

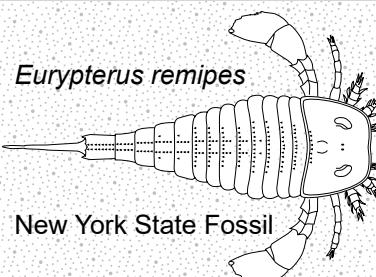
Reference Tables for EARTH & SPACE SCIENCES

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2024 EDITION

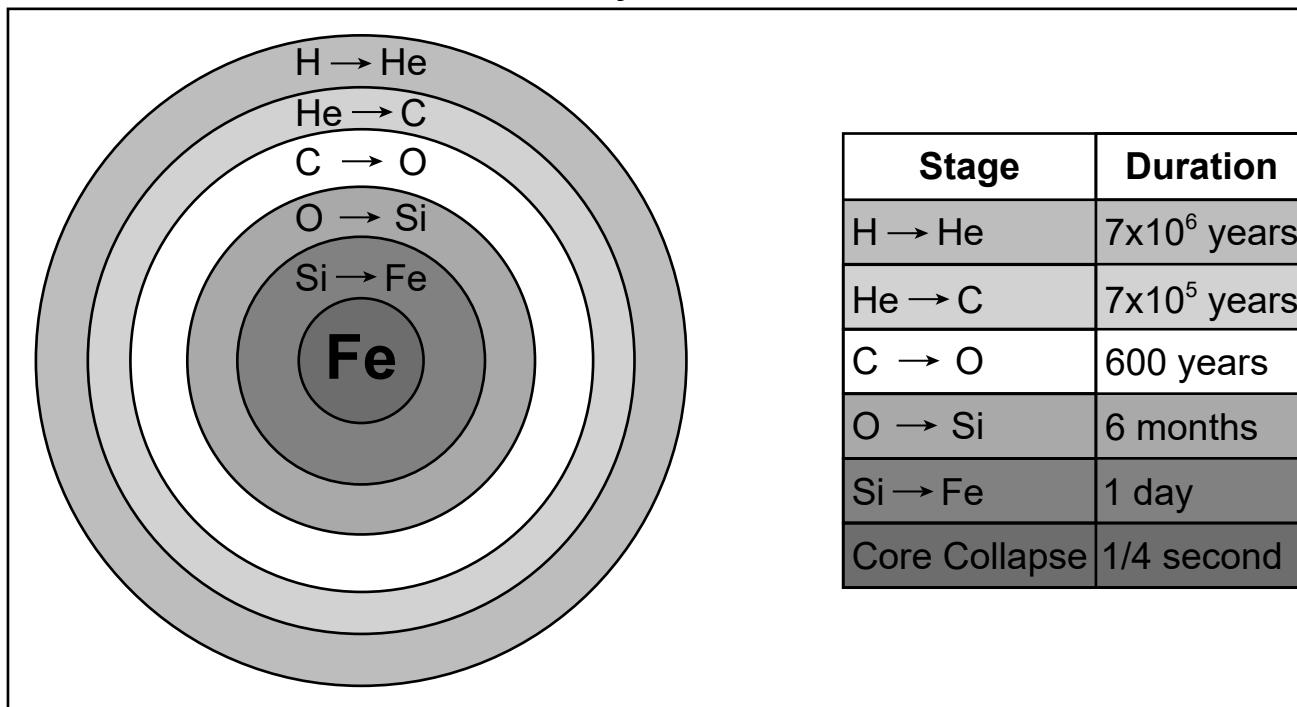
This edition of the Earth and Space Sciences Reference Tables should be used in the classroom beginning in the 2024–25 school year. The first examination for which these tables will be used is the June 2025 Regents Examination in Earth and Space Sciences.



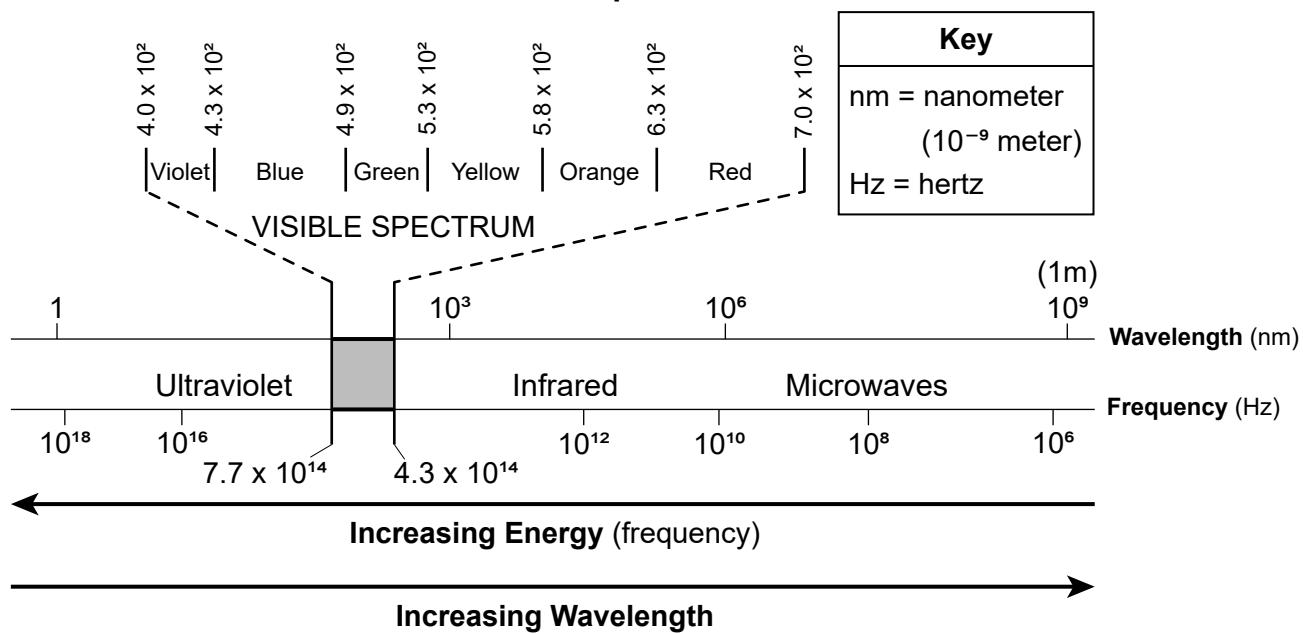
Solar System Objects Data Table

Celestial Object	Mean Distance from Sun (million km)	Period of Revolution (d=Earth days) (y=Earth years)	Period of Rotation at Equator	Eccentricity of Orbit	Equatorial Diameter (km)	Axial Tilt (°)
SUN	---	---	27 d	---	1,392,000	7.25
MERCURY	57.9	88 d	59 d	0.206	4879	0.03
VENUS	108.2	224.7 d	243 d	0.007	12,104	177.4
EARTH	149.6	365.26 d	23 h 56 min 4 s	0.017	12,756	23.49
EARTH'S MOON	149.6 (0.385 from Earth)	27.3 d	27.3 d	0.055	3476	6.68
MARS	228.0	1.9 y	24 h 37 min 23 s	0.093	6792	25.19
CERES	414.0	4.6 y	9 h 6 min	0.076	~939	4.00
PALLAS	414.0	4.6 y	7 h 40 min	0.230	~546	84.00
JUPITER	778.5	11.9 y	9 h 50 min 30 s	0.048	142,984	3.73
SATURN	1432.0	29.5 y	10 h 14 min	0.054	120,536	26.73
URANUS	2867.0	83.7 y	17 h 14 min	0.047	51,118	82.23
NEPTUNE	4515.0	163.7 y	16 h	0.009	49,528	28.32
PLUTO	5906.4	248.0 y	6 d 9 h	0.250	2376	57.47
ERIS	6300	557.2 y	1 d 1 h 58 min	0.436	2400	78.30

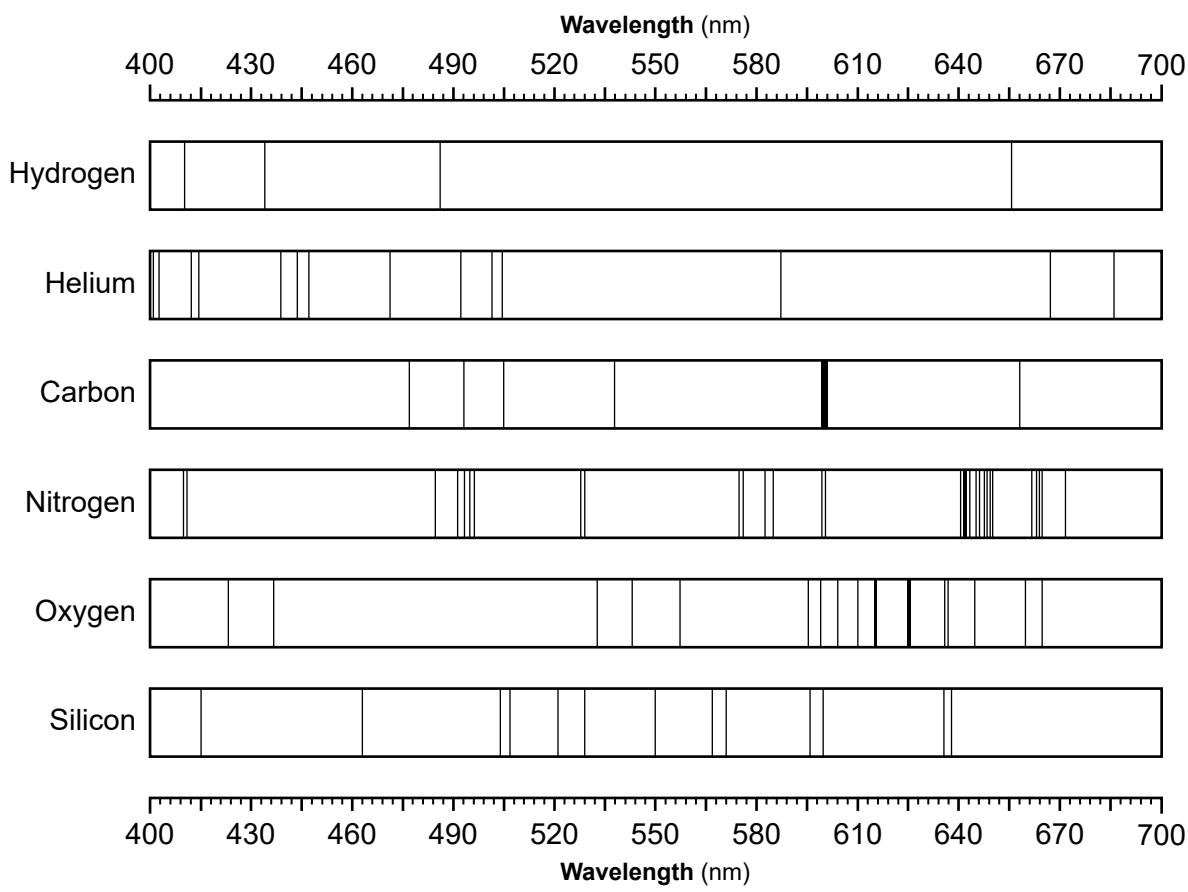
Generalized Nucleosynthesis in a Massive Star

