ПЕРМСКИЙ
ГОСУДАРСТВЕННЫЙ
НАЦИОНАЛЬНЫЙ
ИССЛЕДОВАТЕЛЬСКИЙ
УНИВЕРСИТЕТ

О. В. Манжула

АКАДЕМИЧЕСКАЯ И ПРОФЕССИОНАЛЬНАЯ КОММУНИКАЦИЯ НА ИНОСТРАНОМ ЯЗЫКЕ (АНГЛИЙСКИЙ)

MATERIALS FOR GEO STUDIES

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Издание предназначено для студентов очного отделения магистратуры геологического факультета и является дополнением к основной учебной литературе. В пособии осуществляется формирование общенаучной и терминологической компетенции в ходе обучения студентов терминологии по специальности «Геология» на английском языке. Целью предлагаемого учебного пособия является развитие навыков чтения и понимания оригинальных текстов по специальности, коммуникативных умений различных видов речевой деятельности, а также аннотирования и реферирования научной литературы, составления презентаций и устных докладов на английском языке.

Учебное пособие состоит из четырех глав, каждая из которых включает оригинальные тексты по специальности, а также комплекс речевых упражнений, образцы коммуникативных ситуаций диалогической и монологической речи, соответствующих принципам современной коммуникативной методики.

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Content

PART 1

Unit I. Activization of Professional Lexis

Lecture 1.

Geology

Vocabulary

aligned rows – ровные ряды

bedded – пластовой

beds - пласты

belt – пояс

compounds – соединения

chromium – хром

denudation - обнажение

diagenesis – диагенез

dip – провал

distinctive - выраженные

drift – сдвиг

Earth's crust – земная кора

elastic wave – упругая волна

enabling – позволяющий

faux amphibolite – искусственный амфиболит

folds – складки

faults – недостатки

fixed – неподвижный

Geochemistry – геохимия

geodesy – геодезия

greenstone – нефрит

internal – внутренний

igneous – магматический

inorganic – неорганический

lead – свинец

lithification – литификация

metamorphic – метаморфический

mineralogy – минералогия

plate boundaries – границы плиты

precise – точный

sedimentary – осадочный

solid – твердый

stratigraphy – стратиграфия

subduction zone – зона субдукции

successive intervals - последовательные интервалы

to be composed of – состоять из

to elucidate – разъяснять

to yield – уступать

unconsolidated – рыхлый

wearing down – износ

weathering – выветривание

Read the text

Geology, the fields of study concerned with the solid Earth. Included are sciences such as mineralogy, geodesy, and stratigraphy.

4

faux amphibolite

A rock formation called “faux amphibolite,” from the Nuvvuagittuq greenstone belt in northern Quebec, dated to 4.28 billion years ago.

Jonathan O'Neil

An introduction to the geochemical and geophysical sciences logically begins with mineralogy, because Earth’s rocks are composed of minerals—inorganic elements or compounds that have a fixed chemical composition and that are made up of regularly aligned rows of atoms. Today one of the principal concerns of mineralogy is the chemical analysis of the some 3,000 known minerals that are the chief constituents of the three different rock types: sedimentary (formed by diagenesis of sediments deposited by surface processes); igneous (crystallized from magmas either at depth or at the surface as lavas); and metamorphic (formed by a recrystallization process at temperatures and pressures in the Earth’s crust high enough to destabilize the parent sedimentary or igneous material). Geochemistry is the study of the composition of these different types of rocks.

pahoehoe

Pahoehoe lava flow, Kilauea volcano, Hawaii, November 1985.
J. D. Griggs, U. S. Geological Survey

During mountain building, rocks became highly deformed, and the primary objective of structural geology is to elucidate the mechanism of formation of the many types of structures (e.g., folds and faults) that arise from such deformation. The allied field of geophysics has several subdisciplines, which make use of different instrumental techniques. Seismology, for example, involves the exploration of the Earth’s deep structure through the detailed analysis of recordings of elastic waves generated by earthquakes and man-made explosions. Earthquake seismology has largely been responsible for defining the location of major plate boundaries and of the dip of subduction zones down to depths of about 700 kilometres at those boundaries. In other subdisciplines of geophysics, gravimetric techniques are used to determine the shape and size of underground structures; electrical methods help to locate a variety of mineral deposits that tend to be good conductors of electricity; and paleomagnetism has played the principal role in tracking the drift of continents.

Geomorphology is concerned with the surface processes that create the landscapes of the world—namely, weathering and erosion. Weathering is the alteration and breakdown of rocks at the Earth’s surface caused by local atmospheric conditions, while erosion is the process by which the weathering products are removed by water, ice, and wind. The combination of weathering and erosion leads to the wearing down or denudation of mountains and continents, with the erosion products being deposited in rivers, internal drainage basins, and the oceans. Erosion is thus the complement of deposition. The unconsolidated accumulated sediments are transformed by the process of diagenesis and lithification into sedimentary rocks, thereby completing a full cycle of the transfer of matter from an old continent to a young ocean and ultimately to the formation of new sedimentary rocks. Knowledge of the processes of interaction of the atmosphere and the hydrosphere with the surface rocks and soils of the Earth's crust is important for an understanding not only of the development of landscapes but also (and perhaps more importantly) of the ways in which sediments are created. This in turn helps in interpreting the mode of formation and the depositional environment of sedimentary rocks. Thus the discipline of geomorphology is fundamental to the uniformitarian approach to the Earth sciences according to which the present is the key to the past.

Geologic history provides a conceptual framework and overview of the evolution of the Earth. An early development of the subject was stratigraphy, the study of order and sequence in bedded sedimentary rocks. Stratigraphers still use the two main principles established by the late 18th-century English engineer and surveyor William Smith, regarded as the father of stratigraphy: (1) that younger beds rest upon older ones and (2) different sedimentary beds contain different and distinctive fossils, enabling beds with similar fossils to be correlated over large distances. Today biostratigraphy uses fossils to characterize successive intervals of geologic time, but as relatively precise time markers only to the beginning of the Cambrian Period, about 540,000,000 years ago. The geologic time scale, back to the oldest rocks, some 4,280,000,000 years ago, can be quantified by isotopic dating techniques. This is the science of geochronology, which in recent years has revolutionized scientific perception of Earth history and which relies heavily on the measured parent-to-daughter ratio of radiogenic isotopes (see below).

Paleontology is the study of fossils and is concerned not only with their description and classification but also with an analysis of the evolution of the organisms involved. Simple fossil forms can be found in early Precambrian rocks as old as 3,500,000,000 years, and it is widely considered that life on Earth must have begun before the appearance of the oldest rocks. Paleontological research of the fossil record since the Cambrian Period has contributed much to the theory of evolution of life on Earth.

Several disciplines of the geologic sciences have practical benefits for society. The geologist is responsible for the discovery of minerals (such as lead, chromium, nickel, and tin), oil, gas, and coal, which are the main economic resources of the Earth; for the application of knowledge of subsurface structures and geologic conditions to the building industry; and for the prevention of natural hazards or at least providing early warning of their occurrence.

Astrogeology is important in that it contributes to understanding the development of the Earth within the solar system. The U.S. Apollo program of manned missions to the Moon, for example, provided scientists with firsthand information on lunar geology, including observations on such features as meteorite craters that are relatively rare on Earth. Unmanned space probes have yielded significant data on the surface features of many of the planets and their satellites. Since the 1970s even such distant planetary systems as those of Jupiter, Saturn, and Uranus have been explored by probes.

https://www.britannica.com/science/geology

Exercise 1.

Match the terms and their definitions.

Term		Definition	
1	denudation	a	The geologic science of the size and shape of the earth.
2	drift	b	Any basic igneous rock that is dark green because of the presence of chlorite, actinolite, or epidote
3	geodesy	c	The process by which compacted sediment loses liquid and turns into stone.
4	greenstone	d	The study of the composition, relative positions, etc, of rock strata in order to determine their geological history
5	igneous	e	The wearing away of the land surface by the sum of such processes as weathering and erosion.
6	inorganic	f	A soft, malleable, ductile, bluish-white, dense metallic element, extracted chiefly from galena and used in containers and pipes for corrosives, solder and type metal, bullets, radiation shielding, paints, glass, storage batteries, and antiknock compounds.
7	lead	g	Formed by the accumulation and consolidation of mineral and organic fragments that have been deposited by water, ice, or wind.
8	lithification	h	Derived by solidification of magma or molten lava emplaced on or below the earth's surface.
9	sedimentary	i	Something moving along in a current of air or water
10	stratigraphy	j	Not composed of organic matter.

Exercise 2.

Defining Geology

Fill in the gaps with the appropriate words and phrases:

Geology - from the Greek geo (Earth) and logia (study) has 1. ___ in unlocking many of the secrets of the Earth. We define geology as 2. ___, the materials and processes, structure, and even the physics and chemistry that underlie them. It also includes within several of its subdisciplines, the study of material 3. ___. Examples include paleontology and paleobotany (see below). Another area is the examination of change 4. ___ and processes over time.

The more work that geologists can produce on the history, processes, physics and chemistry of our planet, 5. ___ for cataclysmic events such as volcanoes and earthquakes and shifting in plate tectonics that can cause landslides, flooding and avalanches, but also past shifts to understanding profile changes on timescales of thousands or millions of years. Also, the more information we have, the better we can understand all geosciences (all sciences concerned with our planet). Nor is geology 6. ___ . Some geologists work with astronomers and astrophysicists to understand 7. ___ such as our Moon and our near rocky planetary neighbors - Mercury, Venus, Mars, asteroids, comets and since 2016, the planetoid Pluto.

Geology also has 8. ___ . It is vital to prospecting for and mining of fossil fuels such as natural gas, coal, and crude oil that we convert to fuel our homes, public transportation, and personal vehicles. They examine areas for mining gems and metals too, 9. ___. Also, they examine land 10. ___ – avoiding tectonic plate areas at high risk of such activity.

https://www.environmentalscience.org/geology

a. that was once organic but has mineralized
b. limited our home planet
c. a long and prestigious history
d. industrial applications
e. of the physical structures
f. and groundwater sources
g. the more we can plan
h. for new building projects
i. the geology of terrestrial bodies
j. the study of the Earth

Exercise 3.

Match the halves of the sentences.

	I		II
1	Metamorphic rocks have been modified	a	have a layered or banded appearance that is produced by exposure to heat and directed pressure.
2	Exposure to these extreme conditions	b	that has a banded appearance and is made up of granular mineral grains.
3	There are two basic types	c	has altered the mineralogy, texture, and chemical composition of the rocks.
4	Foliated metamorphic rocks such as gneiss, phyllite, schist, and slate	d	are shown on this page.
5	Non-foliated metamorphic rocks such as hornfels, marble, quartzite, and novaculite	e	of metamorphic rocks.

