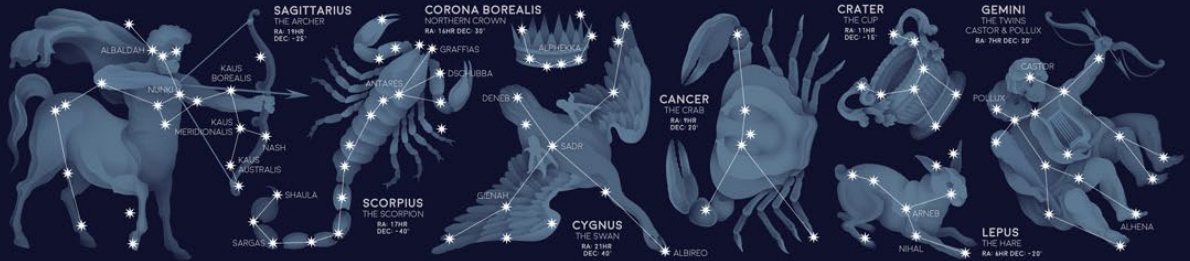
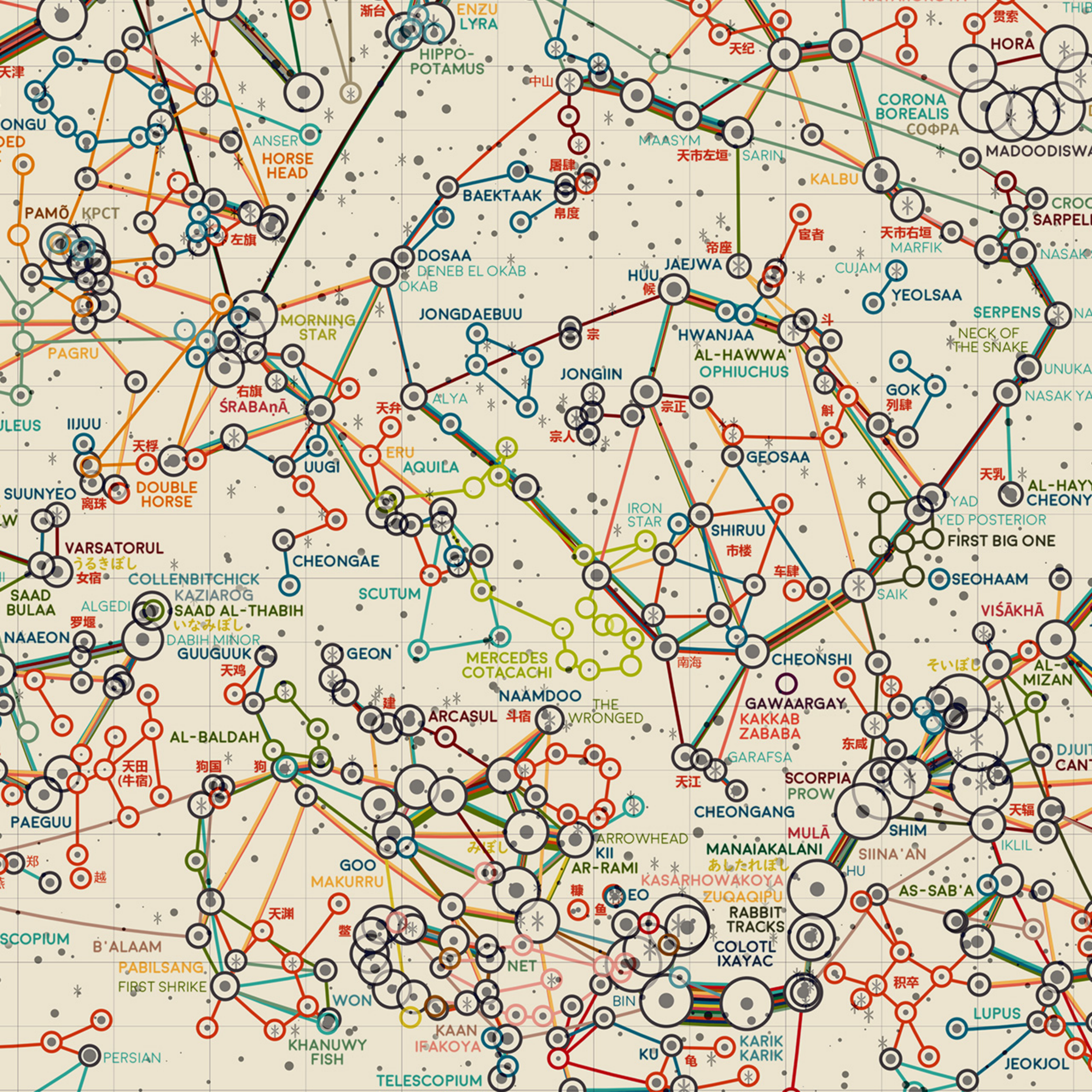
