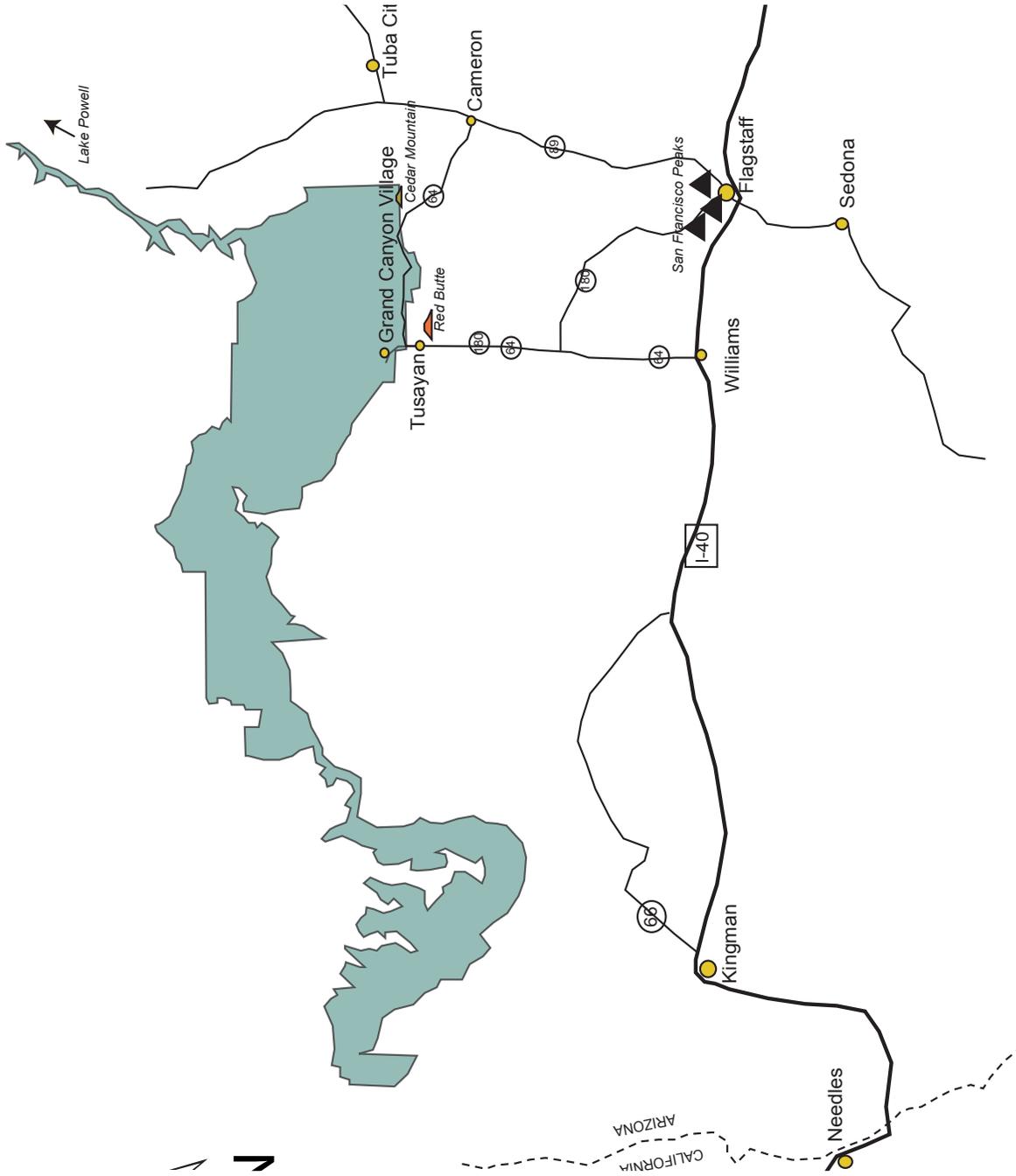


APPENDIX 1: REGIONAL MAP



Regional Map. The green area is the approximate area of Grand Canyon National Park.