6	Pictures and brief descriptions of some common types of metamorphic rocks	f	by heat, pressure, and chemical processes, usually while buried deep below Earth's surface.
7	Gneiss is a foliated metamorphic rock	g	abundant quartz or feldspar minerals.
8	It typically contains	h	the highest rank of coal.
9	The specimen shown above	i	is about two inches (five centimeters) across.
10	Anthracite is	j	do not have a layered or banded appearance.

Exercise 4.

Answer the questions.

Methods in Geology

Modern geology uses a wide range of traditional and technological methods, making it even more accurate and able to produce more data, faster and more accurately than ever before.

Stratigraphy: Used in a wide variety of Earth Sciences / Geosciences, stratigraphy is the study of the layers that make up a geological topography. Each sequence in a layer generally came after the one beneath it. A stratigraphic layer does not represent a period of time, merely a place in a sequence. It can be set down over anything from a few decades (in the case of an archaeological layer) to hundreds of thousands or even millions of years (in the case of geological layers such as the Grand Canyon).

Remote sensing and satellite imagery: Another tool used in many Earth Sciences and not just geology, it's the use of technology to define and locate features and to map locations over a broad area. They collect data, sometimes through images, sometimes through heat signatures, resistance signatures (for material density - suggestive of metal ore deposits).

Geophysics: Looking beneath the surface of the Earth without physical investigation, geophysical survey is similar to remote sensing, but it works on a much smaller scale. Used for locating small pockets, the technology is ground-based and examines areas of no more than an acre or two.

Geographic Information Systems: Also known as GIS, this applied science of using information technology with any geographical data allows for visual representation such as digital maps and statistical analyses using database information taken over small or large areas. GIS has many uses in geology from mapping rock surfaces, soils, plotting global tectonic plates and problem areas for volcanoes and earthquakes amongst others.

Geological modelling: Using such tools as information taken from geodesy, remote sensing, geophysical survey, GIS, geologists in most subdisciplines are able to build up digital profiles of a small or large geological area for most applications. It integrates many areas of geology and subdisciplines to create an integrative information source.

https://www.environmentalscience.org/geology

1. Why does geology use a wide range of traditional and technological methods?
2. What is a Stratigraphy?
3. In what order do sequences in a layer come?
4. Does a stratigraphic layer represent a period of time?
5. What is remote sensing and satellite imagery?
6. What do remote sensing and satellite imagery do?
7. What is Geophysics?
8. What are Geographic Information Systems?
9. What is Geological modelling?
10. What does Geological modelling integrate?

Exercise 5.

Video 1.

Watch the video and answer the questions.

https://www.youtube.com/watch?v=rAYiBSo3JKY&feature=emb_logo

1. What is Geology?
2. Who are geologists?
3. Which categories of the rocks are there?
4. How are these three rocks types called?
5. What formation can we watch in real time?
6. How many active volcanoes are there on the Earth?
7. What are the major parts of the Earth?
8. Where can we see the formation of igneous rocks?
9. What is basalt?
10. What is granite?

Exercise 6.

Find 5 other examples of igneous rocks.

Exercise 7.

Prepare a monologue about the basics of Geology, the three rocks types and the rock cycle, how igneous rocks are formed, the three parts of Earth, some of the differences between two types of igneous rocks, basalt and granite.

Unit 2. Work with a text

Sedimentary Rocks

Vocabulary

carbonate
adjective, noun
mineral created by the action of carbon dioxide on a base.

clastic sediment
Noun
rock composed of fragments of older rocks that have been transported from their place of origin.

detrital rock
Noun
sedimentary rock produced from small pieces of other rocks

dissolution
Noun
termination or destruction by breaking down, disrupting, or dispersing

erosion
Noun
act in which earth is worn away, often by water, wind, or ice.

geomorphology
Noun

study of geographic features on the landscape and the forces that create them.

halite
Noun
natural mineral form of salt (sodium chloride.) Also called rock salt.

limestone
Noun
type of sedimentary rock mostly made of calcium carbonate from shells and skeletons of marine organisms.

lithify
Verb
to change into stone or rock.

precipitation
Noun
all forms in which water falls to Earth from the atmosphere.

sediment
Noun
solid material transported and deposited by water, ice, and wind.

shale
Noun
type of sedimentary rock.

stalactite
Noun
rock formed by mineral-rich water dripping from the roof of a cave. The water drips, but the mineral remains like an icicle.

stalagmite
Noun
mineral deposit formed on a cave floor, usually by water dripping from above.

weathering
Noun
the breaking down or dissolving of the Earth's surface rocks and minerals.

Sedimentary rocks are one of three main types of rocks, along with igneous and metamorphic. They are formed on or near the Earth's surface from the compression of ocean sediments or other processes.

An example of a sedimentary rock,
which is, by definition, composed of many, smaller rocks.
Photo courtesy of Alamy Stock Photo

Sedimentary rocks are formed on or near the Earth's surface, in contrast to metamorphic and igneous rocks, which are formed deep within the Earth. The most important geological processes that lead to the creation of sedimentary rocks are erosion, weathering, dissolution, precipitation, and lithification.

Erosion and weathering include the effects of wind and rain, which slowly break down large rocks into smaller ones. Erosion and weathering transform boulders and even mountains into sediments, such as sand or mud. Dissolution is a form of weathering—chemical weathering. With this process, water that is slightly acidic slowly wears away stone. These three processes create the raw materials for new, sedimentary rocks.

Precipitation and lithification are processes that build new rocks or minerals. Precipitation is the formation of rocks and minerals from chemicals that precipitate from water. For example, as a lake dries up over many thousands of years, it leaves behind mineral deposits; this is what happened in California's Death Valley. Finally, lithification is the process by which clay, sand, and other sediments on the bottom of the ocean or other bodies of water are slowly compacted into rocks from the weight of overlying sediments.

Sedimentary rocks can be organized into two categories. The first is detrital rock, which comes from the erosion and accumulation of rock fragments, sediment, or other materials—categorized in total as detritus, or debris. The other is chemical rock, produced from the dissolution and precipitation of minerals.

Detritus can be either organic or inorganic. Organic detrital rocks form when parts of plants and animals decay in the ground, leaving behind biological material that is compressed and becomes rock. Coal is a sedimentary rock formed over millions of years from compressed plants. Inorganic detrital rocks, on the other hand, are formed from broken up pieces of other rocks, not from living things. These rocks are often called clastic sedimentary rocks. One of the best-known clastic sedimentary rocks is sandstone. Sandstone is formed from layers of sandy sediment that is compacted and lithified.

Chemical sedimentary rocks can be found in many places, from the ocean to deserts to caves. For instance, most limestone forms at the bottom of the ocean from the precipitation of calcium carbonate and the remains of marine animals with shells. If limestone is found on land, it can be assumed that the area used to be under water. Cave formations are also sedimentary rocks, but they are produced very differently. Stalagmites and stalactites form when water passes through bedrock and picks up calcium and carbonate ions. When the chemical-rich water makes its way into a cave, the water evaporates and leaves behind calcium carbonate on the ceiling, forming a stalactite, or on the floor of the cave, creating a stalagmite.

https://www.nationalgeographic.org/encyclopedia/sedimentary-rock/

Exercise 1.

Find the translation of the word.

№	Term	l	Translation
1	carbonate	a	геоморфология
2	clastic sediment	b	обломочная порода
3	detrital rock	c	выветривание
4	dissolution	d	литифицировать
5	erosion	e	сталактит
6	geomorphology	f	растворение
7	halite	g	известняк
8	limestone	h	эрозия
9	lithify	i	обломочные отложения
10	precipitation	j	галит

№	Term	l	Translation
11	sediment	k	карбонат
12	shale	l	осадок
13	stalactite	m	сталагмит
14	stalagmite	n	осадок
15	weathering	o	сланец

Exercise 2.

Fill in the gaps.

What are Sedimentary Rocks?

Sedimentary rocks are 1. ___ which are freely exposed 2. ___ . They are formed 3. ___ since they are made up of the buildup of weathered and 4. ___ .

The weathering, erosion and 5. ___ of igneous, metamorphic or formerly structured sedimentary rocks among other biological sedimentations lead to the formation of sedimentary rocks.

So, sedimentary rocks are produced from 6. ___ that are relentlessly weathered or eroded and then deposited where they undergo compaction and cementation through a process known as lithification-changing of sediments into a rock. This is how the name 7. ___ was coined.

“Sedimentary rocks are types of rock that are formed 8. ___ and subsequent cementation of that material at the Earth’s surface and within bodies of water. Sedimentation is 9. ___ for processes that cause mineral and/or organic particles (detritus) to settle in place. The particles that form a sedimentary rock by accumulating are called sediment.

Before being deposited, the sediment was formed 10. ___ from the source area, and then transported to the place of deposition by water, wind, ice, mass movement or glaciers, which are called agents of denudation."

https://www.eartheclipse.com/geology/formation-types-and-examples-of-sedimentary-rocks.html

a. eroded pre-existing rocks
b. the eventual compaction
c. sedimentary rock
d. sedimentary rock
e. the most common rock type
f. the collective name
g. from other rock materials
h. by weathering and erosion
i. the eventual compaction
j. on the earth's surface