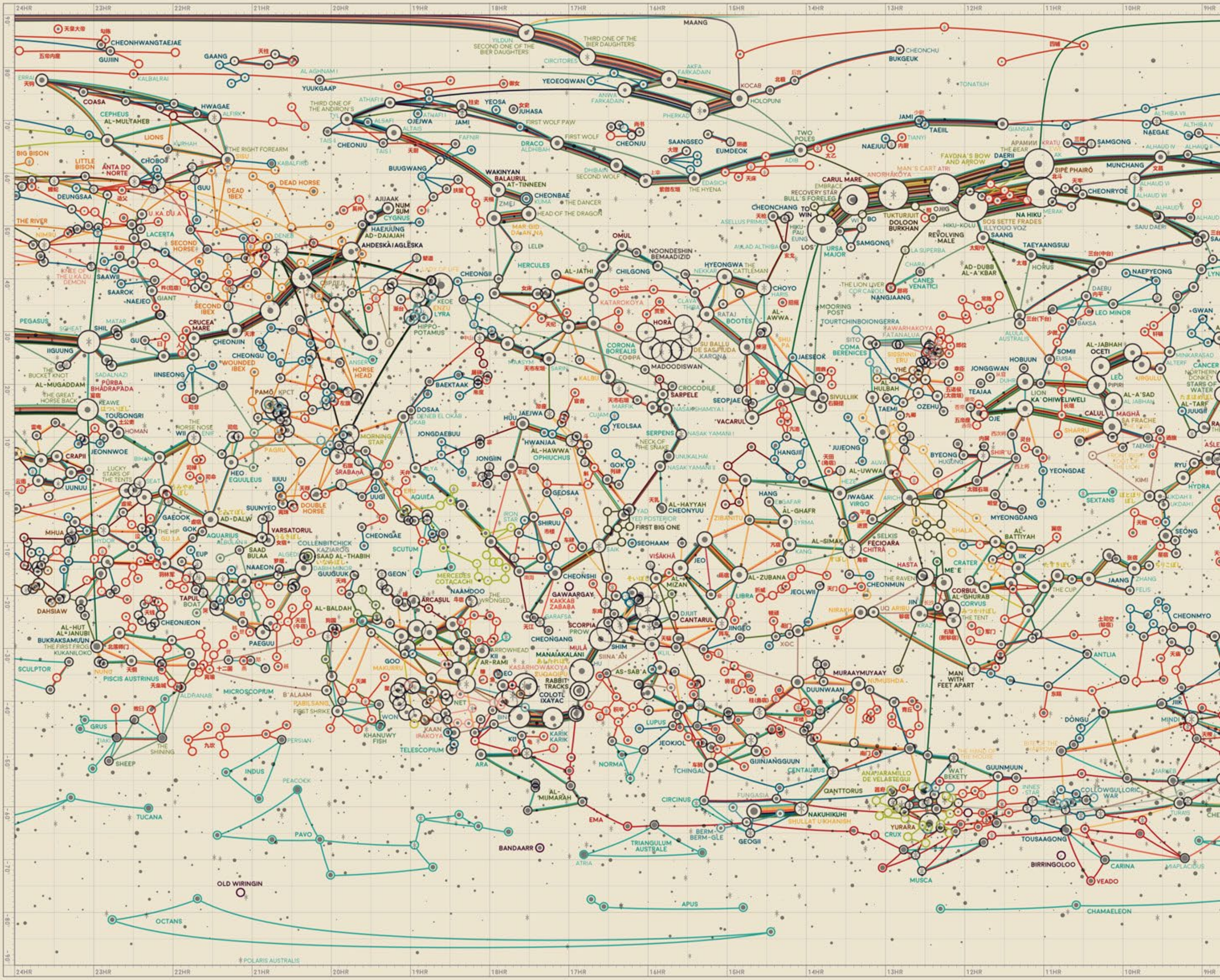