GLOSSARY

absolute age – a numeric unit that is assigned to signify the age of something

angular unconformity – a gap in the geologic record formed where horizontal layers lie directly on top of layers that have been tilted

anticline – an upward fold in rock layers (in the shape of an “A”), where the youngest layers are usually on the top of the fold, and the oldest layers are in the center of the fold

asthenosphere – the soft solid layer of mantle that lies below the lithosphere and drives the movement of tectonic plates

atom – the smallest particle of an element, composed of protons, neutrons and electrons

atomic number – the total number of protons in an atom

atomic weight – the total of the masses of the protons and neutrons in an element

basalt – a dark, fine-grained, extrusive igneous rock composed of low silica, iron-rich minerals

base level – the elevation of a stream’s mouth or outlet; the lowest elevation that the stream can cut down to

butte – a landscape feature with a flat top that is at least as tall as it is wide, generally narrower than a mesa

calcrete – (see *caliche*)

caliche – a hard, white substance composed of primarily calcium carbonate; it forms on the surface of rocks or as a soil layer

chemical weathering – the process by which the chemical composition of a rock is broken down and minerals that in the rock are altered

chert – a hard substance composed of very fine (micro-crystalline) quartz crystals, made of pure silica (SiO₂) that may form irregular shaped nodules and blobs in a rock

continental crust – the thick, buoyant crustal material that underlies continents, which

causes the land to float higher on the mantle and sit above sea level

convergent plate boundary – where two plates slowly collide, one plate usually subducts beneath the other causing volcanoes to form on the over-riding plate and earthquakes to occur where the plates are in contact and on the subducting plate; when two continents collide, there may be no subduction zone

convection – the transport and circulation of energy due to differences in density; it is caused by the circulation of hot, less dense material rising while cold, denser material sinks

core – the center portion of the Earth, which is composed of heavy nickel and iron material

cross bedding – the angled, layered appearance in a sedimentary rock, formed as wind or water deposits particles in ripples or sand dunes

crust – the Earth's outermost layer, which is mainly composed of compounds of oxygen and silica (silicates)

crystalline – a description of metamorphosed rock and/or intrusive igneous rock with visible mineral crystals

daughter isotope – the product of radioactive decay of an unstable, radioactive parent isotope

delta – the fan-shaped sedimentary feature formed where a river meets the ocean or some large body of water, and the sediment carried by the river begins to settle out and deposit; named after the shape of the delta symbol.

dike – a vertical intrusive igneous feature formed when magma cuts across or is squeezed into rock

discharge – the volume of water that a river or stream carries in a given time; usually measured in cubic feet per second (cfs)

disconformity – a gap in the geologic record between sedimentary layers, formed when there is a period of erosion or no deposition, but there is no tilting of the layers

divergent plate boundary – where two plates rip apart and move in opposite directions, usually accompanied by volcanoes and small, shallow earthquakes

earthquake – the energy released due to built up strain energy along a fault

element – the most basic form of matter, which has distinct, identifying physical and

chemical properties

eolian – sediment transported and deposited by wind, such as sand dunes

erosion – the transport of rock material by forces such as water and wind that takes place in conjunction with and subsequent to weathering

estuary - a body of water near a shoreline that is joined with the ocean where fresh and saline water mix

extrusive – (volcanic) igneous rocks that form as lava pours out onto the Earth's surface and quickly cools

evaporite – a mineral that was once dissolved in water, but as the water evaporated the mineral was precipitated out

fault – a crack in rocks with movement parallel to the surface of the crack

flint – dark grey chert colored by impurities

fluvial – river or stream depositional environment

fold – a bend in rocks that were once horizontal and flat

foliation – the parallel alignment of platy or prismatic minerals in metamorphic rocks

formation – a mappable rock layer of a distinct and recognizable rock type(s) that can be distinguished from the rocks above and below it; the fundamental stratigraphic unit

fossil – any mineralized remains, traces, or remnants of once living organisms

fracture – (see *joint*)

geology – the study of the Earth and the surface and sub-surface processes that shape it

geomorphology – the study of the geologic processes that create landscapes on the Earth's surface and shape geologic landforms