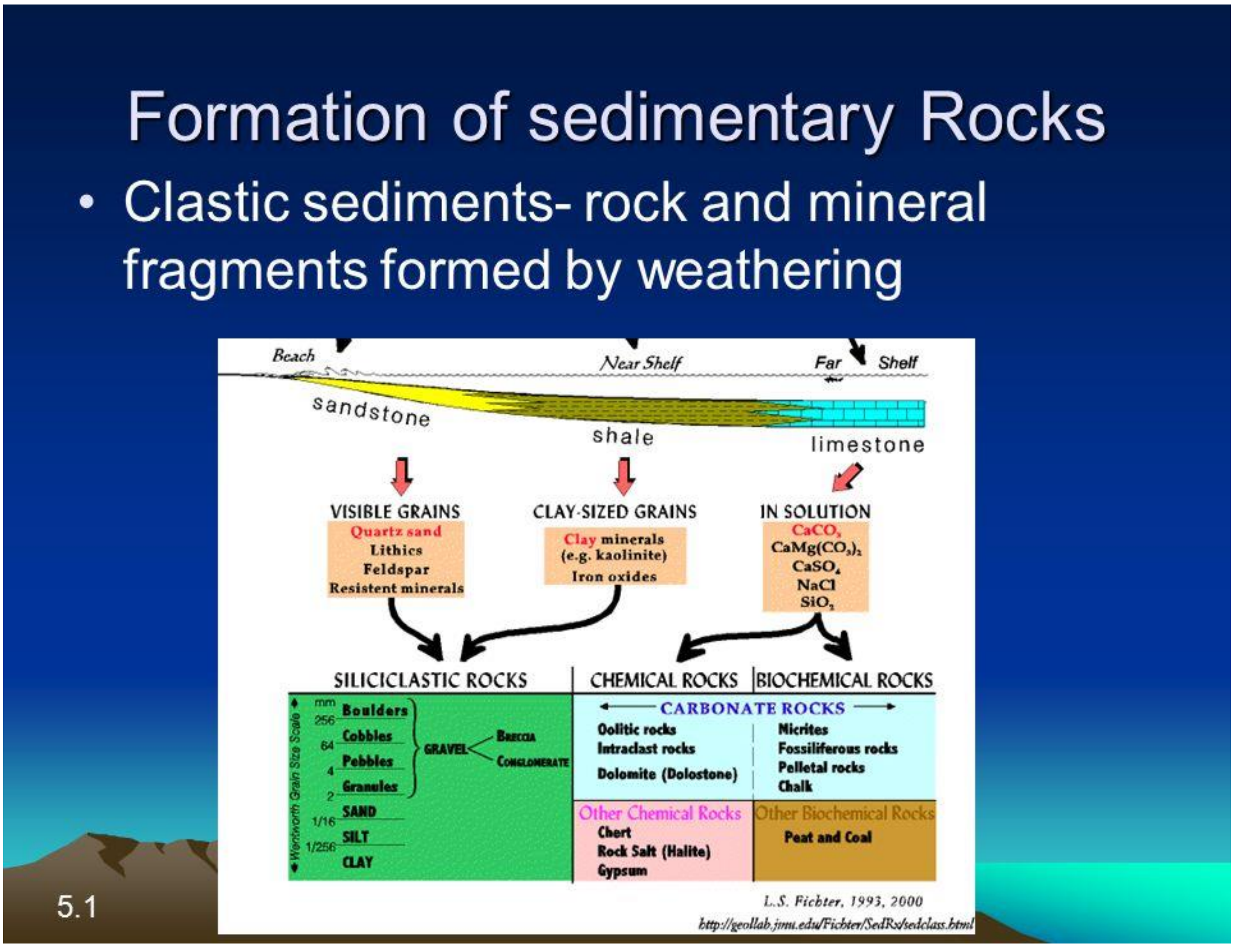
Exercise 3.
Match the halves of the sentences.

№	1 half	l	2 half
1	All rocks, be it igneous, metamorphic, or the already existing sedimentary rocks	a	through the process of sedimentation.
2	Tiny debris from the rock masses and mountains	b	that breaks down the pre-existing rocks into small pieces and then carried away to some distance low areas.
3	After many years, these materials finally settle down	c	are eroded together with soils, sand, and other granite pieces that are normally washed from highlands to low areas.
4	Some may accumulate	d	underwater and others on the lower areas of the land.
5	The weathering and erosion is normally due to the forces of water, thermal expansion, gravity, wind, and salt crystal expansion	e	to form a new sheet of homogenous material.

№	1 half	l	2 half
6	As the materials move, they are smoothened and rounded by abrasion, and they settle down	f	reduces the porosity of the rocks formed and intensifies the cohesion between the grains.
7	At this point, they have deposited a layer after layer	g	are constantly subjected to weathering and erosion.
8	From here, the compaction and cementing agents	h	such as oxides, carbonates, and silica combine together with the deposited material.
9	The compaction effect due to the weight of the piling layers of materials	i	may settle within the sediments leading to cementation.
10	At times, fossil fuels and organic matter	j	by leaving pore spaces between the grains which make them achieve their distorted shape.

Exercise 4.

Look at the picture. Describe the process of the formation of sedimentary rocks.



https://slideplayer.com/slide/6383638/

Exercise 5.

Answer the questions.

1. Where are the sedimentary rocks formed?
2. Which processes are included into the creation of the sedimentary rocks?
3. What effect do erosion and weathering include into the process?
4. What is the role of erosion and weathering in the process of formation of the sedimentary rocks?
5. What is the example of weathering?
6. What are processes that build new rocks or minerals?
7. What is the role of water in these processes?
8. What is precipitation?
9. What is an example of the precipitation?
10. What is lithification?

Exercise 6.

Watch this video and fill in the gaps.

https://www.youtube.com/watch?v=uozyWZ6XQzM&feature=emb_logo

Sedimentary rocks form in a variety of environments on Earth surface. Geologists study modern environments 1 ___ and to use these data to better interpret ancient environments as preserved in the rock record. We can read these rocks to decipher past climates, reconstruct former landscapes, and predict where to search for oil and gas resources.

This lesson has two learning objectives, we will describe the three major classes of sedimentary rocks, discuss their formation and explain where they are forming today on or near the earth surface.

There are three classes of sedimentary rocks; clastic, chemical and biochemical sedimentary rocks. We can differentiate them on the bases of the materials that compose the rock and the processes by which they form.

Let's look at the first category, the clastic sedimentary rocks. There are three steps involved in the formation of clastic sedimentary rocks. Clastic sediments are composed of fragments of rock. In fact, «a clast» is 2. ___ . These fragments weathered from pre-existing rocks to form sediment of various sizes. This sediment is then transported away from its source area and, finally, is deposited and converted to form a new rock through lithification.

Rocks break down on earth surface to form sediment. This sediment may be composed of the rocks constituent minerals, which may then be physically or chemically broken up further to form even smaller grains or other minerals. We can see 3. ___ weathering out of this igneous rock and notice the grains of sediment at the base. Now we need to erode it or transport it away from its source.

Sediment is eroded 4. ___ , for example, this river in Alaska is carrying a high sediment load as reflected by the muddy color of the water and the sand and gravel bars in the stream channel.

Sediment is also eroded by the winds. Much of the topsail of western

Oklahoma and northern Texas was blown away 5. ___ . And we see similar dust storms known as haboobs today in draught stricken western states. Elsewhere, dust and sediment from the Saharan desert may be transported across the Atlantic Ocean to Central and North America.

Finally, sediment of all sizes can be transported by glaciers. For example, 6. ___ reflects the sediment that is exposed as the ice melts. If we look closely at the glacier, we can see layers of sed learned today to recognize that different types of iment encased in the ice.

So sediment is first weathered from rocks during the breakdown phase. Next it is eroded and transported and finally it is dumped or deposited in some location. Sediment is deposited when rivers enter the ocean or when wind velocity decreases or when glacier melt. As more and more sediments build up, the material at the base of the pile is compacted. Compaction squeezes and spaces between grains and pushes the grains closer together. Finally, chemicals precipitate out of water, to cement the grains together and form a rock.

Each size of clastic sediment produces a different type of sedimentary rock. Sometimes length between sediment and rock are obvious. Such as the lithification of sand to form sandstone. Other times the names of the sediments and the resulting sedimentary rock are quiet different. For example, 7. ___ and day sized particles are consolidated to form shale.

The second major category of sedimentary rocks are the chemical sedimentary rocks. Imagine that your left a pan of salted water on the stove for long enough. The water would evaporate away leaving the salt behind. Essentially, the same thing, happens in nature as water evaporates, leaving any dissolved mineral behind. For example, ancient Lake Bonnevile covered much of Utah 10,000 years ago. Most of the lake dried up, leaving the flay lake bed covered in a layer of salt. Most chemical sedimentary rocks, form as a result of precipitation from seawater. But minerals are also dissolved in lesser concentrations in groundwater, freshwater lakes and rivers and are also concentrated in hot waters associated with thermal features such as hot springs and geysers. Travertine is a type of limestone, forms when minerals precipitate in places where warm chemical rich waters come to the surface.

Biochemical sedimentary rocks also result from precipitation, but this precipitation occurs due to the actions of organisms - typically, marine organisms, think, shellfish, for example. They form their shells by causing minerals 8. ___ . The same process can happen for microscopic marine organisms like coccolithophores. Coccolithophores are composed of tiny plates known as coccoliths. Even though, you couldn't see one of these with your naked eye if you get enough of them together you can create spectacular chalk cliffs such as those along the southeast coast of England.

Other marine organisms, 9. ___ also build shells that eventually form biochemical sedimentary rocks. Plants can also end up as rocks. For example, the vegetation in tropical swamps can be compacted and compressed to form coal.

Finally, we can summarize what we have learned today to recognize that different types of sedimentary rocks leave clues to past environments on Earth. Clastic sedimentary rocks such as conglomerates, shale and sandstone can form in environments such as mountains, streams, swamps, deltas, deserts and beaches.

Chemical sedimentary rocks are formed10. ___ . Biochemical sedimentary rocks such as limestone or chalk form in marine environments, while coal indicates the former presence of tropical wetland conditions.

We had two objectives for todays lessons. How confident are you that you could complete both of these tasks?

Okay, that is it for us. We're of to use some dead coccolithophores to write some stuff on chalk boards.

Exercise 7.

Prepare a presentation about sedimentary rocks. Give examples.

Unit 3. Work with a text
Metamorphic Rocks
Vocabulary

igneous rock
Noun
rock formed by the cooling of magma or lava.

lava
Noun
molten rock, or magma, that erupts from volcanoes or fissures in the Earth's surface.

magma
Noun

molten, or partially melted, rock beneath the Earth's surface.

metamorphic rock
Noun
rock that has transformed its chemical qualities from igneous or sedimentary.

plate tectonics
Noun
movement and interaction of the Earth's plates.

rock cycle
Noun
processes that explain the relationship between the three rock types: igneous, sedimentary, and metamorphic. Any rock type can become any other.

sedimentary rock
Noun
rock formed from fragments of other rocks or the remains of plants or animals.

uplift
Noun
elevation of the Earth's surface due to tectonic or other natural activity.

Metamorphic Rock Isua
Metamorphic rock, estimated to be as old as 3.8 billion years, located near Isua at Qorqut Sound, Greenland

The term “metamorphosis” is most often used in reference to the process of a caterpillar changing into a butterfly. However, the word “metamorphosis” is a broad term that indicates a change from one thing to another. Even rocks, a seemingly constant substance, can change into a new type of rock. Rocks that undergo a change to form a new rock are referred to as metamorphic rocks.

In the rock cycle, there are three different types of rocks: sedimentary, igneous, and metamorphic. Sedimentary and igneous rocks began as something other than rock. Sedimentary rocks were originally sediments, which were compacted under high pressure. Igneous rocks formed when liquid magma or lava—magma that has emerged onto the surface of the Earth—cooled and hardened. A metamorphic rock, on the other hand, began as a rock—either a sedimentary, igneous, or even a different sort of metamorphic rock. Then, due to various conditions within the Earth, the existing rock was changed into a new kind of metamorphic rock.