DATA: HYG DATABASE V3.0, ROYAL OBSERVATORY EDINBURGH, STELLARIUM, MARC VAN DER SLUYS, W. H. FINLAY. MAP: ©ELEANOR LUTZ 2019



渐台
ENZU
LYRA
贯索
THE
天津
天纪
HORA
HIPPO-
POTAMUS
中山
CORONA
BOREALIS
СОФРА
ONGU
ANSER
MAASYM
天市左垣
SARIN
MADOODISWA
HORSE
HEAD
屠肆
KALBU
BAEKTAAK
帛度
CROC
SARPELI
PAMÕ
KPCT
宦者
天市右垣
MARFIK
左旗
帝座
NASAK
DOSAA
DENEB EL OKAB
OKAB
JAEJWA
CUJAM
HUU
候
YEOLSAA
MORNING
STAR
JONGDAEBUU
宗
斗
SERPENS
HWANJAA
NECK OF
THE SNAKE
PAGRU
AL-HAWWA'
OPHIUCHUS
JONGIIN
UNUKA
右旗
ŚRABAṇĀ
天弁
ALYA
宗正
GOK
列肆
NASAK YA
斛
IIJUU
宗人
天桴
ERU
AQUILA
UUGI
GEOSAA
天乳
SUUNYEO
DOUBLE
HORSE
AL-HAY
CHEONY
离珠
IRON
STAR
YAD
YED POSTERIOR
SHIRUU
FIRST BIG ONE
VARSATORUL
市楼
うるきぼし
女宿
CHEONGAE
车肆
SEOHAAM
COLLENBITCHICK
SCUTUM
SAIK
SAAD
BULAA
KAZIAROG
ALGEDI
SAAD AL-THABIH
VIŚĀKHĀ
罗堰
いなみぼし
NAAEON
DABIH MINOR
GUUGUUK
GEON
MERCEDES
COTACACHI
CHEONSHI
南海
そいぼし
AL-
MIZAN
天鸡
NAAMDOO
GAWAARGAY
建
THE
WRONGED
KAKKAB
ZABABA
ARCASUL
斗宿
东咸
DJUI
CANT
AL-BALDAH
GARAFSA
天田
(牛宿)
狗国
狗
天江
SCORPIA
PROW
PAEGUU
CHEONGANG
天辐
MULĀ
SHIM
ARROWHEAD
KII
みぼし
MANAIAKALANI
IKLIL
郑
GOO
AR-RAMI
あしたれぼし
SIINA'AN
越
MAKURRU
HU
KASARHOWAKOYA
糠
EO
ZUQAQIPU
AS-SAB'A
天渊
鱼
RABBIT
TRACKS
SCOPIUM
鳖
B'ALAAM
COLOTL
IXAYAC
PABILSANG
NET
积卒
FIRST SHRIKE
WON
BIN
LUPUS
KAAN
KHANUWY
FISH
IFAKOYA
KARIK
KARIK
PERSIAN
KU
龟
JEOKJOL
TELESCOPIUM



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For thousands of years, humans have looked up at the stars in the night sky for navigation, divination, and storytelling. Before the invention of telescopes, ancient Egyptians used the bright star Sirius to predict the annual flooding of the Nile river. Ancient Polynesians navigated by the stars through the open ocean for hundreds of kilometers.