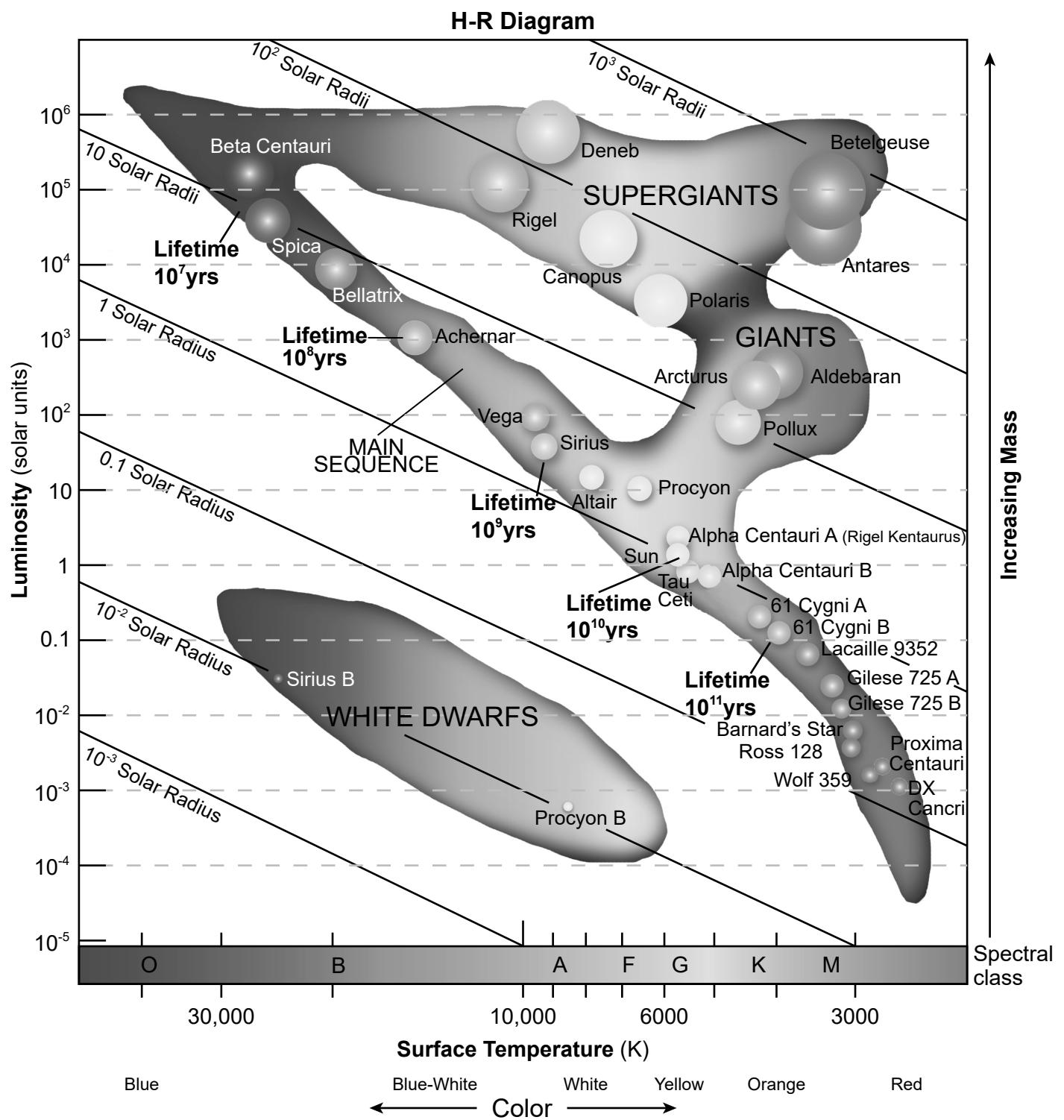


Portion of Electromagnetic Spectrum Related to Earth and Space Sciences

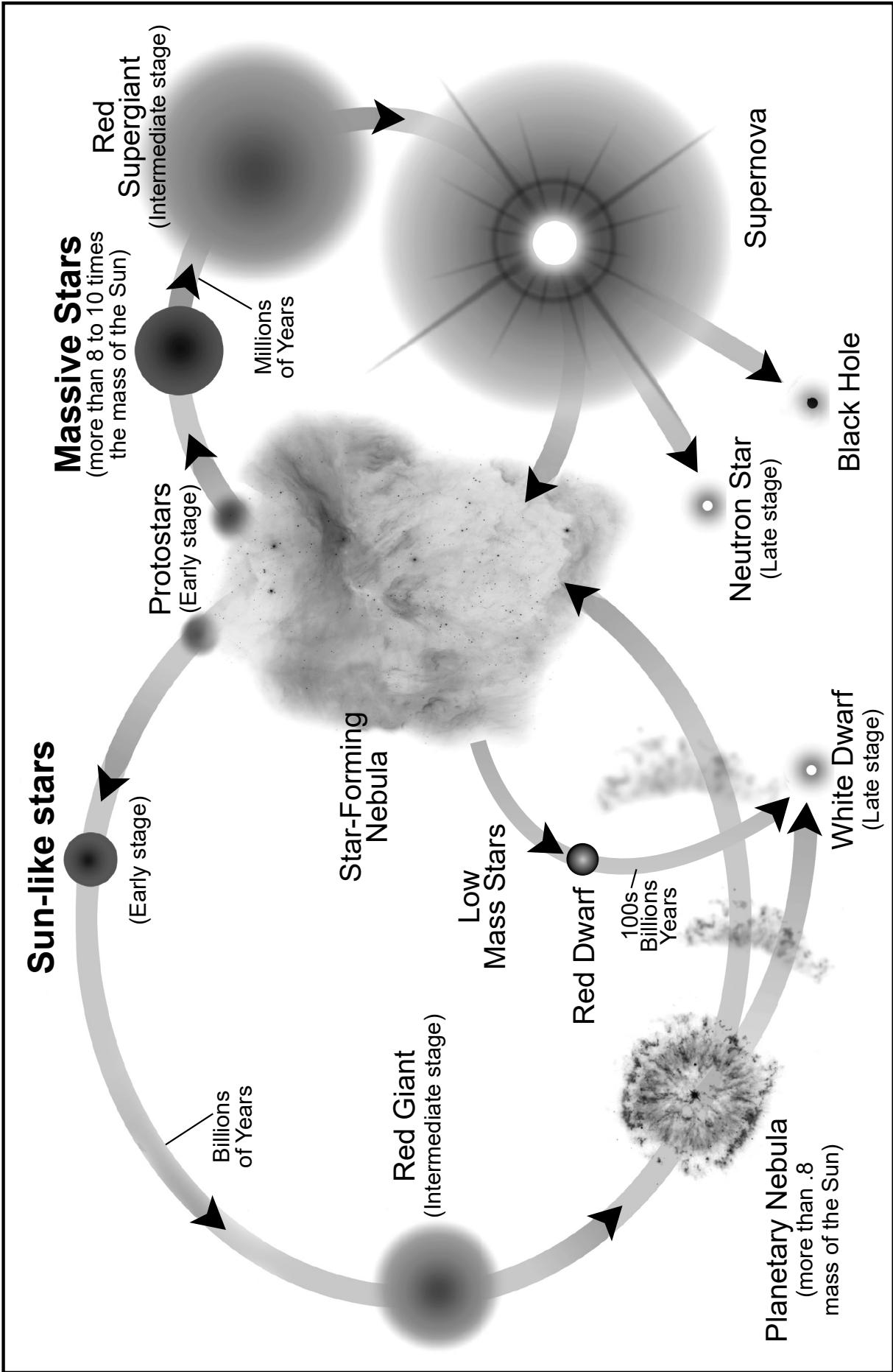


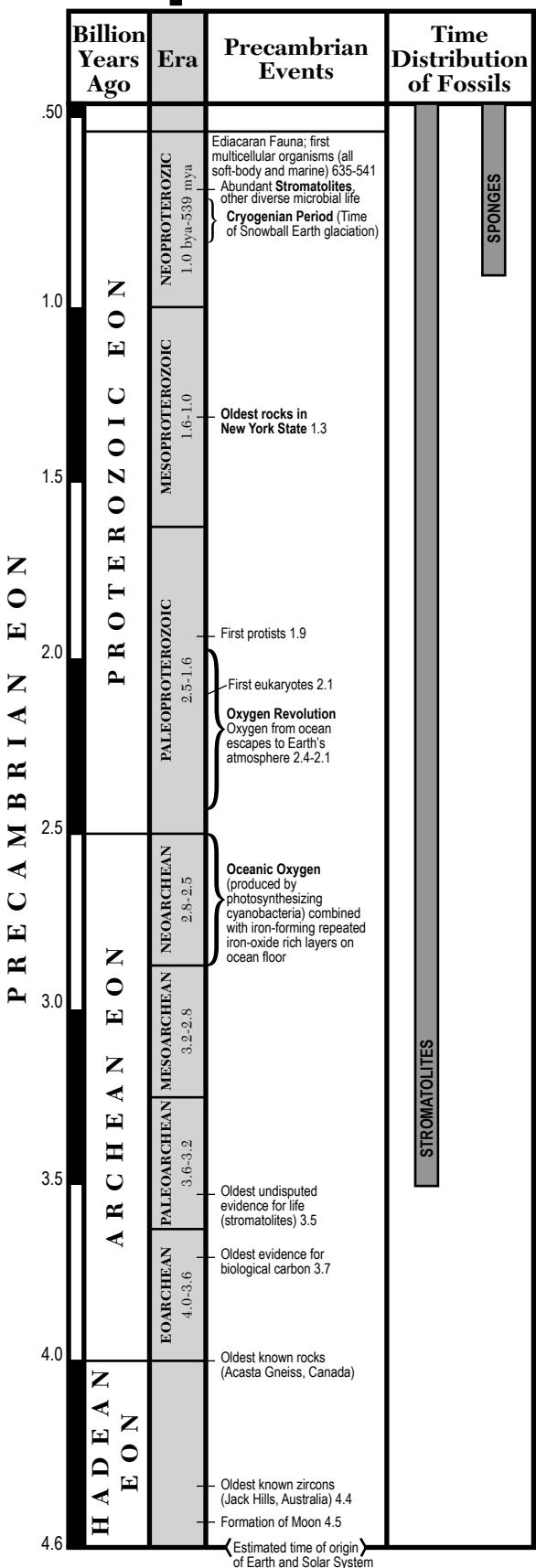
Emission Spectra of Some Elements from Stars