The conditions required to form a metamorphic rock are very specific. The existing rock must be exposed to high heat, high pressure, or to a hot, mineral-rich fluid. Usually, all three of these circumstances are met. These conditions are most often found either deep in Earth’s crust or at plate boundaries where tectonic plates collide. In order to create metamorphic rock, it is vital that the existing rock remain solid and not melt. If there is too much heat or pressure, the rock will melt and become magma. This will result in the formation of an igneous rock, not a metamorphic rock.

Consider how granite changes form. Granite is an igneous rock that forms when magma cools relatively slowly underground. It is usually composed primarily of the minerals quartz, feldspar, and mica. When granite is subjected to intense heat and pressure, it changes into a metamorphic rock called gneiss.

Slate is another common metamorphic rock that forms from shale. Limestone, a sedimentary rock, will change into the metamorphic rock marble if the right conditions are met.

Although metamorphic rocks typically form deep in the planet’s crust, they are often exposed on the surface of the Earth. This happens due to geologic uplift and the erosion of the rock and soil above them. At the surface, metamorphic rocks will be exposed to weathering processes and may break down into sediment. These sediments could then be compressed to form sedimentary rocks, which would start the entire cycle anew.

https://www.nationalgeographic.org/encyclopedia/metamorphic-rocks/

Exercise 1.

Read the text again and decide whether the following statements are true (T) or false (F).

1. The term “metamorphosis” is most often used in reference to the process of a geological cycle.
2. Rocks can change into a new type of rock.
3. Rocks that undergo a change to form a new rock are referred to as igneous rocks.
4. In the rock cycle, there are three different types of rocks: earth, igneous, and metamorphic.
5. Sedimentary and igneous rocks began as something other than rock.
6. Sedimentary rocks were originally sediments, which were compacted under high pressure.
7. Igneous rocks formed when liquid magma or lava wormed and hardened.
8. The conditions required to form a metamorphic rock are always similar.
9. If there is no heat or pressure, the rock will melt and become magma.
10. Granite is an igneous rock that forms when magma cools relatively slowly underground.

Exercise 2.

Ten sentences have been removed from the article. Choose from the sentences A-K the one which fits each gap (1-10). There is one extra sentence which you don’t need to use.

What are Metamorphic Rocks?

Metamorphic rocks have been modified by heat, pressure, and chemical processes, usually while buried deep below Earth's surface. 1. ()

There are two basic types of metamorphic rocks. 2. () Examples of foliated rocks include: gneiss, phyllite, schist, and slate.

Non-foliated metamorphic rocks do not have a layered or banded appearance. 3. ()

Photographs and brief descriptions of some common types of metamorphic rocks are shown on this page.

Amphibolite is a non-foliated metamorphic rock that forms through recrystallization under conditions of high viscosity and directed pressure. 4. () The specimen shown above is about two inches (five centimeters) across.

Anthracite is the highest rank of coal. 5. () It has a bright, lustrous appearance and breaks with a semi-conchoidal fracture. It is often referred to as "hard coal"; however, this is a layman's term and has little to do with the hardness of the rock. The specimen shown above is about two inches (five centimeters) across.

Gneiss is a foliated metamorphic rock that has a banded appearance and is made up of granular mineral grains. 6. () The specimen shown above is about two inches (five centimeters) across.

Lapis Lazuli, the famous blue gem material, is actually a metamorphic rock. 7. () Blue rocks are rare, and we bet that it captured your eye. The round objects in the photo are lapis lazuli beads about 9/16 inch (14 millimeters) in diameter. Image copyright iStockPhoto / RobertKacpura.

Marble is a non-foliated metamorphic rock that is produced from the metamorphism of limestone or dolostone. 8. () The specimen shown above is about two inches (five centimeters) across.

Mariposite is a word that has been used in many ways. 9. () Gold prospectors learned that gold could be found in areas where these green rocks were present. This is because mariposite is an ore of gold.

Novaculite is a dense, hard, fine-grained, siliceous rock that breaks with a conchoidal fracture. 10. () The specimen shown above is about three inches across.

https://geology.com/rocks/metamorphic-rocks.shtml

1. Examples of nonfoliated rocks include: hornfels, marble, novaculite, quartzite, and skarn.
2. Most people are surprised to learn that, so we added it to this photo collection as a surprise.
3. Foliated metamorphic rocks have a layered or banded appearance that is produced by exposure to heat and directed pressure.
4. It forms from sediments deposited in marine environments where organisms such as diatoms (single-celled algae that secrete a hard shell composed of silicon dioxide) are abundant in the water.
5. Exposure to these extreme conditions has altered the mineralogy, texture, and chemical composition of the rocks.
6. It has been exposed to enough heat and pressure that most of the oxygen and hydrogen have been driven off, leaving a high-carbon material behind.
7. It is composed primarily of hornblende (amphibole) and plagioclase, usually with very little quartz.
8. It can refer to green mica minerals, or metamorphic rocks that contain enough green mica to impart a green color.
9. It typically contains abundant quartz or feldspar minerals.
10. It is composed primarily of calcium carbonate.
11.The surface of phyllite is typically lustrous and sometimes wrinkled. It is intermediate in grade between slate and schist.

Exercise 3.

Unscramble the words.

1. iomehamrosstp
2. ydeiemnatrs
3. ugsieno
4. srpeeurs
5. qiludi
6. mmgaa
7. aalv
8. retah
9. tcurs
10. epalt

Exercise 4.

Choose the correct answer.

1. The term "metamorphosis" is most often used in reference
   a. to the process of a caterpillar changing into a butterfly.
   b. to geological cycle
   c. in processing of igneous rocks
2. Even rocks, a seemingly constant substance
   a. can't change into a new type of rock.
   b. can change into a new type of rock.
   c. can change into new different types of rock
3. In the rock cycle, there are
   a. two different types of rocks: sedimentary and metamorphic.
   b. four different types of rocks: sedimentary, igneous, volcanic and metamorphic.
   c. three different types of rocks: sedimentary, igneous, and metamorphic.
4. Sedimentary rocks were originally
   a. sediments, which were compacted under high pressure.
   b. rocks which were pressed by earth.
   c. stones formed by water.
5. A metamorphic rock
   a. began as a rock.
   b. began as sediments, which were compacted under high pressure.
   c. began as stones formed by water.
6. Due to various conditions within the Earth, the existing rock was

a. left the same

b. changed into a new kind of metamorphic rock.

c. changed into sand.

7. The existing rock must be exposed to

a. high frost, high pressure, or to a cold, mineral-rich fluid.

b. high heat, high pressure, or to a hot, mineral-rich fluid.

c. neutral temperature

8. If there is too much heat or pressure

a. the rock will harden.

b. the rock will break.

c. the rock will melt and become magma. This will result in the formation of an igneous rock, not a metamorphic rock.

9. Granite is

a. a metamorphic rock.

b. a sedimentary rock.

c. an igneous rock

10. When granite is subjected to intense heat and pressure, it changes into a metamorphic rock called

a. gneiss.

b. marble

c. mariposite

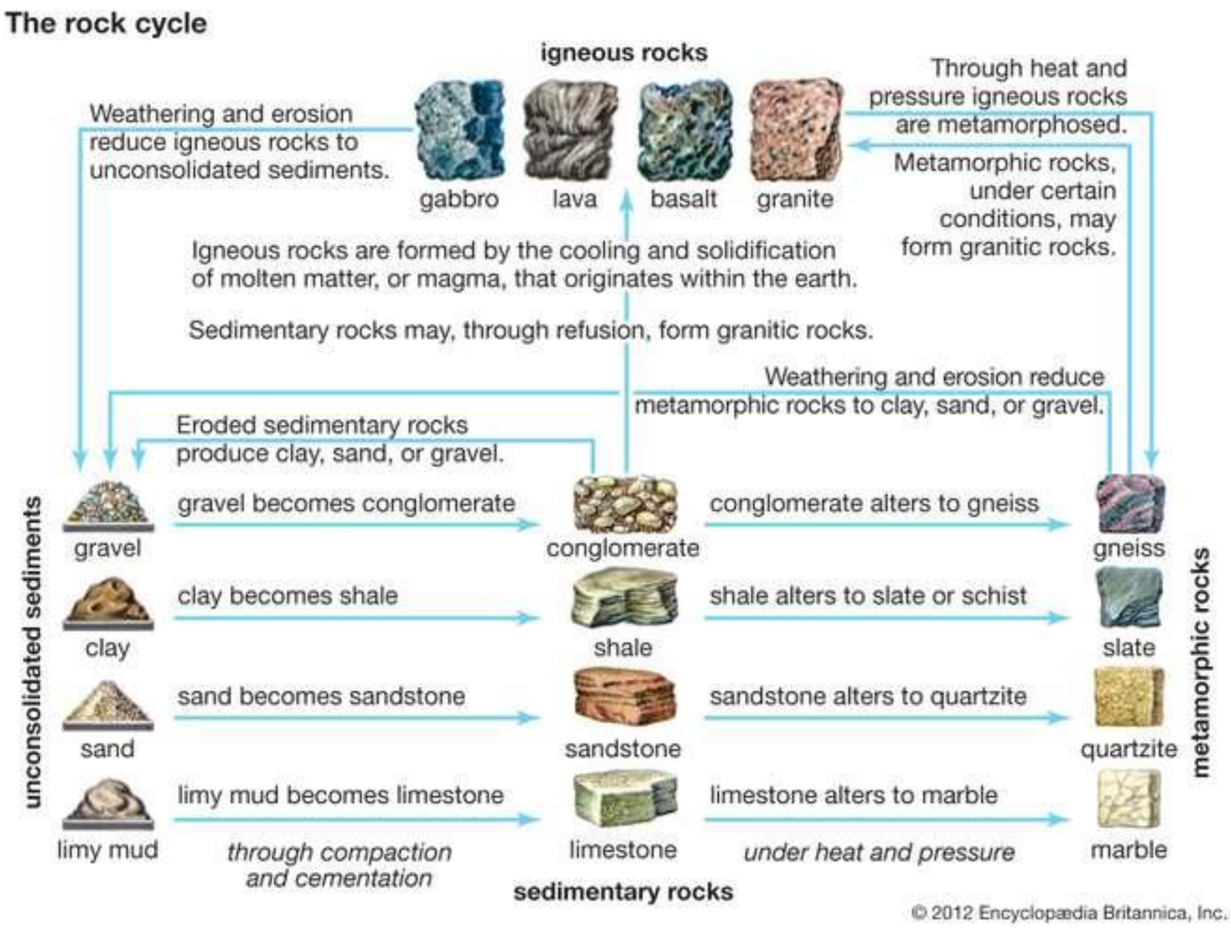
Exercise 5.