This map shows every star that might be visible to the human eye on the darkest night. It also shows the asterisms, or the pattern of stars in the sky that were recorded by cultures and ancient texts around the world.

The star locations in this map are based on scientific databases. However, the asterisms are based on an open source database updated by volunteers. Many of the asterisms are approximate, and we are unsure of the exact patterns of many asterisms - especially those from hundreds of years in the past. Although we can't say for sure that these are the exact names and patterns invented by each culture, we can still use these historical estimates to visualize the breadth of human creativity and our shared fascination with the sky.

MAGNITUDE

THE SIZE OF THE STARS AS SEEN FROM EARTH

STAR MAGNITUDE

The magnitude of stars describes the relative brightness as seen from Earth. Closer, smaller stars may therefore have a bigger magnitude than extremely large stars that are far away.

VARIABLE STARS

Variable stars change in magnitude over time. Some variable stars appear to pulsate because another object periodically blocks its light, and others actually change in diameter over time.

STAR POPULARITY

Circles surround stars that are included in one (colored circle) or more (black circle) asterisms.

HOME ON EARTH

APPROXIMATE ORIGINS & NUMBER OF ASTERISMS

- ARABIC 77
- ARMINTXE 11
- AZTEC 5
- BELARUSAN 20
- BOORONG 29
- CHINESE 339
- DAKOTA 13
- EGYPTIAN 28
- HAWAIIAN 13
- INDIAN 28
- INUIT 11
- JAPANESE 28
- KAMILAROI 13
- KOREAN 272
- LOKONO 11
- MACEDONIAN 19
- MAORI 6
- MAYA 14
- MONGOLIAN 4
- MUL.APIN 60
- NAVAJO 8
- NORSE 6
- NORTHERN ANDES 5
- OJIBWE 10
- ROMANIAN 39
- SAMI 10
- SARDINIAN 11
- SELEUCID 60
- SIBERIAN 3
- TONGAN 11
- TUKANO 11
- TUPI 7
- WESTERN 88