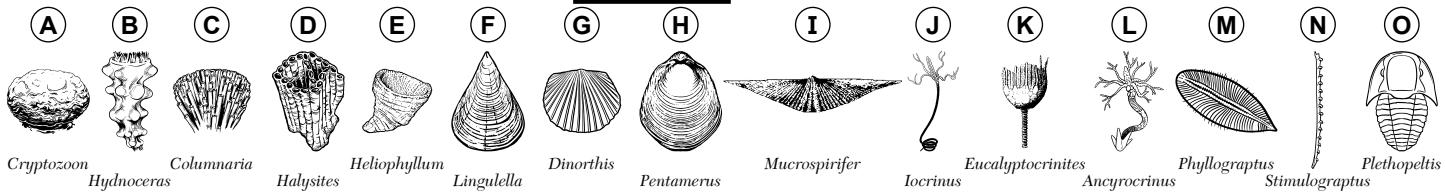


Life Cycles of Stars Model

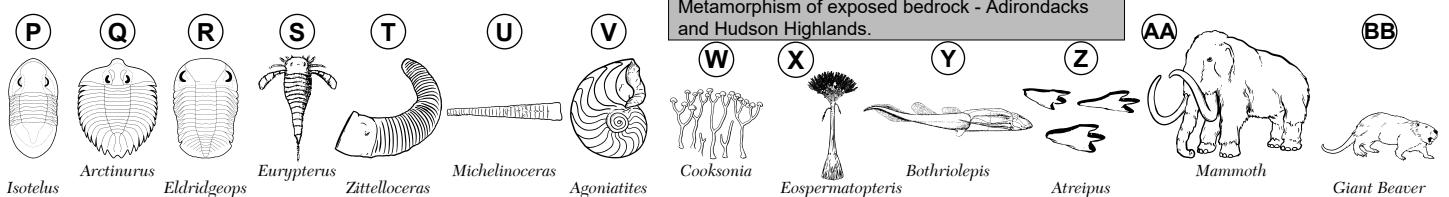
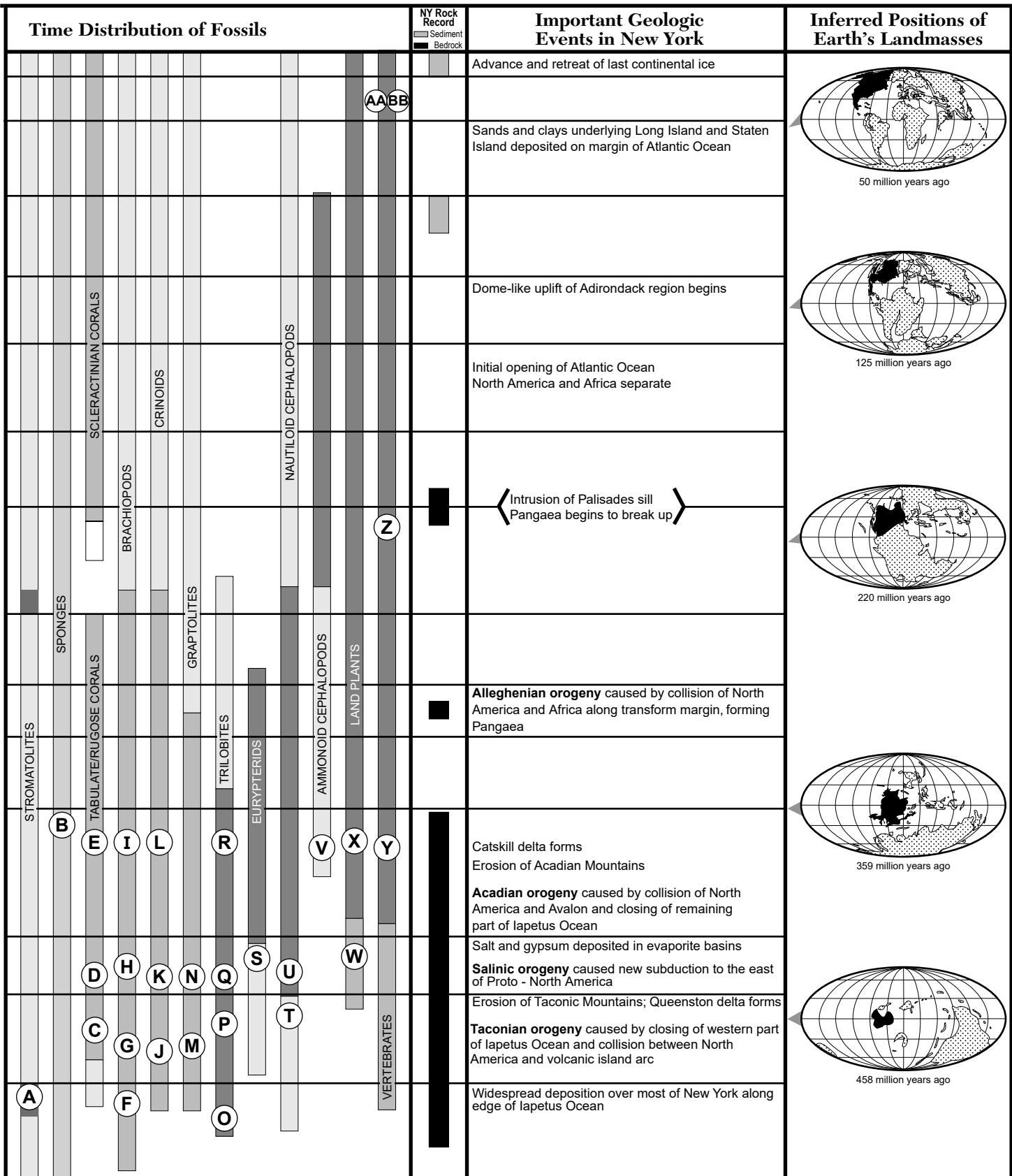


**PROTEROZOIC EON**

Million Years Ago	Era	Period	Epoch (million years ago)	Life on Earth
539 - present	CENOZOIC	QUATERNARY	Holocene (.012- present) Pleistocene 2.6-0.012	End of Ice Ages; human populations grow Humans, mammoths, giant beaver
2.6 - 0.012	NEOGENE		Pliocene 5.3-2.6 Miocene 23.0-5.3	Large carnivorous mammals; diverse human ancestors Abundant grazing mammals; giant crocodiles
23		PALEOGENE	Oligocene 34-23 Eocene 56-34 Paleocene 66-56	Grasslands become widespread First horses and whales Many modern groups of mammals evolve
66		CRETACEOUS	Late Cretaceous 101-66 Early Cretaceous 145-101	Mass extinction of all non-avian dinosaurs, many land plants, ammonoids, and other marine organisms Grasses first evolve. Earliest placental mammals
145		JURASSIC	Late Jurassic 162-145 Middle Jurassic 175-162 Early Jurassic 201-175	Giant marine reptiles (ichthyosaurs, plesiosaurs) Rays and modern sharks become common Earliest flowering plants Diverse bony fishes
201		TRIASSIC	Late Triassic 237-201 Middle Triassic 247-237 Early Triassic 252-247	Earliest birds; peak of sauropods and ammonoids Abundant dinosaurs and ammonoids Oldest sauropods
252		PERMIAN	Late Permian 260-252 Middle Permian 273-260 Early Permian 299-273	Fifth largest extinction event Dinosaur tracks in NY (Rockland County) Earliest mammals
299		PENNSYLVANIAN	Early Mississippian 331-323 Middle Mississippian 347-331 Late Mississippian 331-323	Ancestors to mammals were diverse Extensive coal-forming vegetation in swamps
323		MISSISSIPPAN	Early Mississippian 359-347	Reptiles more common than amphibians for first time Abundant amphibians
359		CARBONIFEROUS	Late Devonian 383-359 Middle Devonian 393-383 Early Devonian 419-393	Large and numerous vascular plants Earliest reptiles Extinction of many marine organisms, possibly caused by climate change due to spread of forests Earliest amphibians and seed plants Earth's earliest forests - Gilboa and Cairo, NY Abundant fishes and brachiopods Earliest ammonoids
419		DEVONIAN	Pridoli 423-419 Ludlow 427-423 Wenlock 433-427 Llandovery 444-433	Abundant eurypterids in NY; earliest sharks Earliest land animals (arthropods) Earliest fish with jaws; first vascular plants Widespread reefs; rising global temperatures
444		SILURIAN	Late Ordovician 458-444	Mass extinction affecting all major groups of marine organisms
485		ORDOVICIAN	Middle Ordovician 470-458 Early Ordovician 485-470	Earth's first reef-containing corals, first land plants Rapid diversification of Paleozoic animals
539		CAMBRIAN	Furongian 497-485 Miaolingian 509-497 Epoch 2 521-509 Terreneuvian 539-521	Extinction of many early life forms Peak trilobite diversity Earliest trilobites; earliest fishes First life forms with hard shells