Read the text and choose the appropriate headings 1–6 for A–E passages. There is one extra heading you don't need to use:

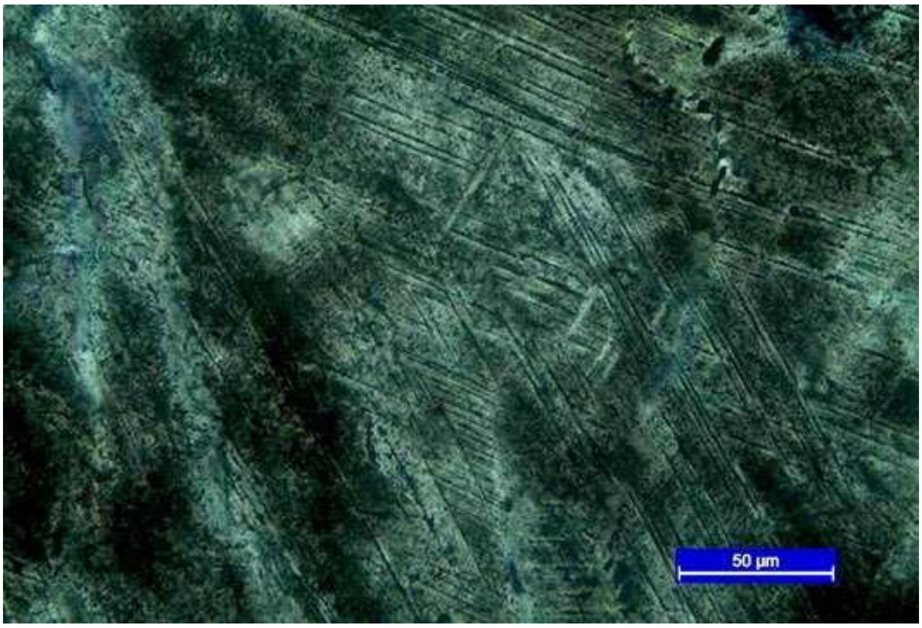
1. Metamorphism results from a complex interplay between physical and chemical processes that operate on a scale ranging from micrometres (e.g., fine mineral grain sizes, thickness of intergranular fluid, diffusion distances for chemical species) to tens or hundreds of kilometres (e.g., crustal thickness, width of collision zone between lithospheric plates, depth to subducting plate). Despite this wide range and the many processes involved in the recrystallization of sedimentary and igneous protoliths (source rocks) into metamorphic rocks, there are relatively few variables that effect metamorphic changes. Those of greatest importance are temperature, pressure, and the original chemical composition of the protolith. Each is briefly discussed below.

schist and sandstone
Schist (left) is a fine-grained metamorphic rock rich in mica,
and sandstone (right) is a type of sedimentary rock

2. Temperatures at which metamorphism occurs range from the conditions of diagenesis (approximately 150–200 °C) up to the onset of melting. Rocks of different compositions begin to melt at different temperatures, with initial melting occurring at roughly 650–750 °C in rocks of granitic or shaley composition and approximately 900–1,200 °C in rocks of basaltic composition. Above these temperatures, metamorphic processes gradually give way to igneous processes. Hence, the temperature realm of metamorphism spans an interval of about 150–1,100 °C and is strongly dependent on the composition of the protolith.



3. The pressure experienced by a rock during metamorphism is due primarily to the weight of the overlying rocks (i.e., lithostatic pressure) and is generally reported in units of bars or kilobars. The standard scientific notation for pressure is expressed in pascals or megapascals (1 pascal is equivalent to 10 bars). For typical densities of crustal rocks of two to three grams per cubic centimetre, one kilobar of lithostatic pressure is generated by a column of overlying rocks approximately 3.5 km (about 2 miles) thick. Typical continental crustal thicknesses are on the order of 30–40 km (roughly 19–25 miles) but can be as great as 60–80 km (about 37–50 miles) in mountain belts such as the Alps and Himalayas. Hence, metamorphism of continental crust occurs at pressures from a few hundred bars (adjacent to shallow-level intrusions) to 10–20 kilobars at the base of the crust. Oceanic crust is generally 6–10 km (about 4–6 miles) in thickness, and metamorphic pressures within the oceanic crust are therefore considerably less than in continental regions. In subduction zones, however, oceanic and, more rarely, continental crust may be carried down to depths exceeding 100 km (62 miles), and metamorphism at very high pressures may occur. Metamorphic recrystallization also occurs in the mantle at pressures up to hundreds of kilobars.



4. Common metamorphic rock types have essentially the same chemical composition as what must be their equally common igneous or sedimentary precursors. Common greenschists have essentially the same compositions as basalts; marbles are like limestones; slates are similar to mudstones or shales; and many gneisses are like granodiorites. In general, then, the chemical composition of a metamorphic rock will closely reflect the primary nature of the material that has been metamorphosed. If there are significant differences, they tend to affect only the most mobile (soluble) or volatile elements; water and carbon dioxide contents can change significantly, for example.

5. The number of minerals present in an individual metamorphic rock is limited by the laws of thermodynamics. The number of mineral phases that can coexist stably in a metamorphic rock at a particular set of pressure-temperature conditions is given by the Gibbs phase rule: number of mineral phases = number of chemical components − number of degrees of freedom + 2, where the 2 stands for the two

variables of pressure and temperature. The degrees of freedom of the system are the parameters that can be independently varied without changing the mineral assemblage of the rock. For example, a rock with no degrees of freedom can only exist at a single set of pressure-temperature conditions; if either the pressure or the temperature is varied, the minerals will react with one another to change the assemblage. A rock with two degrees of freedom can undergo small changes in pressure or temperature or both without altering the assemblage. Most metamorphic rocks have mineral assemblages that reflect two or more degrees of freedom at the time the rock recrystallized. Thus, a typical pelitic rock made up of the six chemical components silica (SiO_2), aluminum oxide (Al_2O_3), ferrous oxide (FeO), magnesium oxide (MgO), potash (K_2O), and water would contain no more than six minerals; the identity of those minerals would be controlled by the pressure and temperature at which recrystallization occurred. In such a rock taken from Earth's surface, the identity of the six minerals could be used to infer the approximate depth and temperature conditions that prevailed at the time of its recrystallization. Rocks that contain more mineral phases than would be predicted by the phase rule often preserve evidence of chemical disequilibrium in the form of reactions that did not go to completion. Careful examination of such samples under the microscope can often reveal the nature of these reactions and provide useful information on how pressure and temperature conditions changed during the burial and uplift history of the rock.

6. A very simple mineralogical system and its response to changing pressure and temperature provide a good illustration of what occurs in metamorphism. An uncomplicated sediment at Earth's surface, a mixture of the clay mineral kaolinite [$Al_4Si_4O_{10}(OH)_8$] and the mineral quartz (SiO_2), provides a good example. Most sediments have small crystals or grain sizes but great porosity and permeability, and the pores are filled with water. As time passes, more sediments are piled on top of the surface layer, and it becomes slowly buried. Accordingly, the pressure to which the layer is subjected increases because of the load on top, known as overburden. At the same time, the temperature will increase because of radioactive heating within the sediment and heat flow from deeper levels within Earth.

https://www.britannica.com/science/metamorphic-rock/Pressure

a. Reactions in a kaolinite-quartz system
b. Temperature
c. Pressure
d. Eruptions
e. Metamorphic Variables
f. Thermodynamics of metamorphic assemblages
g. Classification into four chemical systems

Exercise 6.
Match the synonyms.

№	Term	L	Synonym
1	rock	a	phase
2	cycle	b	method
3	uplift	c	calidity
4	process	d	deposit
5	sediment	e	stone
6	coal	f	ground
7	heat	g	carbon
8	surface	h	cover
9	earth	i	elevate
10	grain	j	texture

Exercise 7.
Choose the correct word to complete the sentences.

1. Sedimentary rocks are types of rock that ___ by the accumulation or deposition of mineral or organic particles at the Earth's surface, followed by cementation.

a. are formed
b. are reduced
c. are found

2. Sedimentation is the collective name for processes that ___ these particles to settle in place.

a. brake
b. cause
c. form

3. The particles that ___ a sedimentary rock are called sediment, and may be composed of geological detritus (minerals) or biological detritus (organic matter).

a. reduce
b. find
c. form

4. The geological detritus ___ from weathering and erosion of existing rocks, or from the solidification of molten lava blobs erupted by volcanoes.

a. originated
b. found

c. formed

5. The geological detritus is transported to the place of deposition by water, wind, ice or mass movement, which are called agents of denudation.

a. is transported
b. is originated
c. is found

6. Biological detritus was formed by bodies and parts (mainly shells) of dead aquatic organisms, as well as their fecal mass, suspended in water and slowly piling up on the floor of water bodies (marine snow).

a. is found
b. was formed
c. is originated

7. Sedimentation may also occur as dissolved minerals precipitate from water solution.

a. form
b. occur
c. reduce

8. The sedimentary rock ___ of the continents of the Earth's crust is extensive (73 % of the Earth's current land surface), but sedimentary rock is estimated to be only 8 % of the volume of the crust.

a. reduce
b. form
c. cover

9. Sedimentary rocks ___ in layers as strata, forming a structure called bedding.

a. are formed
b. are covered
c. are deposited

10. Sedimentary rocks ___ on Mars.

a. have also been found
b. have also been formed
c. have also been built

Unit 4. Work with a text
Volcanoes

Volcanoes, explained
Vocabulary

array – массив
aside – в сторону
belch up – изрыгать
bleak – мрачный
bulge – выпуклость
bump – врезаться
burp – извержение, выброс
burst – взрыв
butt up – соединять впритык
campfire – походный костер
carve – отрезать
charred – обугленный
craft – мастерить
debris – развалины
descending – нисходящий
effusive – экспансивный
entire – весь
flank – сторона
fluffy – пушистый
heed – прислушиваться
horseshoe-shaped zone – подковообразная зона
imminent – неизбежный
infamous – печально известный
inhale – вдыхать
lahar – лахар
molten rock – расплавленная порода
mudflow – сель
outage – перерыв
overdue – запоздалый
pending eruption – ожидание извержения
plunge – погружение
pose – представлять
post-eruption – после извержения
race – гонка
reawaken – пробудиться

runny – текучий
shatter – разбить вдребезги
shovel away – отгребать подальше
slumbering – дремлющий
stir – мешать
swell – раздуться
subduction – субдукция, подвиг; движение по разломам
subduction zone – зона движения по разломам
thrive – процветать
tick by – протекать
tip – совет
vent – выходное отверстие
viscous – вязкий
wipe out – уничтожать

https://media.wired.com/photos/5926605ef3e2356fd800909d/191:100/pass/EruptingVolcanoHP_GettyImages-142924771.jpg

These fiery peaks have belched up molten rock, hot ash, and gas since Earth formed billions of years ago.