glauconite – a mineral in clay or shale that often has a greenish color

gneiss – a highly metamorphosed rock with foliation of light and dark bands of minerals

gradient – the slope of a stream or change in elevation of the channel over some distance

granite – a light, usually pink colored, intrusive igneous rock composed of large, high-silica minerals

groundwater – water that flows through channels and pore spaces within rocks beneath the Earth's surface

group – several stratigraphic formations that represent similar depositional environments in geologic time

gypsum – a soft evaporite mineral usually colorless, yellow, white, grey, or pink

half-life – the amount of time it takes for half of a parent isotope to decay to form a daughter isotope

headward erosion – the process of erosion from the steepest parts of river channels as a river cuts back towards its headwaters

hydrology – the study of the movement of water

hypothesis – a testable scientific idea that is an attempt to explain the observations of some phenomenon may have occurred

ice wedging – the physical weathering process that occurs when water freezes in cracks and the ice expands, gradually widening the cracks in the rock

igneous rock – cooled and hardened Earth material that was once partly or completely molten

inner core – the center-most, solid portion of the Earth, composed of the dense iron and nickel-rich minerals

intertidal zone – a low-lying area near sea level that is sometimes submerged and other times exposed due to tidal or sea level changes

intrusive – (plutonic) igneous rocks that cool and harden slowly beneath the Earth's surface

isotope – one of many forms of an element that has the same number of protons, but a different number of neutrons, giving it a different atomic weight; one element can have several isotopes and some may be radioactive

jasper – red chert colored by impurities

joint – a crack in a rock with little or no upward or downward movement in directions

parallel to the crack; the rocks simply move apart *perpendicular* to the cracked surface

lava – igneous, molten rock that is erupted onto the Earth surface

limestone – a sedimentary rock composed mainly of calcium carbonate (CaCO_3), or “lime,” that has chemically precipitated from seawater or composed of the hard parts of some marine organisms; the lime settles on the sea floor, eventually forming a hardened rock

lithosphere – the Earth’s solid outer layer made up of both the crust and the uppermost part of the mantle; it is divided into tectonic plates

mantle – the layer between the core and the crust of the Earth made up of compounds of oxygen and silica (silicates) rich in iron and magnesium

magma – igneous, molten rock that exists below the Earth’s surface

mass movement – the physical weathering process that occurs when huge portions of rock are washed away or fall

mechanical weathering – (see *physical weathering*)

member – the stratigraphic division of a rock unit in a formation

mesa – a large, flat-topped hill that is wider than its height; generally wider than a butte

mesosphere – the lower, solid layer of the mantle that lies between the asthenosphere and the outer core

metamorphic rock – sedimentary, igneous, or other metamorphic rocks that have been re-crystallized by heat and/or pressure

mineral – a substance that occurs naturally, is inorganic, and is composed of different elements combined to make a crystalline solid

monocline – a fold that is neither an anticline nor a syncline, with only one folded side, which looks similar to a ramp

mud crack – a sedimentary feature formed when mud is exposed to air, dries and cracks into pieces

nonconformity – a gap in the geologic record formed where sedimentary layers lie directly on top of intrusive igneous or metamorphic rock

normal fault – a fault that forms as the upper block drops down relative to the lower

block, usually as a result of pulling or extensional geologic forces, such as occurs at divergent plate boundaries

ocean crust – the thin, heavy crustal material that exists beneath the oceans

outer core – the liquid, outer portion of the core of the Earth

parent isotope – the initial unstable, radioactive isotope that decays to form a daughter isotope

physical weathering – (mechanical weathering) the simple breakdown of the rocks by physical processes, without any chemical changes

plate tectonics – the theory that Earth's outer shell is composed of plates that move and interact with each other

pluton – a large chamber that holds magma beneath the Earth's surface

plutonic – (see *intrusive*)

precipitate – the process that forms solids from liquid as chemicals interact; or the solids that form due to liquid chemical reactions

Principle of Original Horizontality – the concept that rock layers are deposited as flat, horizontal layers, therefore if the layers are tilted or bent, they must have been deformed by some later geologic event