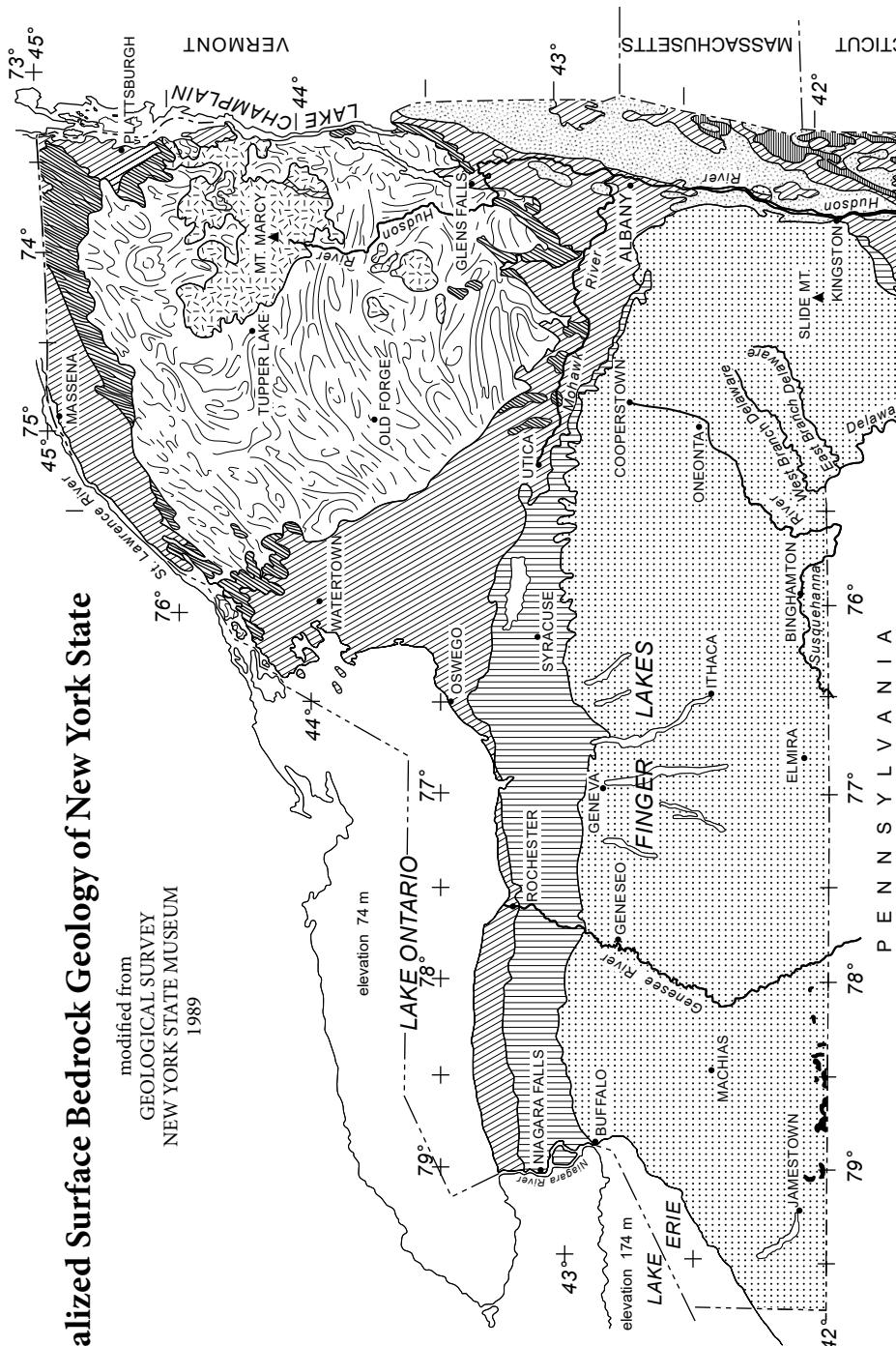
PHANEROZOIC EON

OF NEW YORK STATE



Generalized Surface Bedrock Geology of New York State

modified from
GEOLOGICAL SURVEY
NEW YORK STATE MUSEUM
1989



GEOLOGIC PERIODS AND ERAS IN NEW YORK

CRETACEOUS, PALEOGENE, NEOGENE, PLEISTOCENE (Epoch) weakly consolidated to unconsolidated gravels, sands, and clays

LATE TRIASSIC and EARLY JURASSIC conglomerates, sandstones, red shales, and dolomite (in Palisades sill)

PENNYSYLVANIAN conglomerates, sandstones, and shales

DEVONIAN limestones, shales, sandstones, and conglomerates

Silurian also contains salt, gypsum, and hematite.

ORDOVICIAN limestones, shales, sandstones, and dolostones

CAMBRIAN and EARLY ORDOVICIAN sandstones and dolostones

Moderately to intensely metamorphosed east of the Hudson River.

CAMBRIAN and ORDOVICIAN (undifferentiated) quartzites, dolostones, marbles, and schists

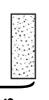
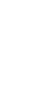
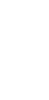
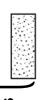
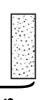
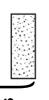
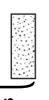
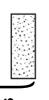
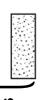
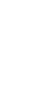
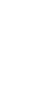
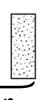
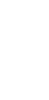
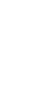
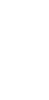
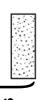
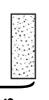
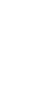
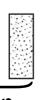
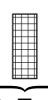
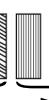
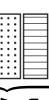
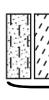
INTERMEDIATE METAMORPHOSIS; includes portions of the Taconic Sequence and Cortlandt Complex

TACONIC SEQUENCE sandstones, shales, slates, phyllite

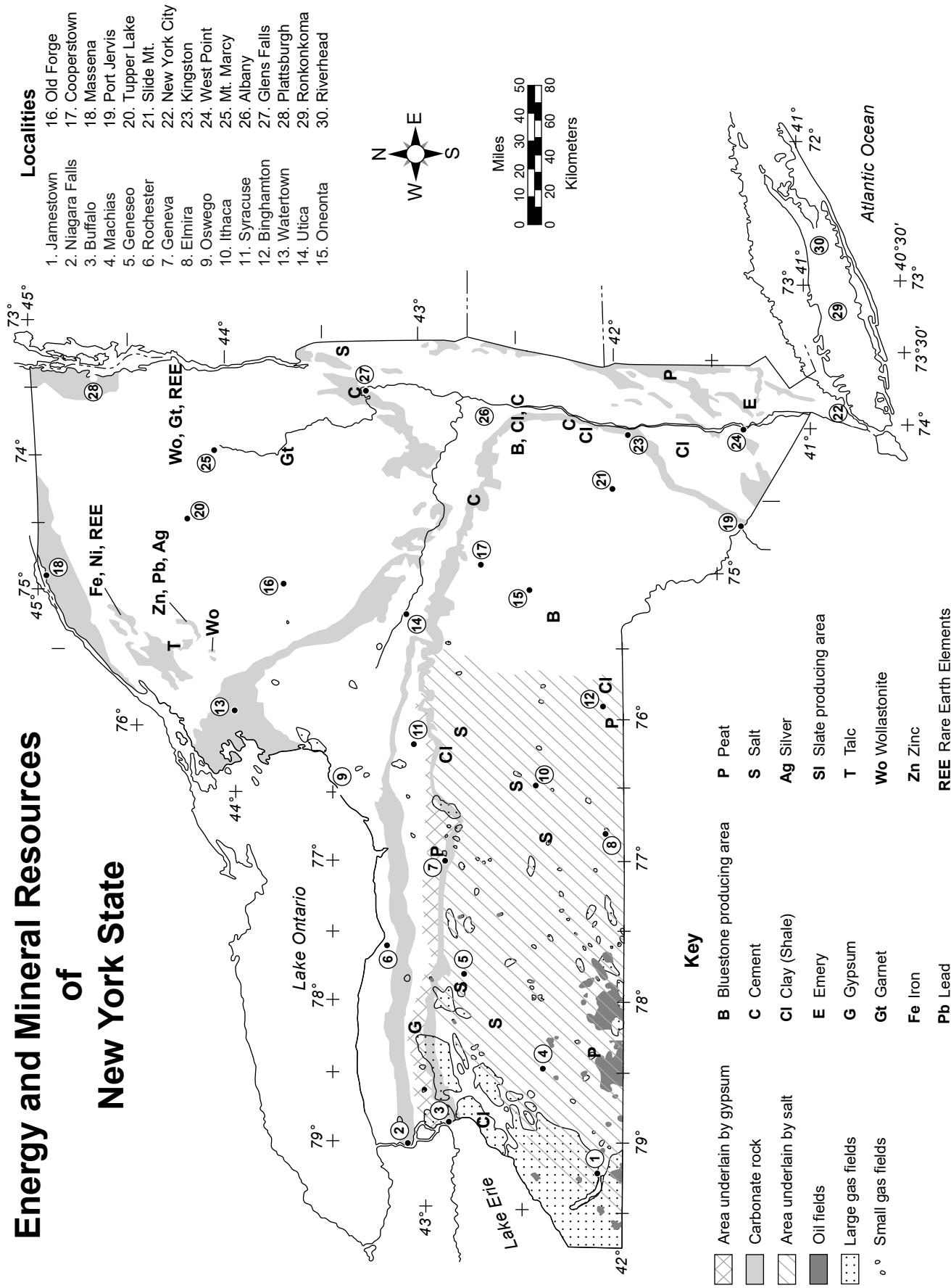
Sedimentary to moderately metamorphosed rocks of CAMBRIAN through MIDDLE ORDOVICIAN ages

Some intensely metamorphosed rocks

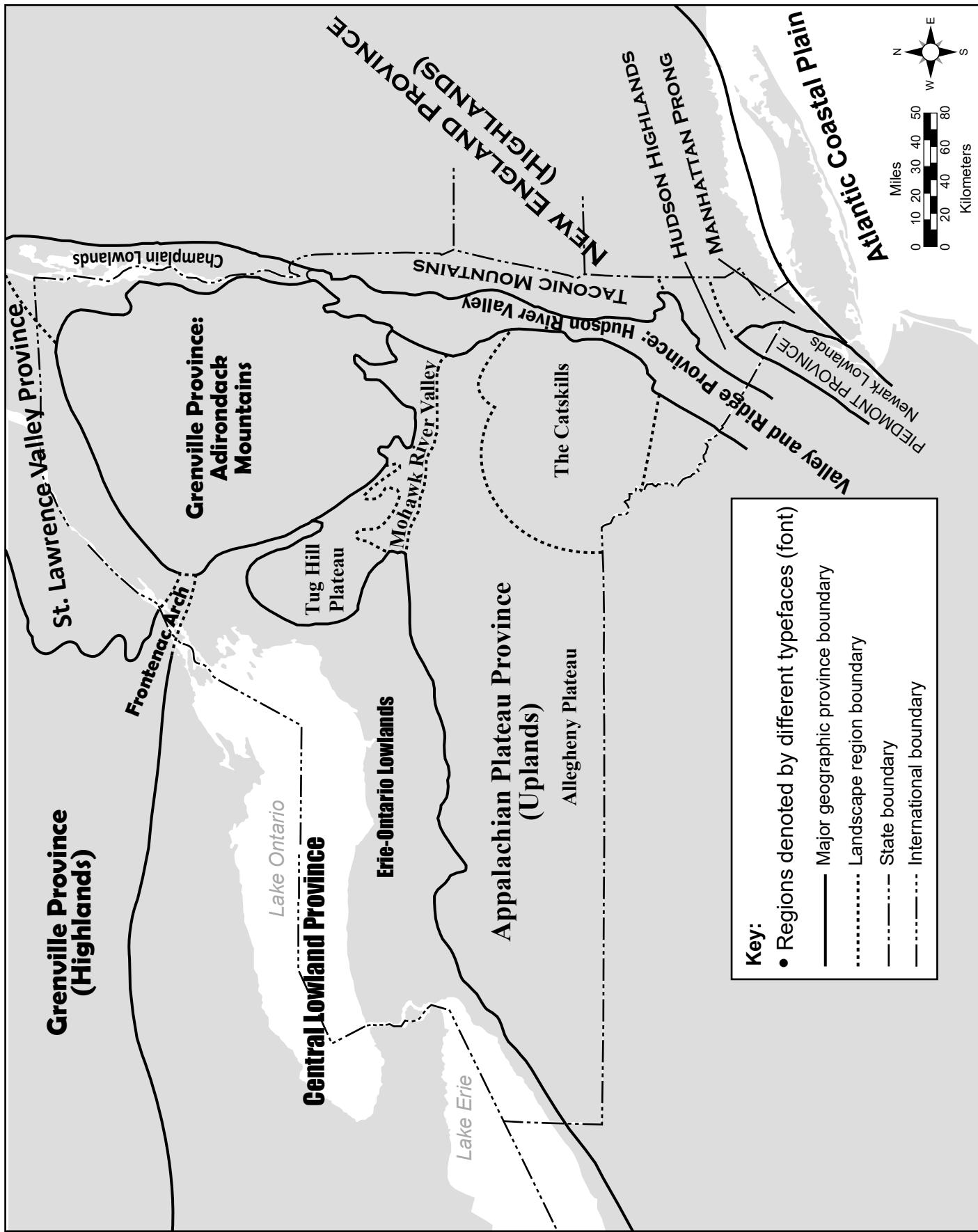
(regional metamorphism about 1,000 m.y.a.)