BY MAYA WEI-HAAS

Volcanoes are Earth's geologic architects. They've created more than 80 percent of our planet's surface, laying the foundation that has allowed life to thrive. Their explosive force crafts mountains as well as craters. Lava rivers spread into bleak landscapes. But as time ticks by, the elements break down these volcanic rocks, liberating nutrients from their stony prisons and creating remarkably fertile soils that have allowed civilizations to flourish.

There are volcanoes on every continent, even Antarctica. Some 1,500 volcanoes are still considered potentially active around the world today; 161 of those—over 10 percent—sit within the boundaries of the United States.

But each volcano is different. Some burst to life in explosive eruptions, like the 1991 eruption of Mount Pinatubo, and others burp rivers of lava in what's known as an effusive eruption, like the 2018 activity of Hawaii's Kilauea volcano. These differences are all thanks to the chemistry driving the molten activity. Effusive eruptions are more common when the magma is less viscous, or runny, which allows gas to escape and the magma to flow down the volcano's slopes. Explosive eruptions, however, happen when viscous molten rock traps the gasses, building pressure until it violently breaks free.

How do volcanoes form?

The majority of volcanoes in the world form along the boundaries of Earth's tectonic plates—massive expanses of our planet's lithosphere that continually shift, bumping into one another. When tectonic plates collide, one often plunges deep below the other in what's known as a subduction zone.

As the descending landmass sinks deep into the Earth, temperatures and pressures climb, releasing water from the rocks. The water slightly reduces the melting point of the overlying rock, forming magma that can work its way to the surface—the spark of life to reawaken a slumbering volcano.

Not all volcanoes are related to subduction, however. Another way volcanoes can form is what's known as hotspot volcanism. In this situation, a zone of magmatic activity—or a hotspot—in the middle of a tectonic plate can push up through the crust to form a volcano. Although the hotspot itself is thought to be largely stationary, the tectonic plates continue their slow march, building a line of volcanoes or islands on the surface. This mechanism is thought to be behind the Hawaii volcanic chain.
https://www.youtube.com/watch?v=vt3eiaduSnw

FOLLOW A LAVA RIVER'S MESMERIZING PATH OF DESTRUCTION

Located in Hawai'i Volcanoes National Park, Kīlauea is one of the most active volcanoes in the world. Watch magma carve a path of destruction in Kīlauea's otherworldly landscape in this mesmerizing short film by Tyler Hulett.

Where are all these volcanoes?

Some 75 percent of the world's active volcanoes are positioned around the ring of fire, a 25,000-mile long, horseshoe-shaped zone that stretches from the southern tip of South America across the West Coast of North America, through the Bering Sea to Japan, and on to New Zealand.

This region is where the edges of the Pacific and Nazca plates butt up against an array of other tectonic plates. Importantly, however, the volcanoes of the **ring aren't** geologically connected. In other words, a volcanic eruption in Indonesia is not related to one in Alaska, and it could not stir the infamous Yellowstone supervolcano.

What are some of the dangers from a volcano?

Volcanic eruptions pose many dangers aside from lava flows. It's important to heed local authorities' advice during active eruptions and evacuate regions when necessary.

One particular danger is pyroclastic flows, avalanches of hot rocks, ash, and toxic gas that race down slopes at speeds as high as 450 miles an hour. Such an event was responsible for wiping out the people of Pompeii and Herculaneum after Mount Vesuvius erupted in A.D. 79.

Similarly, volcanic mudflows called lahars can be very destructive. These fast-flowing waves of mud and debris can race down a volcano's flanks, burying entire towns.

Ash is another volcanic danger. Unlike the soft, fluffy bits of charred wood left after a campfire, volcanic ash is made of sharp fragments of rocks and volcanic glass each less than two millimeters across. The ash forms as the gasses within rising magma expand, shattering the cooling rocks as they burst from the volcano's mouth. It's not only dangerous to inhale, it's heavy and builds up quickly. Volcanic ash can collapse weak structures, cause power outages, and is a challenge to shovel away post-eruption.

Can we predict volcanic eruptions?

Volcanoes give some warning of pending eruption, making it vital for scientists to closely monitor any volcanoes near large population centers. Warning signs include small earthquakes, swelling or bulging of the volcano's sides, and increased emission of gasses from its vents. None of those signs necessarily mean an eruption is imminent, but they can help scientists evaluate the state of the volcano when magma is building.

However, it's impossible to say exactly when, or even if, any given volcano will erupt. Volcanoes don't run on a timetable like a train. This means it's impossible for one to be “overdue” for eruption—no matter what news headlines say.

https://www.youtube.com/watch?v=A_CalBJ21y4

SEE A SPECTACULAR LAVA "WATERFALL" POUR INTO THE OCEAN

WATCH: A spectacular "firehose" of lava poured into the ocean in January, 2017 at Hawai'i Volcanoes National Park. Video courtesy Warren Fintz

https://www.nationalgeographic.com/environment/natural-disasters/volcanoes/

Exercise 1.

Read and translate the following words and word combinations.

1. Earth's geologic architects
2. To allow life to thrive
3. explosive force
4. bleak landscapes
5. fertile soils
6. to be considered potentially active
7. explosive eruptions
8. molten activity
9. Effusive eruptions
10. To trap the gasses

Exercise 2.

Make nouns from the following verbs according to the model and translate them.

1. Create
2. Found
3. Liberate
4. Flourish
5. Erupt
6. Escape
7. Form
8. Subduct
9. Continue
10. Build

Exercise 3.

Place the letter of the term beside the correct definition.

Definition	Term
1. ______The round hole at the top of a volcano, or a hole in the ground	a. Volcano
2. ______ Any substance that plants or animals need in order to live and grow	b. Crater

Definition	Term
3. _____ Hot liquid rock that comes out of the earth through a volcano, or the solid rock formed when it cools	c. Lava
4. _____ An occasion when a volcano explodes, and flames and rocks come out of it	d. Nutrient
5. _____ A volcanic region thought to be fed by underlying mantle that is anomalously hot compared with the surrounding mantle.	e. Eruption
6._____A mountain with a large, circular hole at the top through which lava, gases, steam, and dust are or have been forced out	f. Magma
7. _____ A situation in which of one of the earth's plates slides under another, often causing an earthquake or volcano	g. Subduction
8._____ Hot liquid rock found just below the surface of the earth	h. hotspot

Exercise 4.
Answer the following questions.

1. When were the volcanoes created?
2. Where are the volcanoes situated?
3. How do volcanoes form?
4. What happen when the descending landmass sinks deep into the Earth?
5. In which region are the most of the volcanoes situated?
6. Where is the ring of fire?
7. What are some of the dangers from a volcano?
8. Why is volcanic ash dangerous?
9. Can we predict volcanic eruptions?
10. What do warning signs include?

Exercise 5.

Watch this video. Choose the correct word to complete the sentences.

https://www.youtube.com/watch?v=1bsmv6PyKs0&feature=emb_logo

1. Vesuvius explodes Italy's historic volcano bursts into the most fearsome and devastating _____in 70 years over the fiery crater a great ball of smoke and lava dust spirals into the sky.
   a. eruption
   b. earthquake
   c. flooding
2. Naples_____ miles from the slumbering peak lies in comparative safety except for the deluge of volcanic ash that will blanket the city.
   a. 20
   b. 10
   c. 100
3. An all-consuming force _____ feet high throwing off terrific heat and sulfurous fumes as it ignites everything combustible in its path venture.
   a. from 60 to 90
   b. from 90 to 150
   c. from 30 to 90
4. A wall of lava sweeps on frightened Italians fry barricades of brush hoping to check the cooling edge of the flood until it may _____ and build up a dam but man's weak efforts against this monstrous force or hopeless mushrooming into the sky.
   a. solidify
   b. melt
   c. evaporate
5. The enormous gray black pall of _____ fills the air with cinders for miles around from fiery regions far deeper in the earth than any mine ever dug by man.
   a. smoke
   b. fire
   c. gas
6. Lava may have a temperature of more than _____ degrees Fahrenheit and in this major eruption it blows carries the terrific heat far down the slopes of the mouth. It carries a crushing weight that doom cities in town.
   a. 3,000
   b. 2,000
   c. 5,000
7. The people of San Sebastiano are warned to leave their homes as the moving wall of _____ grinds to the very edge of the city.

a. hard rock
b. molten rock
c. ash

8. So long as the eruption continues the catastrophe grows with ever the chance that new rivers of fire will flood_____.

a. down the slopes
b. from the earth
c. from the crater

9. The eruption continues _____ the lava flow and all throughout the second day dense clouds of stifling black smoke dust billow upward heavily laden with hot cinders.

a. smelling
b. moving
c. swelling

10. Each generation seems to forget this horror though once in every _____ the cycle of the volcano's activity seems certain to reach a period of unpredictable danger.

a. century
b. decade
c. millennium

Exercise 6.
Divide the text into passages an sentences and put punctuation marks.

Your commentator is Robert Stevenson Vesuvius explodes Italy's historic volcano bursts into the most fearsome and devastating eruption in 70 years over the fiery crater a great ball of smoke and lava dust spirals into the sky a giant specter of endless grief for the Italian people suffering under many years of brutal fascism then German occupation then Allied bombing then the devastation of battle now it is Vesuvius at least once in every century of the Christian era it is hurl disaster the city of Pompeii was buried when the huge mountain first thundered into volcanic life in the year 79 AD thousands of Italians perish excavations have revealed their tragic story this was a pleasure resort of wealthy Romans almost nineteen hundred years ago rising four thousand feet above the fertile plain of Campania Vesuvius lazily pours for for harmless curtain of smoke Naples 10 miles from the slumbering peak lies

in comparative safety except for the deluge of volcanic ash that will blanket the city then with a few warning rumbles the Silvius belches fire flame and molten rock and a fearsome spectacle thumbs of ashen cinders are borne skyward while fiery lava streams now near to the doomed valleys the overflowing crater erupts with a mounting temperature of liquid steel close to the summit which carries its fiery heat long after it loses incandescent the Italian people are stuffed the crushing mass of lava moves relentlessly for towns in the valley an all-consuming force from 30 to 90 feet high throwing off terrific heat and sulfurous fumes as it ignites everything combustible in its

path venture some youngsters linger too long in the danger zone and have to run for it a wall of lava sweeps on frightened Italians fry barricades of brush hoping to check the cooling edge of the flood until it may solidify and build up a dam but man's weak efforts against this monstrous force or hopeless mushrooming into the sky the enormous gray black pall of smoke fills the air with cinders for miles around from fiery regions far deeper in the earth than any mine ever dug by man a hot lava is a reminder that the earth was once just