NORTH AND SOUTH POLE STARS

THE STARS THAT POINT THE WAY

The North and South pole stars are the stars th
to be very close to the North and South celesti
These stars move the least throughout the night
Earth rotates on its axis. The North pole star is
directly over the North Pole, and can be used in
Northern Hemisphere to estimate a traveler's latitu
as compass direction. Currently there is no South
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position of the stars appears to change over tim
seen from Earth. As a result, the pole stars are
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is called Polaris in English, and is circled with a t
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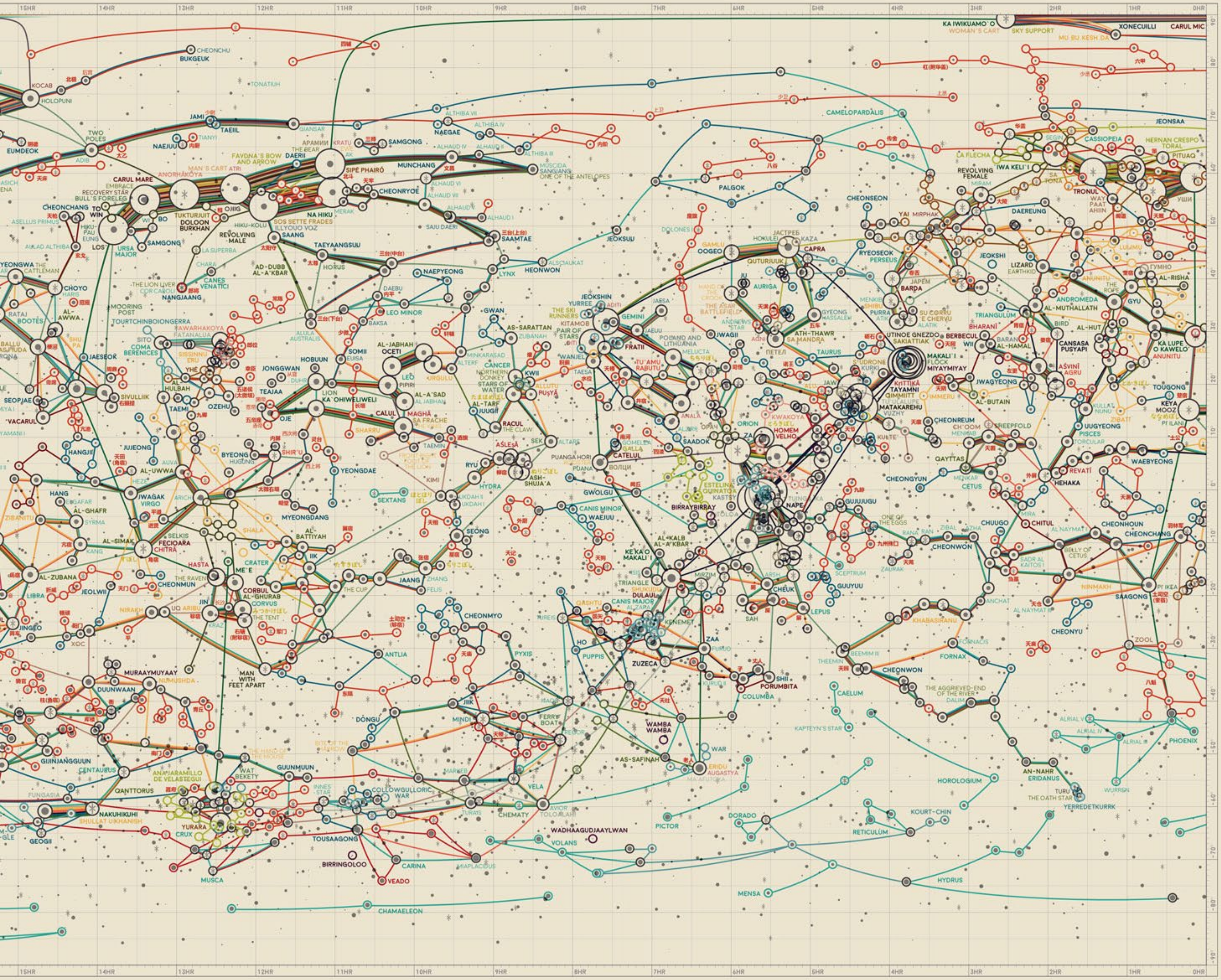
the place of Polaris as the closest star to the c
North pole. This particular map shows the positio
star on New Year's Day of the year 2000.



NORTH AND SOUTH POLE STARS

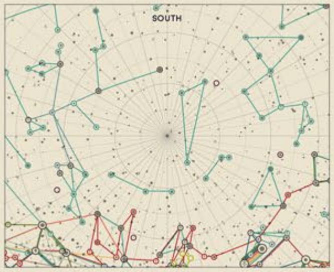
THE STARS THAT POINT THE WAY

The North and South pole stars are the stars that happen to be very close to the North and South celestial poles. These stars move the least throughout the night as the Earth rotates on its axis. The North pole star is positioned directly over the North Pole, and can be used in the Northern Hemisphere to estimate a traveler's latitude as well as compass direction. Currently there is no South pole star bright enough to be used reliably for navigation.

Because the Earth wobbles slightly around its axis, the position of the stars appears to change over time when seen from Earth. As a result, the pole stars are not fixed and change throughout history. The current North pole star is called Polaris in English, and is circled with a thick line on the map to the right. But 5000 years ago Thuban was the pole star, and in another 14000 years Vega will take the place of Polaris as the closest star to the celestial North pole. This particular map shows the position of each star on New Year's Day of the year 2000.