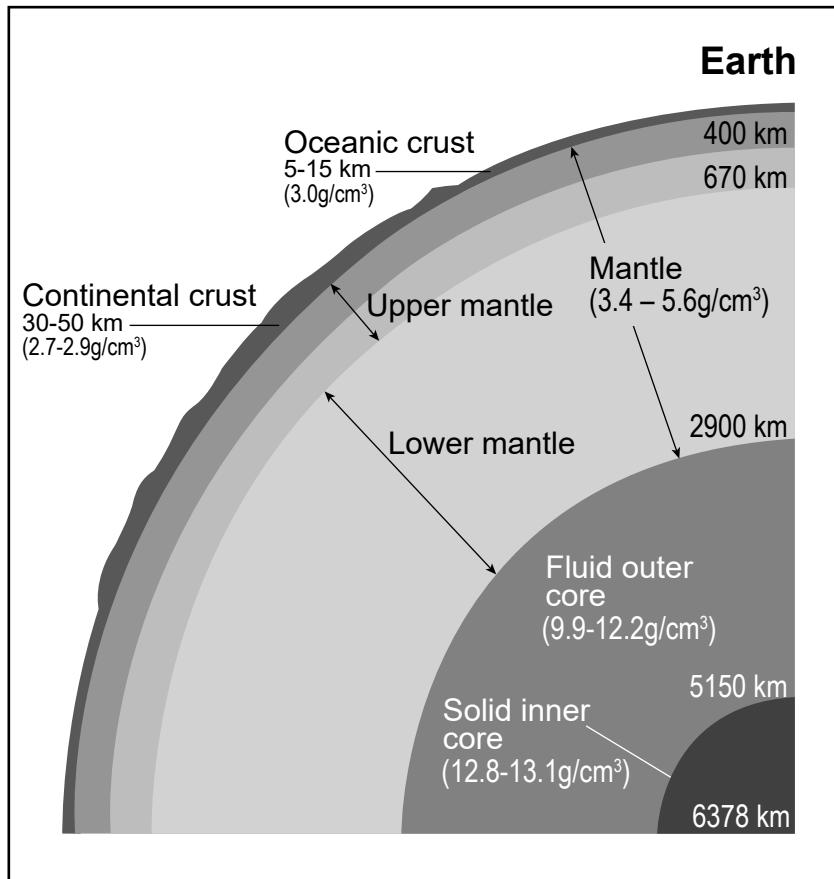
Energy and Mineral Resources of New York State



GEOGRAPHIC PROVINCE AND LANDSCAPE REGIONS OF NEW YORK STATE

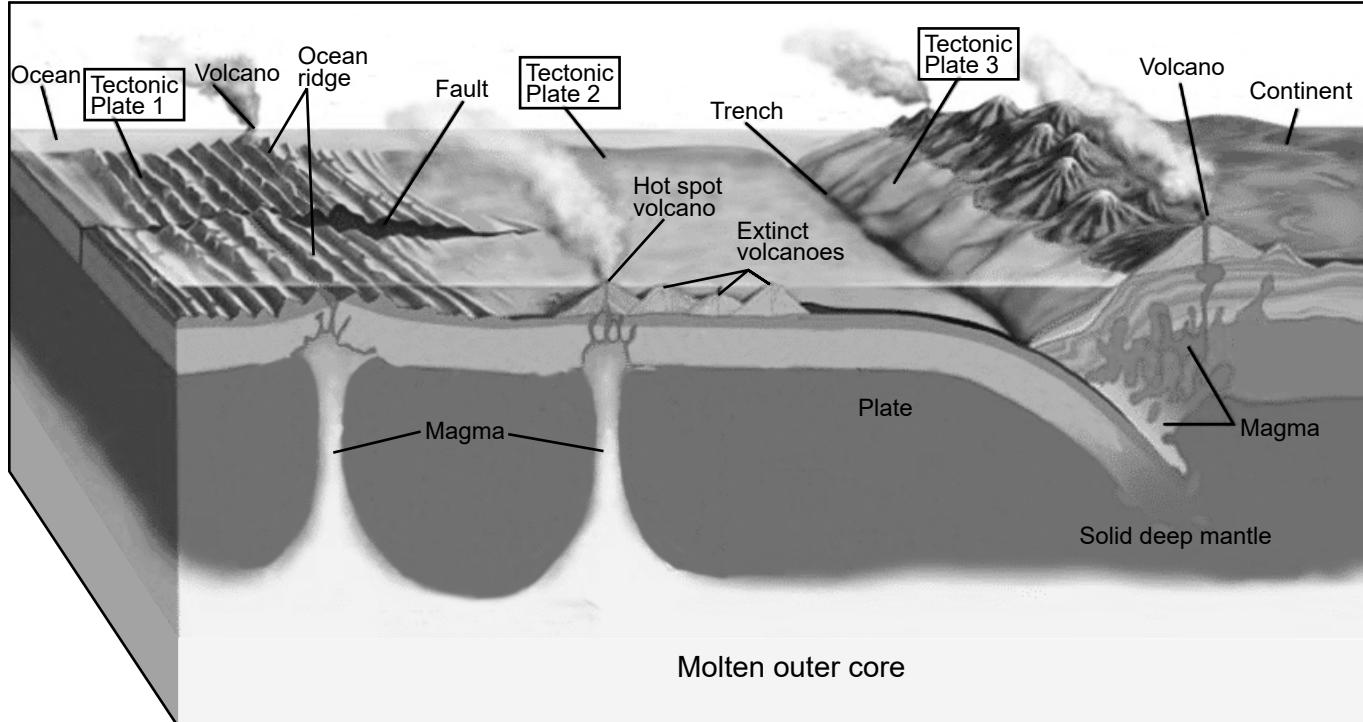


Model of Earth's Interior Structure



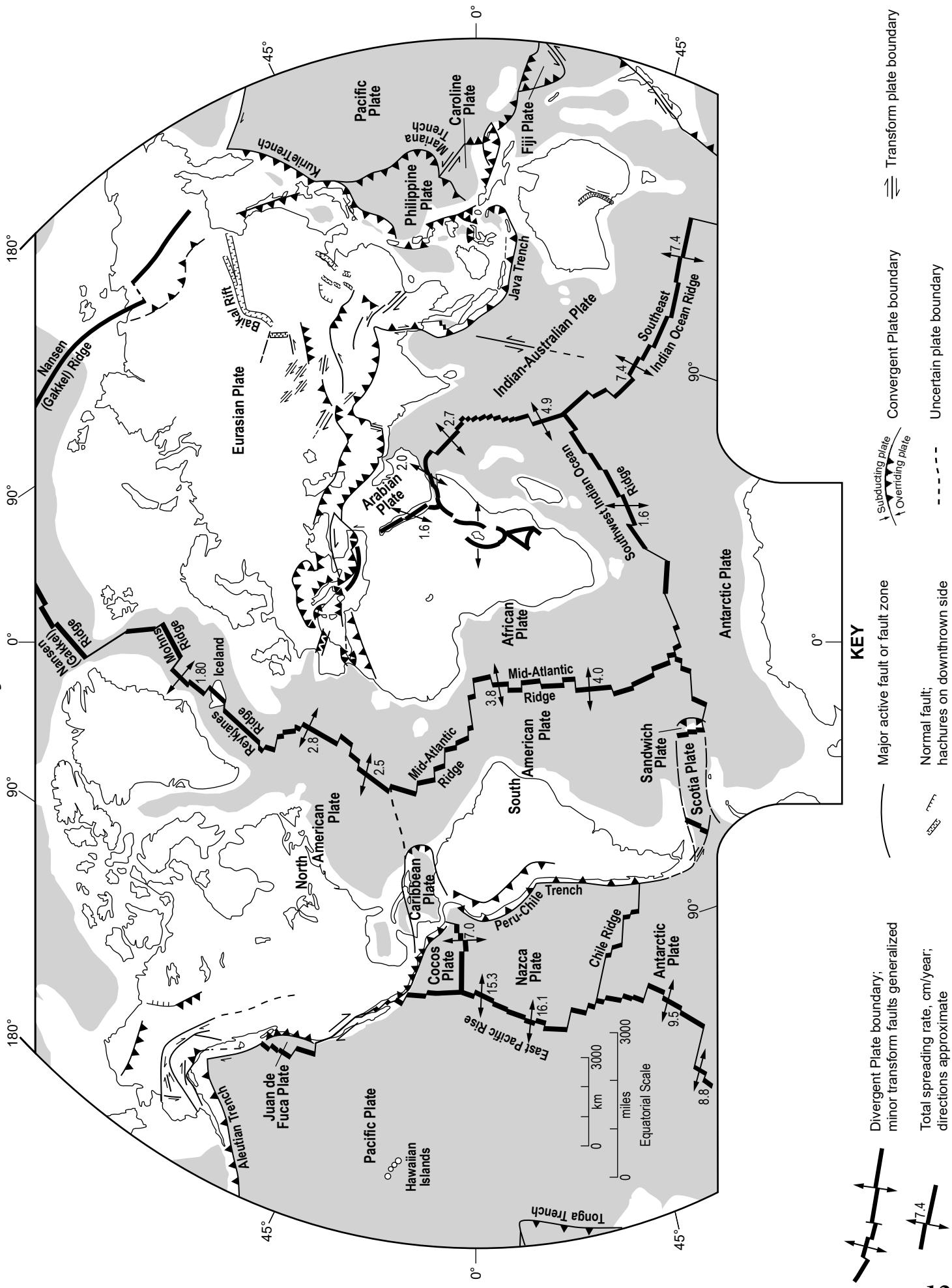
(Not drawn to scale)