such a molten mass gradually cooling until it formed an outer shell this phenomenon the simply a weak spot in the shelf from the flaming depth the liquid rock is forced to the surface by the pressure of the Earth's crust as it boils from the crater of Vesuvius lava may have a temperature of more than 2,000 degrees Fahrenheit and in this major eruption it blows carries the terrific heat far down the slopes of the mouth it carries a crushing weight that doom cities in town so there no 17 miles away is buried in lava dust three feet in Devon an Army bulldozer helps to clear streets and soldiers aided by the people labor to enable military traffic to move a costly disaster is soon apparent the people of San Sebastiano are warned to leave their homes as the moving wall of molten rock grinds to the very edge of the city there is time only to save a few pitiful possessions the burning mass is already threatening to engulf them as it comes on at 3 feet a minute and nothing stops the flow the revered image of San Sebastiano später and saved his best tuned with offerings the faithful may leave worldly things behind but not a blessed statue so long as the eruption continues the catastrophe grows with ever the chance that new rivers of fire will flood from the crater the moving mass is gathering its forces now to engulf the city no puny structures built by man can slow the

tempo of it's crushing mark already smoke and dust from crashing balls are seen as fire spread with the flow of the lava tied into the heart of the city itself

it's people are appalled these are their home hoping against hope others wait until it's imperative to move up war has seared much of Italy with half the land of battlefield but as tricking people see before them forces of destruction more devastating than the worst that man has ever devised or people are ordered to evacuate the eruption continues swelling the lava flow and all throughout the second day dense clouds of stifling black smoke dust billow upward heavily laden with hot cinders people in another doom town are born to get out the molten rock Sears everything it touches now the destruction spreads to Masada summer it buys with war for diabolical supremacy orphans of war hardened to bombing and shelling our phenom by this new terror but so were their elders as they watched the drama of a perishing city the unyielding tired of molten rock is accompanied by the continuous rumble of

crashing walls Mace's reflect the tragic scene Rowen spread throughout the city built within two miles of a volcano's peak and ignoring its tragic history they moved to safe havens but they'll come back each generation seems to forget this horror though once in every century the cycle of the volcano's activity seems certain to reach a period of unpredictable danger the crater pours forth its blackish Paulding giant clouds of lava dust but it covers the land with precious hash that makes the earth fertile and grapes will grow again to produce a wealth of wine so the people will return and defiantly rebuild their homes on the slopes of the threatening volcano they call the slopes the happy land and all little T prays that happier days will come once more with the end of this devastating eruption of Mount Vesuvius

Exercise 7.

Topics for discussion

1. Can we predict the volcano eruptions?
2. Should it be forbidden to live near the volcanoes?
3.What should authorities do to avoid victims during the volcano eruption?

Lecture 5.

Work with terminology.

Exercise 1.

Read the text and write down the highlighted terms.

Introduction

Growth faulting has an impact on a wide variety of related geological and hydro-chemical conditions in the Houston area as well as other areas along the Gulf coast. These conditions range from the relationship of the faulting to local subsidence and **large-scale groundwater withdrawal** to the occurrence of radionuclides and natural gas in the principal **aquifers** of the Houston area, which in turn relates to the health and safety of the general public and their perception of risk, and costly adjustments to building designs and/or repairs to foundations. Geological and environmental investigations converge when a natural resource affects human health and the environment. When constituents of concern, whether they are **dissolved constituents** (e.g., **solvents**, **BETX**, uranium and associated degradation products, 226radium and 222radon, etc.), or gas (e.g., methane, hydrogen sulfide, etc.), migrate into the groundwater used for drinking water, or otherwise migrates to the surface, their presence, once identified, often trigger both environmental and geological investigations and costly adjustments to building designs and/or repairs to foundations

The Houston area, as well as much of the Gulf Coast, depends on groundwater produced from thick, unconsolidated aquifers and on oil and gas from the sediments deep below. Oil and gas movement in the area is often driven by the hydrogeological dynamics of heated brines migrating into reservoirs structurally arranged by rising salt domes. Economic minerals are sometimes also formed within environments located over and around the flanks of **salt domes**. Groundwater, oil and gas, and mining (e.g., uranium and sulphur) investigations are often interrelated, having much in common [1-3]. However, in many cases, they are still treated separately by the three fields of geology involved (hydrogeology, petroleum, and mining). The opportunity exists for new collaborations and **technical synergism**, particularly in the study of faults and **fault-related hazards** in the Houston area. The absence of this opportunity was noted by [4,5] and also noted and explored over the years by Campbell and Lehr [6] and Campbell [287] in the early 1970s, by Dahlberg [7] in the early 1980s, and by LaMoreaux [8] in the early 1990s.

Acknowledgements

The subject matter of this report was identified, in part, by the graduates and instructors of The Institute of Environmental Technology (IET) in Houston, Texas, which together with many of the senior environmental professionals in the Houston area, provided a forum for continuing dialogue and technical discourse to support some 400 graduates of the IET program since its beginning in 1992 (more). IET also invited funding for research on environmental methods and techniques, field conditions in and around Houston, Texas, and for assessing the technology in use today and in the foreseeable future in the environmental consulting field in the U.S.

This guide was produced primarily for the **IET graduates** and their continuing education on the subjects treated herein. However, this guide also serves the same function for the members of the Houston Geological Society, especially the young geologists in the region (more) and for the members of the Texas Section of American Institute of Professional Geologists and the thousands of members of AIPG in the U.S. who may have an interest in the subjects discussed in this guide. Its usefulness may also extend to other interested parties such as personnel of the various municipal utility districts (MUDs), university students, and personnel of the regulatory agencies of the Gulf Coast and wherever growth faults reach the surface.

http://sciaeon.org/articles/Growth-Faulting-and-Subsidence-in-the-Houston-Texas-Area-Guide-to-the-Origins-Relationships-Hazards-Potential-Impacts-and-Methods-of-Investigation-An-Update

Exercise 2.

Determine the part of speech of each term (Noun, Verb, Adjective, Adverb)

№	**Term**	**Part of Speech**
1	Growth faulting	
2	large-scale groundwater withdrawal	
3	aquifers	
4	dissolved constituents	
5	solvents	
6	BETX	
7	salt domes	
8	technical synergism	
9	fault-related hazards	
10	IET graduates	

Exercise 3.

Translate the terms into Russian.

№	**Term**	**Part of Speech**
1	Growth faulting	
2	large-scale groundwater withdrawal	
3	aquifers	
4	dissolved constituents	
5	solvents	
6	BETX	
7	salt domes	
8	technical synergism	
9	fault-related hazards	
10	IET graduates	

Exercise 4.

Give the definitions of the terms in English.

№	**Term**	**Part of Speech**
1	Growth faulting	
№	**Term**	**Part of Speech**
2	large-scale groundwater withdrawal	
3	aquifers	
4	dissolved constituents	
5	solvents	
6	BETX	
7	salt domes	
8	technical synergism	
9	fault-related hazards	
10	IET graduates	

Unit 6. Work with terminology

Exercise 1.

Read the text and write down the highlighted terms in their initial forms.

Data

In this study, Clementine multispectral images of 415nm, 750nm and 950nm were used for **ratio calculation**, in which 415 / 750 jointly reflects the changes of lunar surface **maturity** and Ti content, while 750 / 950 ratio reflects Fe content, and then false color images were synthesized according to the above ratios [34-35]. Different colors in the false color image reflect different compositions and albedo, on the premise that the same geological body has the same material composition [16], different geological units can be relatively accurately divided according to the color change of the image, and then the crater size - frequency distribution can be fixed by combining Chang ‘e- 1 DEM data (with resolution of 500m) [36] and LROC data (with resolution of 100m) [37].

This study selected LU106016 crater database, which has a crater diameter greater than 500m [38] and it, contains the largest number, most complete type and most systematic **shape index** [39]so far.

Temporal Distribution of Mare Impact Craters

There are 5175 craters that we can use in the **mare area** from LU106016 crater database (figure 2.1). Based on Clementine UV/VIS image data, the mare area is divided into 78 **geological units** (figure 2.2), and each geological unit is dated by combining Chang ‘e 1 DEM and LROC data. The area of each geological unit, the number of craters and the dating results are shown in (table 2.1).

Referring to the geochronology scheme proposed by Guo Dijun (2014) and Ouyang Ziyuan (2014) [40-41], the 78 geological units are chronologically classified into five categories (Table 2.2) which are Aitkenian, Nectarian, **Late Imbrian**, Early Eratothenian and Late Eratothenian, and the Period of impact craters and number of geological units, number of impact craters and impact area are statistically analyzed respectively (Figure 2.3). According to the results of statistical analysis, the Late Imbrian is a time full of frequent impact events, and larger than those in the other four periods. From Aitkenian to Late Eratothenian, the strength of impact shows a trend of increasing first and then decreasing.

Spatial Distribution of Mare Impact Craters
Kernel Density Estimation

In the space-time domain of geography, an impact crater exists only at one **spatial point** at one time point, and the formation of the impact craters on the lunar surface satisfies the basic assumption of isotropy, but the distribution characteristics of the impact craters are different in different regions and different spatial scales. Based on the above principles, the space analysis of the point pattern is carried out by regarding the lunar impact craters as the points [8].The method of kernel density estimation is used to analyze the spatial distribution characteristics of lunar mare impact craters in different periods. In the kernel density estimation, the bandwidths of 100Km, 200Km, 300Km, 400Km and 500Km were selected for comparison. The smaller the bandwidth is, the larger the density value within the bandwidth and the more abrupt the density curve is. The larger the bandwidth selection is, the smaller the density value within the bandwidth and the smoother the density value curve are [42]. After comparison and analysis, the bandwidth of 300Km was finally selected, which can clearly show the density center of the impact craters and density difference?

The total number of Aitkenian impact craters is 60, and the total number used to determine the age is 57. The analysis of the **nuclear density map** shows that the Aitkenian impact craters are concentrated in four regions, located in Mare Orientale,

Mare Humorum, Mare Serenitatis and Mare Marginis areas respectively, with a total of two nuclear sites (Table 3.1.1) located in Mare Humorum and Mare Marginis respectively (the red part in the figure), and the nuclear area of the Mare Marginis is larger than that of the Mare Humorum, indicating that the Aitkenian impact craters are clustered on a large scale located in Mare Serenitatis area and the other three are located in the Mare Imbrium, Mare Crisium and the Mare Australe. Among the four nuclear sites, the one in Mare Crisium is the smallest. The total area of the three small cores is not as large as that in Mare Serenitatis. It can be seen from this that a large number of impact craters in the Late Imbrian are clustered in Mare Serenitatis area, and there are also impact craters in the areas of Mare Imbrium, Mare Crisium and the Mare Australe, but the cluster area is much smaller than Mare Serenitatis area.

Early Eratothenian contains 552 impact craters, of which 505 are used for dating. According to the **kernel density distribution map**, there is only one core (Table 3.1.4), which is located in Mare Imbrium area, and all of the 552 craters are distributed in Mare Imbrium area with relatively scattered distribution and low kernel density.

