

TAMU GEOL 101 – Comprehensive Exam 1 Cheat Sheet

ORIGIN OF UNIVERSE & EARTH SEISMIC WAVES

Big Bang: 13.7 Ga (Universe forms)
Nebular Theory: Solar system from rotating solar nebula
Earth age: 4.6 Ga

Formation sequence: Collapse → Spinning disk → Proto-sun → Planetesimals → Planets

Chemical differentiation: Dense Fe-Ni sank → Core formed → Mantle + crust layered by density

EARTH SYSTEMS

Geosphere	Solid Earth
Hydrosphere	Liquid water
Atmosphere	Gases
Cryosphere	Ice
Biosphere	Life

Steady State: Input = Output
Output \downarrow Input → depletion
Input \downarrow Output → accumulation

Uniformitarianism: Present = key to past

EARTH STRUCTURE (COMPOSITIONAL)

Crust	Oceanic: Basalt, 8 km, 3.0 g/cm ³ Continental: Granite, 30–70 km, 2.7 g/cm ³
Mantle	Peridotite (largest by volume)
Outer Core	Liquid Fe-Ni
Inner Core	Solid (pressure)

Thickest sphere: Geosphere

Geothermal gradient: Temp ↑ with depth

PHYSICAL LAYERS

Lithosphere = crust + upper mantle (rigid plates)
Asthenosphere = ductile/plastic
Mesosphere = lower mantle
Boundary (lith/asth) = temperature-controlled

P-wave	Solids + liquids
S-wave	Solids only
No S-wave in outer core → liquid	

PLATE TECTONICS

Divergent	Ridge, rift valley, decompression melting
Convergent (O-C)	Subduction, volcanoes on continent
Convergent (C-C)	Mountain belts, no volcanism
Transform	Shear, no creation/destruction

Drivers: Slab pull, Ridge push, Convection

Rate: 3 cm/yr

Old seafloor \downarrow 200 Ma (recycled)

Stress types: Tension (rift), Compression (convergent), Shear (transform)

VOLCANISM

Shield	Mafic, low viscosity, effusive
Stratovolcano	Felsic/intermediate, explosive
Caldera	Chamber collapse
Hot spot	Mantle plume track

Most volcanoes: Convergent-subduction

Melting types: Decompression → ridges/hot spots

Volatile melting → subduction

Heat-transfer → continental crust

Lahars = water + ash debris flows

CO₂ hazard = colorless, dense, suffocation

MAGMA PROPERTIES

Temp ↑	Viscosity ↓
Silica ↑	Viscosity ↑
Volatiles ↑	Explosivity ↑

Silica content: Ultramafic 38–45%

Mafic 45–52%

Intermediate 52–66%

Felsic 66–76%

Magma temp: 650–1100°C

BASALTIC vs FELSIC

	Basaltic	Felsic
Silica	Low	High
Viscosity	Low	High
Density	High	Low
Temp	High	Lower
Volcano	Shield	Stratovolcano
Color	Dark	Light

Mafic = Mg, Fe rich

Felsic = Si, Al rich

ROCK TYPES

Igneous = cooling magma/lava

Sedimentary = lithified sediment

Metamorphic = heat + pressure (solid state)

Metamorphic grade: Slate → Phyllite → Schist → Gneiss

Sandstone → Quartzite

Limestone → Marble

WEATHERING & SEDIMENT

Mechanical = frost wedging

Chemical = acid reaction

Rainwater + CO₂ → carbonic acid

Grain size: Gravel \downarrow Sand \downarrow Silt \downarrow Clay

Glacial deposits = very poorly sorted

FAULTS & DEFORMATION

Fault = fracture + displacement

Joint = no displacement

Elastic deformation = returns to shape

Brittle deformation = faults

Reverse fault = compression

Normal fault = tension

Strain = result of stress

KEY NUMBERS

Earth age: 4.6 Ga

Universe age: 13.7 Ga

Oceanic crust density: 3.0 g/cm³

Continental crust density: 2.7 g/cm³