Cross Section Model of Earth's Surface and Interior

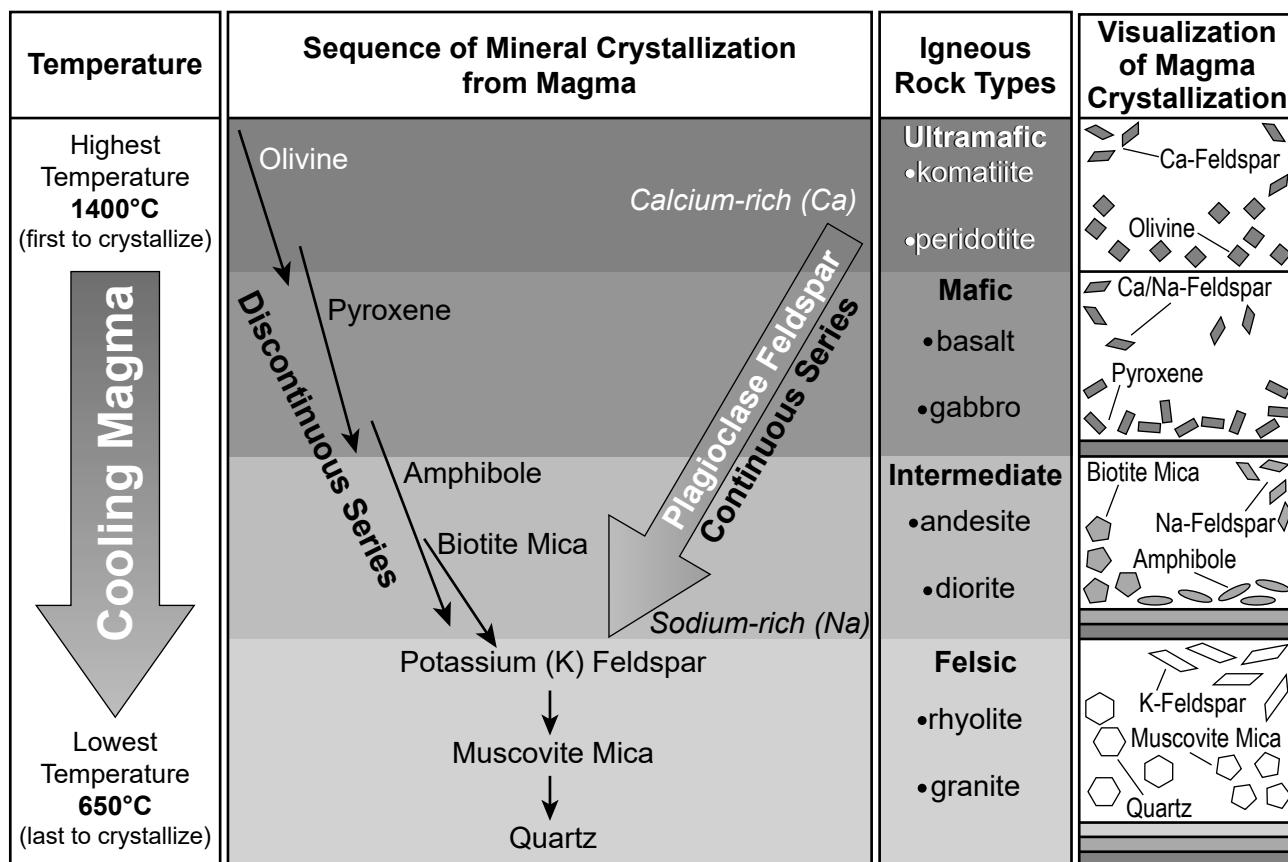


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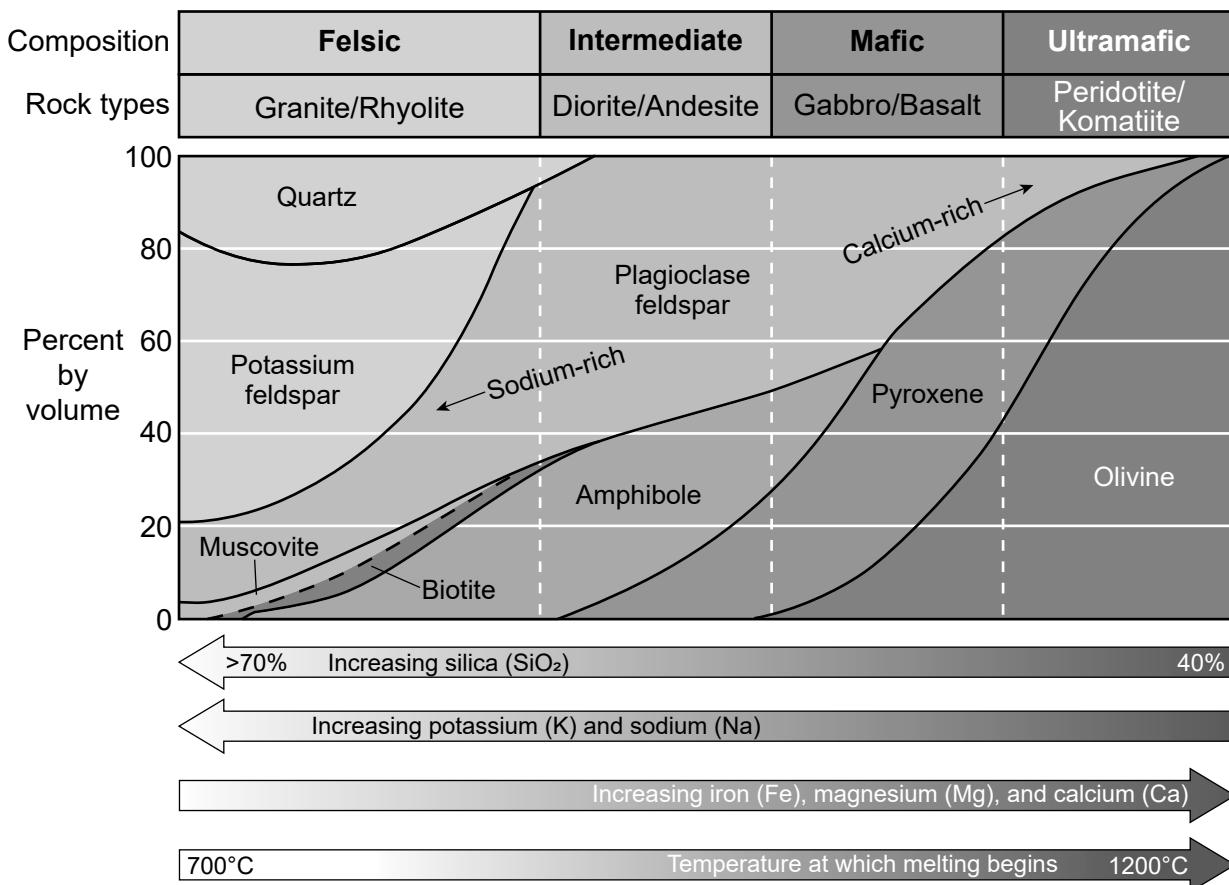
Global Tectonic Activity of the Last One Million Years