Principle of Superposition – the concept that layers are deposited one on top of another over time, therefore the oldest layer is on the bottom, and layers above are progressively younger

radioactive isotopes – isotopes that are unstable and naturally decay to form stable isotopes

radiometric dating – the absolute dating of materials performed by comparing the amount of parent and daughter isotopes within the material

reactivation - when a fault is “re-broken” in response to geologic forces that occur after those that initially formed it

regression – when the shoreline moves away from land, possibly because of a lowering of sea level or uplift of the land

relative age – a comparative age without a number value assigned

relief - the difference in elevation between high points and the surrounding region on the Earth's surface

reservoir – a lake or body of water that forms as water backs up behind a dam or other obstruction

reverse fault – a fault that forms as the upper block is shoved up relative to the lower block, usually as a result of compressional geologic forces, such as occurs at convergent plate boundaries

ripple – miniature dune-like features that form as water transports and deposits fine-grained particles

rock – an aggregate of different minerals that have been chemically or physically cemented together

rock fall – the physical weathering process that occurs when any small or large rock breaks off and falls freely

rockslide – the physical weathering process that occurs when a large portion of rock breaks off along a weak zone and slides down slope, usually because of excess water

sandstone – a sedimentary rock composed of particles of sand that are cemented together by chemical processes and pressure

schist – a metamorphic rock with platy minerals, such as biotite mica, that have a parallel orientation

shale – technically speaking, shale is a sedimentary rock with a significant amount of clay, but for this manual, shale is used to describe a sedimentary rock composed of very tiny particles of mud, silt, and sand that have been compressed together

silicate – a class of minerals rich in compounds of oxygen and silica

sill – a horizontal layer of igneous rock that forms as magma that is injected and spreads out between horizontal layers of rock

sediment – particles of rock of any size

sediment load – the amount of sediment carried by a river

sedimentary rock – a rock composed of fragments of pre-existing rock, remains of deceased organisms, and/or chemical precipitates (such as salt or calcium carbonate) that have been compacted, cemented and hardened

seismic wave – a vibration of energy that travels through the Earth after a sudden movement of rock during an earthquake

spire – (temple) a landscape feature that is tall and slender and usually much taller than it is wide; generally narrower than a butte

stratigraphic column – a cross-sectional representation that shows information about the different rock types and features found in each rock unit, for a given location

stratigraphy – the study, description, and classification of different sedimentary rock layers, or strata

stream capture – when one stream intersects with another stream and diverts the water into its channel, leaving the other channel abandoned

strike-slip fault – a fault that forms where parts of the Earth's crust slide past one another, such as along transform plate boundaries, with little to no vertical movement of the rocks on either side of the fault

stromatolite – a finely layered fossil formed of alternating mats of algae and layers of very fine sediment

structure – a feature created as the Earth's crust is deformed, such as a fault, fold, or fracture

structural geology – the study of deformation of the Earth's crust, such as folding and faulting of rocks

subduction zone – where two plates collide and one plate is shoved beneath the other (subducts)

supergroup – a large stratigraphic group of formations

syncline – a downward fold in rock layers (in the shape of a "U"), where the oldest layers are on the outside of the fold, and the youngest layers are in the middle of the fold

tectonic plates – large pieces of the Earth's hard outer shell (the lithosphere) that move slowly over the asthenosphere

theory – a scientifically proven explanation for some phenomenon that began as a hypothesis and was repeatedly tested but not proven wrong

topography – the shape of the Earth's surface

trace fossil – fossilized traces of a once living organism, such as a track, mold, or foot-

print, that does not include actual parts of the organism

transform plate boundary – where two plates slide past one another, often accompanied by earthquakes, but not volcanoes

transgression – when the shoreline moves inland over a region, possibly because of a rise of sea level or lowering of the land

unconformity – a gap in the geologic record formed as rocks are deposited followed by a period of erosion or a period when no rocks are deposited

volcanic – (see *extrusive*)

weathering – the process of rocks being physically or chemically broken down

FURTHER READING LIST

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