NAMES FOR THE NORTH POLE STAR

- **ARABIC**: The Goat
- **BELARUSAN**: The Nail
- **CHINESE**: 元始
- **DAKOTA**: Wicanhpi Owanjila
- **HAWAIIAN**: Hokupa'a
- **INDIAN**: Dhruva
- **INUIT**: Never Moves
- **MACEDONIAN**: Mediterranean Star
- **MONGOLIAN**: Altan Hadaas
- **NORSE**: Guide Star
- **OJIBWE**: Giwedin'Anung
- **ROMANIAN**: The Sky's Votive Light
- **SARDINIAN**: Polar Star
- **SELEUCID**: Heir of the Sublime Temple
- **SIBERIAN**: Golden Stake
- **WESTERN**: Polaris



DATA: HYG DATABASE V3 & STELLARIUM. MAP: ©ELEANOR LUTZ 2019

THE EARTH

As far as we know, the Earth is the only planet to harbor life. Fossils and chemical evidence show that life existed on Earth as far back as 3.5 billion years ago. Life on Earth has profoundly changed the planet and its climate.

INTERIOR STRUCTURE: The Earth is the most geologically active planet in the solar system. It has around 12 tectonic plates that slowly move, powered by the convective heat transfer from the mantle layer. Note that layers in the core diagram are not to scale.

- **Inner Core:** Solid iron and nickel sphere
- **Outer Core:** Molten liquid iron and nickel
- **Mantle:** Caramel-like layer of molten rock
- **Crust:** Rocky crust divided into tectonic plates
- **Troposphere:** Most weather occurs in this layer
- **Stratosphere:** Absorbs and scatters UV radiation
- **Mesosphere:** Meteors burn in this atmosphere layer
- **Thermosphere:** Auroras and satellites occur in this layer
- **Ionosphere:** Variable thickness, absorbs solar radiation

DATA: NASA, USGS & NATURAL EARTH. MAP: ©ELEANOR LUTZ 2019

Greenland Ice sheet
Scoresby Sund
CAPE BREWSTER
NORWEGIAN SEA
SVARTISEN
GRÍMSEY
SURTSEY
NUNAP ISUA
ROCKALL
Sea of the Hebrides
NORTH SEA
LABRADOR SEA
CAPE BAULD
MIQUELON
CHURCHILL
HUDSON BAY
YELL ICEFIELD
MOUNT BAKER
TRAPPER PEAK
GRAND TETON
MINNEAPOLIS
CHICAGO
ST. LOUIS
MONTREAL
BOSTON
CAPE SABLE
NEW YORK CITY
WASHINGTON
Chesapeake Bay
CAPE MAY
CAPE HATTERAS
CAPE FEAR
CAPE CANAVERAL
BERMUDA ISLANDS
SAN SALVADOR
ATLANTIC OCEAN
NORTH AMERICAN TECTONIC PLATE
EURASIAN TECTONIC PLATE
CABO FISTERRA
LISBON
CABO DE SÃO VICENTETE
Strait of Gibraltar
Bristol Channel
LANDS END
English Channel
BAY OF BISCAY
BARCELONA
PARIS
BRUSSELS
BERLIN
PRAGUE
VIENNA
WARSAW
KIEV
MOSCOW
OSLO
Gulf of Bothnia
Gulf of Riga
BLACK SEA
ISTANBUL
MEDITERRANEAN
CAP BON
ALGIERS
TRIPOLI
Gulf of Sidra
QATTARA DEPRESSION
LIBYA
ATLAS MOUNTAINS
CASABLANCA
RAS CANTIN
JÉBEL TOUBKAL
SAHARA
CABO BOJADOR
ER RICHAT DEPRESSION
CAP BLANC
Niger River
KANO
DAKAR
CAPE VERDE
LAGOS
ABIDJAN
ACCRA
MONROVIA
CAPE PALMAS
GULF OF GUINEA
CAP LOPEZ
PONTA DAS PALMEIRINHAS
LUANDA
PONTA DAS SALINAS
ANTIGUA
DOMINICA
SAINT LUCIA
BARBADOS
TOBAGO
ARUBA
CARIBBEAN TECTONIC PLATE
CARIBBEAN SEA
MEDELLIN
BOGOTA
CERO RAYA
AMAZON BASIN
CABO ORANGE
BELEM
PONTA DE JERICOACOARA
FORTALEZA
CABO DE S O ROQUE
RECIFE
BRAZILIAN HIGHLANDS
SALVADOR
BRASILIA