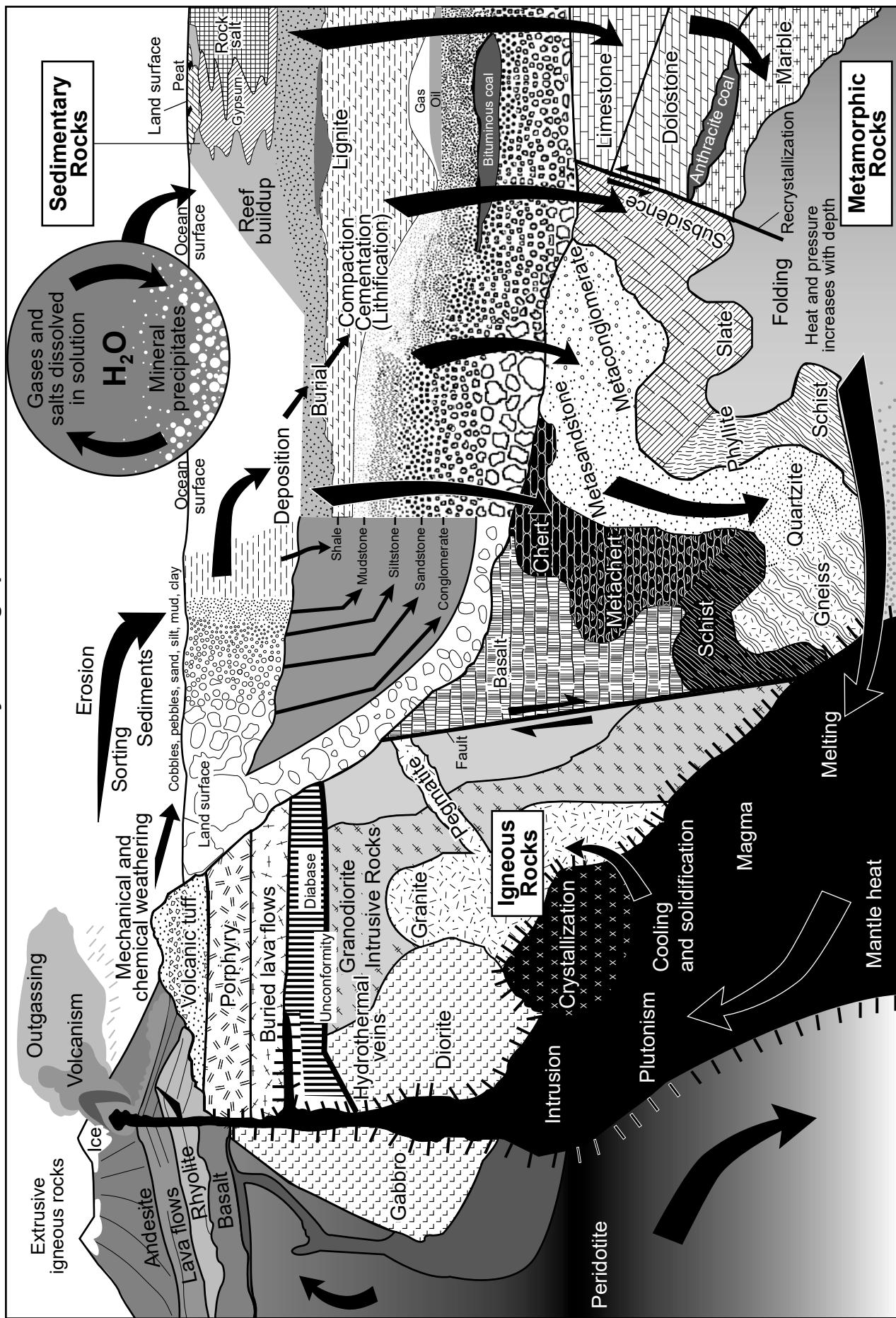
Model of Bowen's Reaction Series



Mineral Composition of Igneous Rocks



Rock Cycle Infographic



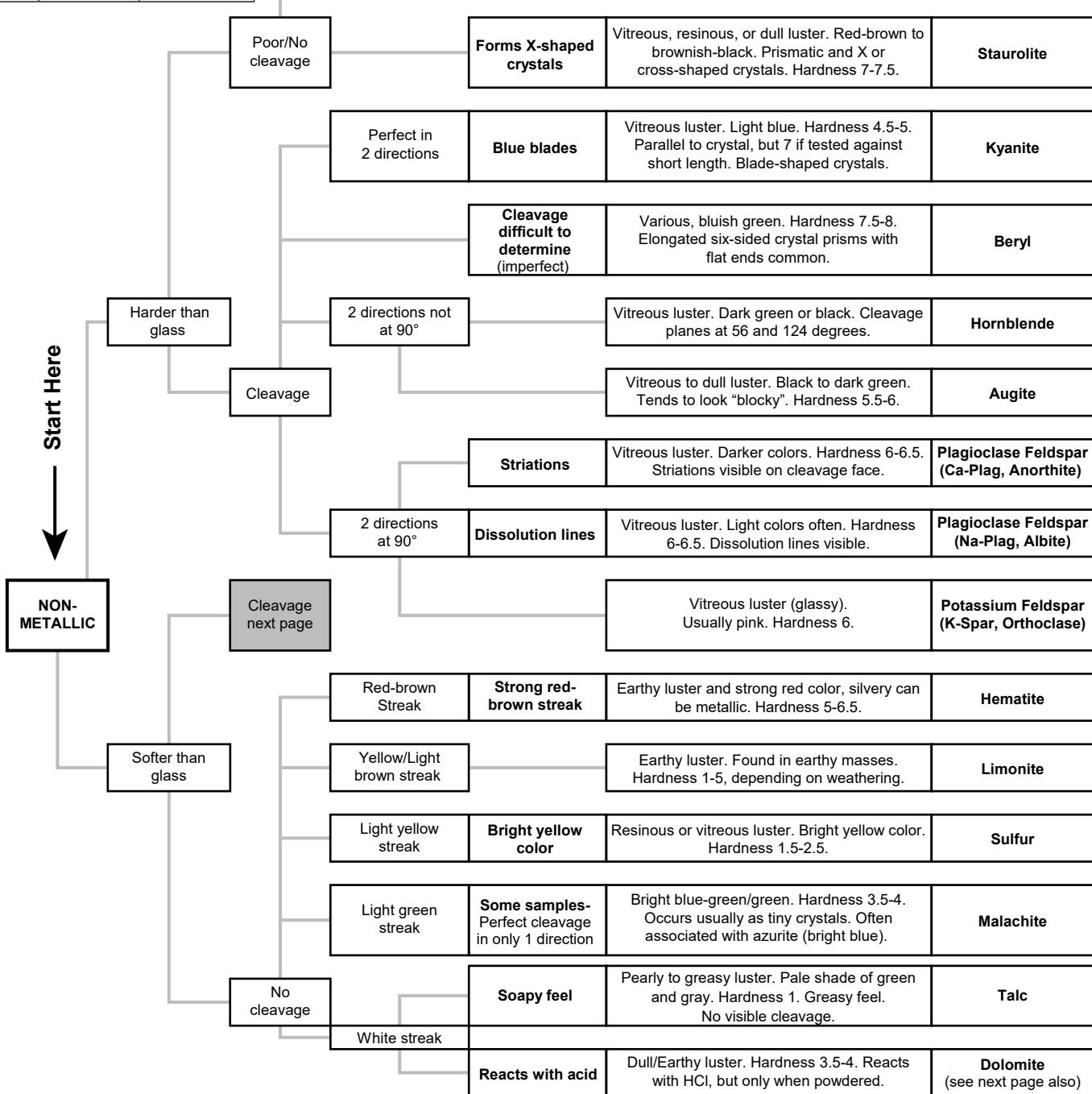
Geologically Important Radioactive Elements Used for Radiometric Dating

Parent Isotope	Daughter Decay Product	Half-life (years)	Useful Dating Range (years)	Dataable Materials
Samarium-147	Neodymium-143	106 billion	10 million - 4.6 billion	Garnets, micas
Rubidium-87	Strontium-87	48.8 billion	10 million - 4.6 billion	Potassium-bearing minerals (mica, feldspar, hornblende), whole igneous or metamorphic rock
Uranium-238	Lead-206	4.5 billion	10 million - 4.6 billion	Uranium-bearing minerals (zircon, apatite, uraninite)
Uranium-235	Lead-207	713 million	10 million - 4.6 billion	Uranium-bearing minerals (zircon, apatite, uraninite)
Potassium-40	Argon-40	1.3 billion	100,000 - 4.6 billion	Potassium-bearing minerals (mica, feldspar, hornblende), igneous or volcanic rock (tuff and/or lava flows)
Carbon-14	Nitrogen-14	5730	100 - 70,000	Organic materials, glacial ice containing carbon dioxide, groundwater, and ocean water

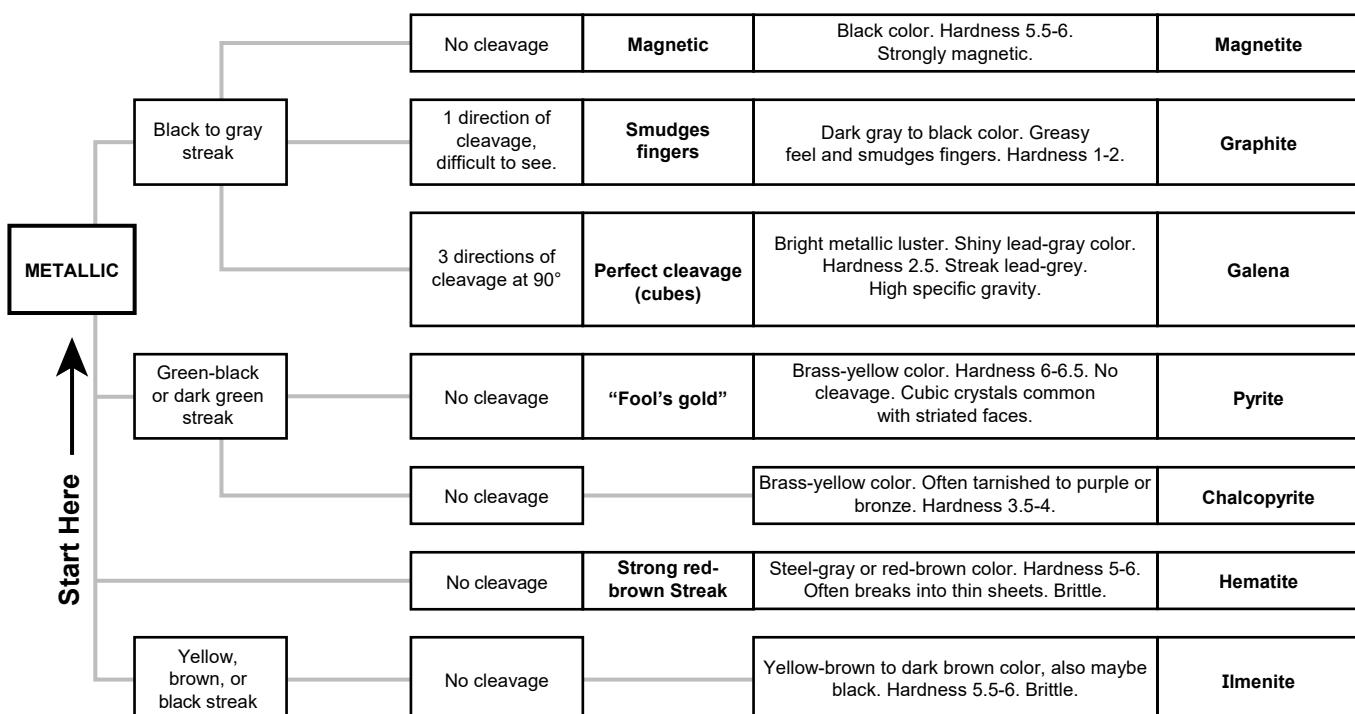
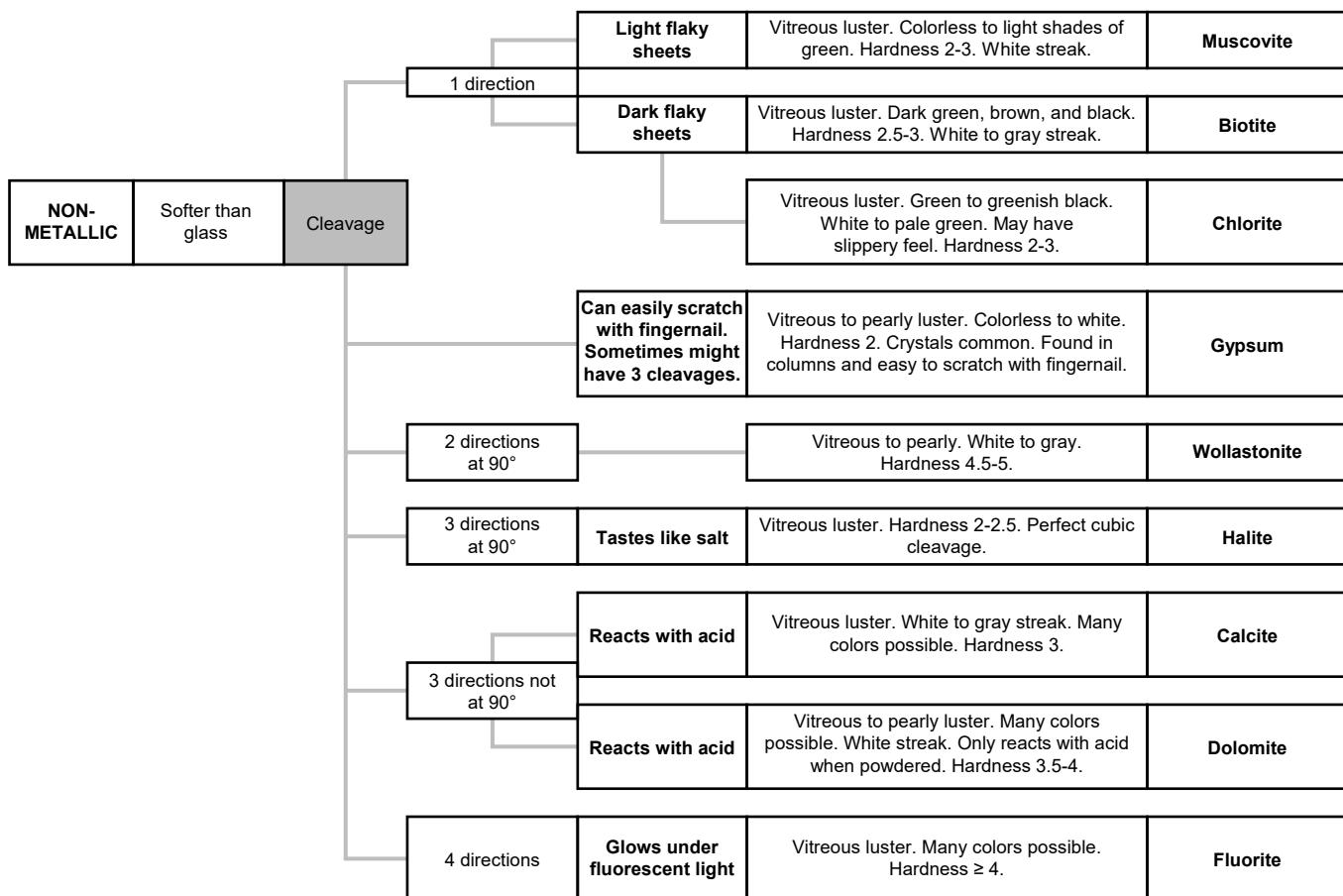
Mohs Hardness Scale

Hardness	Mineral Name	Tools
10	Diamond	
9	Corundum	
8	Topaz	
7	Quartz	
6	Orthoclase	Streak plate
5.5		Glass plate
5	Apatite	
4.5		Steel nail
4	Fluorite	
3.5		Copper penny
3	Calcite	
2.5		Finger nail
2	Gypsum	
1	Talc	

Mineral Identification Flowchart

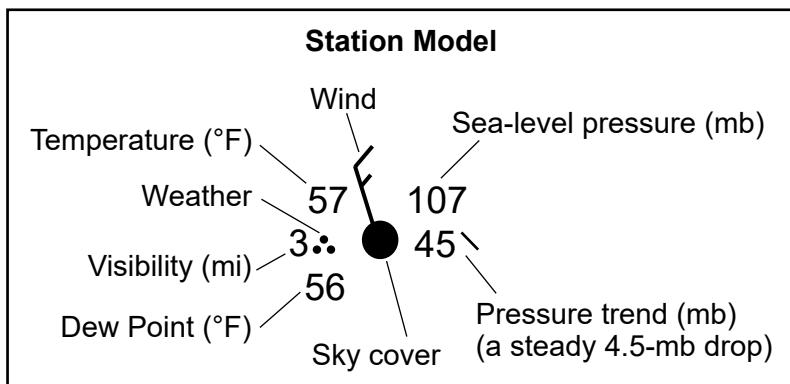


Mineral Identification Flowchart (Continued)



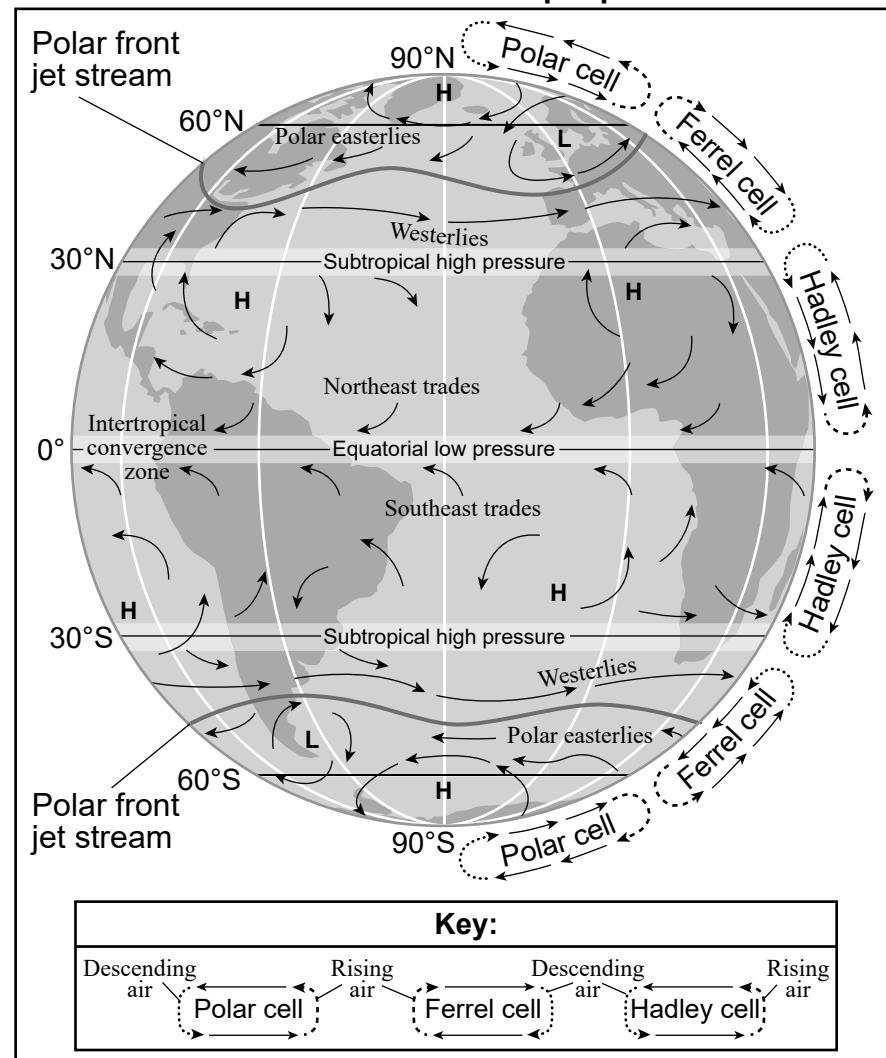
Start Here ↑

Key to Weather Map Symbols

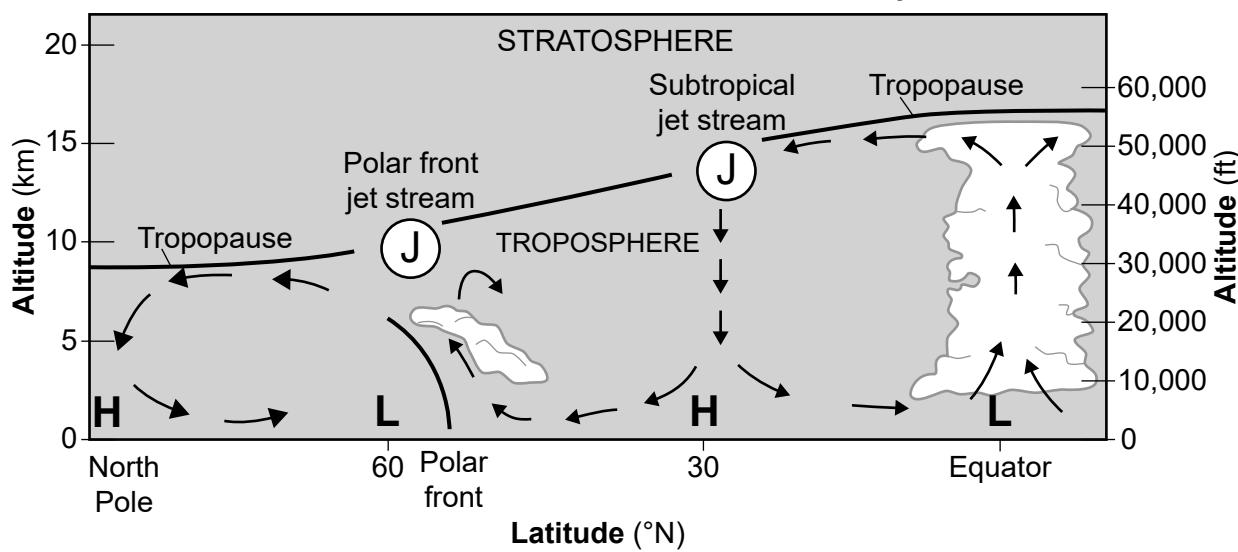


Wind Speed	Weather Conditions	Cloud Coverage	Misc. Sky Cover																																				
 	<table border="1"> <thead> <tr> <th colspan="3">Intermittent</th> </tr> <tr> <th>Light</th><th>Moderate</th><th>Heavy</th></tr> </thead> <tbody> <tr> <td>Rain</td><td>●</td><td>●</td><td>●●</td></tr> <tr> <td>Snow</td><td>*</td><td>*</td><td>*</td></tr> <tr> <td>Drizzle</td><td>,</td><td>,</td><td>,</td></tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="3">Steady</th> </tr> <tr> <th>Light</th><th>Moderate</th><th>Heavy</th></tr> </thead> <tbody> <tr> <td>Rain</td><td>●●</td><td>●●</td><td>●●●</td></tr> <tr> <td>Snow</td><td>**</td><td>**</td><td>***</td></tr> <tr> <td>Drizzle</td><td>,,</td><td>,,</td><td>,,</td></tr> </tbody> </table>	Intermittent			Light	Moderate	Heavy	Rain	●	●	●●	Snow	*	*	*	Drizzle	,	,	,	Steady			Light	Moderate	Heavy	Rain	●●	●●	●●●	Snow	**	**	***	Drizzle	,,	,,	,,	 	
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Hail	▴	▴																																					
Air Pressure	Fronts	Pressure																																					
H High L Low	 	<p>Sea-level pressure is plotted in tenths of millibars (mb) with the leading 10 or 9 omitted.</p> <p>410: 1041.0 mb 103: 1010.3 mb 987: 998.7 mb 872: 987.2 mb</p>																																					

Model of Generalized Planetary Wind Belts in the Troposphere



Cross Section Model of Earth's Lower Atmosphere



Surface Ocean Currents Model