The total number of impact craters included in Late Eratothenian is 12, and the total number of impact craters used to determine the age is 8. The number is small, but the distribution is regular. From the kernel density map, we can see that there are two **cores** (Table 3.1.5) located in Mare Imbrium and Mare Anguis regions respectively. The two cores are close in area and symmetrical in distribution.
http://sciaeon.org/articles/Analysis-of-Temporal-and-Spatial-Distribution-Characteristics-of-Lunar-Mare-Craters.pdf

Exercise 2.

Determine the part of speech of each term (Noun, Verb, Adjective, Adverb)

№	**Term**	**Part of speech**
1	ratio calculation	
2	maturity	
3	shape index	
4	mare area	
5	geological unit	
6	Late Imbrian	
7	spatial point	
8	nuclear density map	
9	kernel density distribution map	
10	cores	

Exercise 3.

Translate the terms into Russian.

№	Term	Translation
1	ratio calculation	
2	maturity	
3	shape index	
4	mare area	
5	geological unit	
6	Late Imbrian	
7	spatial point	
8	nuclear density map	
9	kernel density distribution map	
10	cores	

Exercise 4.

Write the category to each term.

№	Term	Translation
1	ratio calculation	
2	maturity	
3	shape index	
4	mare area	
5	geological unit	
6	Late Imbrian	
7	spatial point	
8	nuclear density map	
9	kernel density distribution map	
10	cores	

Exercise 5.

Give definition in English to each term.

№	Term	Translation
1	ratio calculation	
№	**Term**	**Translation**
2	maturity	
3	shape index	
4	mare area	
5	geological unit	
6	Late Imbrian	
7	spatial point	
8	nuclear density map	
9	kernel density distribution map	
10	cores	

Individual work

Task 1.
Find the authentic scientific text according to your field of science.

Task 2.
Find in the text and write 25 terms in your field of science.

Task 3.
Translate the terms into Russian.

Task 4.
Determine the categories of the terms.

Gibe the definition of each term in English.

Task 6.
Write the terms in the context.

Test work

Exercise 1.

Read the text.

The Four Types of Thermal Features - Yellowstone Association

Geyser: A geyser is a hot spring with the intriguing habit of tossing underground water into the air. Water falling as rain or snow seeps through porous layers of rock. Eventually that water comes into contact with extremely hot rocks that have been heated by a large body of molten material, called magma, underneath the park. This hot water then rises through a series of cracks and fissures underneath the surface of the Earth. In a sense, these fissures are the "plumbing system" of a thermal feature. A geyser is the equivalent of a giant pressure cooker; even though the temperature of water deep down may be well above boiling, the weight and pressure of the water above prevents that boiling from happening. Eventually, though, the pressure builds enough to push the water in the upper reaches up and out, causing an overflow. That overflow, in turn, relieves the pressure on the super-heated water below, causing it to flash into steam. That flash, that explosion through a narrow, constricted place in the rocks, is what sends water shooting into the air.

Hot Spring: Hot springs let off enough heat by boiling or surface evaporation to avoid the kind of steam explosions common to geysers. Some of Yellowstone's hot springs take the form of quiet pools. Others are flowing. The waters of many of this latter type, such as those at Mammoth Hot Springs, become charged with carbon dioxide while underground, creating a mild carbonic acid. That acid dissolves underground limestone rocks and carries the mixture to the surface of the Earth. Once on the surface, the carbon dioxide gas escapes. Without carbon dioxide, the water is less able to carry the dissolved limestone. The dissolved limestone precipitates out, creating beautiful travertine terraces. In areas underlaid with volcanic rock, as opposed to more easily dissolved limestone, a modification of the plumbing system-perhaps through small earthquakes-can easily turn a hot spring into a geyser.

Fumarole (also called steam vent): In simplest terms, a fumarole is a vent in the Earth's crust. The supply of water around fumaroles is not as plentiful as in hot springs and geysers. Modest amounts of groundwater come into contact with hot rocks underground and are turned to steam. This steam rushes up through a series of cracks and fissures and out the vent, sometimes with enough force to create a loud hiss or roar.

Mudpot: In this feature, steam rises through groundwater that has dissolved surrounding rocks into clay; various minerals in the rocks make wide variations in the color of the mud. More often than not, such water is quite acidic, which help is the breaking down and dissolving process.

https://www.yellowstonenationalpark.com/geology.htm

Exercise 2.
Answer the questions.

1. What is geyser?
2. How does geyser form?
3. What is the equivalent of a geyser?
4. What relieves the pressure on the super-heated water below, causing it to flash into steam?
5. How do hot springs let off enough heat?
6. What is the form of some Yellowstone's hot springs?
7. What elements are the waters of Mammoth Hot Springs charged with?
8. What is the other name for fumarole?
9. What is a fumarole?
10. What is the supply of water around fumaroles?

Exercise 3.
Read and translate the following words and word combinations.

1. intriguing habit
2. tossing
3. molten material
4. fissures
5. surface evaporation
6. steam explosions
7. mild carbonic acid
8. underground limestone rocks
9. steam vent
10. rush up

Exercise 4.
Make nouns from the following verbs according to the model and translate them.
Vape – vapor

1. heat
2. deep
3. boil
4. push
5. escape
6. dissolve
7. oppose
8. supply
9. rush
10. break

Exercise 5.

Place the letter of the term beside the correct definition.

№	Term		Definition
1	denudation	a	The geologic science of the size and shape of the earth.
2	drift	b	Any basic igneous rock that is dark green because of the presence of chlorite, actinolite, or epidote
3	geodesy	c	The process by which compacted sediment loses liquid and turns into stone.
4	greenstone	d	The study of the composition, relative positions, etc, of rock strata in order to determine their geological history
5	igneous	e	The wearing away of the land surface by the sum of such processes as weathering and erosion.
6	inorganic	f	A soft, malleable, ductile, bluish-white, dense metallic element, extracted chiefly from galena and used in containers and pipes for corrosives, solder and type metal, bullets, radiation shielding, paints, glass, storage batteries, and antiknock compounds.
7	lead	g	Formed by the accumulation and consolidation of mineral and organic fragments that have been deposited by water, ice, or wind.
8	lithification	h	Derived by solidification of magma or molten lava emplaced on or below the earth's surface.
9	sedimentary	i	Something moving along in a current of air or water
10	stratigraphy	j	Not composed of organic matter.

Exercise 6.

Match the halves of the sentences.

№	I	L	II
1	A geyser is a hot spring with the intriguing habit	a	evaporation to avoid the kind of steam explosions common to geysers.
2	Hot springs let off enough heat by boiling or surface	b	seeps through porous layers of rock.
3	In simplest terms, a fumarole is	c	become charged with carbon dioxide while underground, creating a mild carbonic acid.
4	Water falling as rain or snow	d	is not as plentiful as in hot springs and geysers.
5	Some of Yellowstone's hot springs	e	and fissures underneath the surface of the Earth.
6	The supply of water around fumaroles	f	of tossing underground water into the air.
7	Eventually that water comes into contact with extremely hot rocks	g	with hot rocks underground and are turned to steam.
8	The waters of many of this latter type, such as those at Mammoth Hot Springs,	h	that have been heated by a large body of molten material, called magma, underneath the park.
9	Modest amounts of groundwater come into contact	i	take the form of quiet pools.
10	This hot water then rises through a series of cracks	j	a vent in the Earth's crust.

Exercise 7.

Translate the phrases into Russian.

1. a hot spring with the intriguing habit
2. Water falling as rain or snow
3. comes into contact
4. the equivalent of a giant pressure cooker
5. the pressure builds enough to push the water
6. sends water shooting into the air
7. to avoid the kind of steam explosions
8. the form of quiet pools
9. become charged with carbon dioxide
10. dissolves underground limestone rocks

PART II. READING

Text 1

Exercise 1.

Read the text.

Increased seismic activity and Main Crater Lake changes at Taal volcano, Philippines
Posted by Teo Blašković on February 15, 2021 at 14:29 UTC (2 days ago)
Category: Volcanoes

A series of 50 relatively weak tremor episodes were recorded at Taal volcano, Philippines from 05:00 to 15:00 LT on Monday, February 15, 2021 (21:00 UTC on February 14 to 07:00 UTC on February 17). There is an increased possibility of sudden steam-driven or phreatic explosions, lethal accumulations or expulsions of volcanic gas, and minor ashfall from the Main Crater that can occur and threaten areas within Taal Volcano Island (TVI).

These tremor episodes ranged in duration from 2 to 5 minutes and occurred at shallow depths of less than 1 km (0.62 miles), signaling increased hydrothermal activity beneath Taal Volcano Island.

Since February 13, 2021, a total of 68 shallow tremor episodes have occurred in TVI.

Furthermore, geochemical data on the Main Crater Lake indicate continuous acidification of lakewater from a pH 2.79 to pH 1.59 between January 2020 and February 2021, an unseasonal temperature high of 77 °C (170 °F) and CO_2/H_2S gas flux ratios consistent with shallow magma degassing.

Ground deformation data from continuous electronic tilt on Volcano Island record a slight deflation localized around the Main Crater, although very slight inflation from GPS data and InSAR analysis and positive microgravity changes have been steadily recorded across the Taal region consistent with continuous magmatic degassing and hydrothermal unrest.

The volcano remains at Alert Level 1 (Abnormal).

There is an increased possibility of sudden steam-driven or phreatic explosions, lethal accumulations or expulsions of volcanic gas, and minor ashfall from the Main Crater that can occur and threaten areas within TVI, PHIVOLCS said.

Entry into TVI, Taal's Permanent Danger Zone or PDZ, especially the vicinities of the Main Crater and the Daang Kastila fissure, must remain strictly prohibited.

Local government units are advised to continuously assess previously evacuated barangays around Taal Lake for damages and road accessibilities and to strengthen preparedness, contingency, and communication measures in case of renewed unrest.

People are also advised to observe precautions due to possible ashfall, ground displacement across fissures and minor earthquakes in the event of a phreatic eruption.

Civil aviation authorities must advise pilots to avoid flying close to the volcano as airborne ash and ballistic fragments from sudden explosions and wind-remobilized ash may pose hazards to aircraft.

Geological summary

Taal is one of the most active volcanoes in the Philippines and has produced some of its most powerful historical eruptions. Though not topographically prominent, its prehistorical eruptions have greatly changed the topography of SW Luzon. The 15 x 20 km (9 x 12 feet) Talisay (Taal) caldera is largely filled by Lake Taal, whose 267 km2 (103 mi2) surface lies only 3 m (9.8 feet) above sea level.

The maximum depth of the lake is 160 m (525 feet), and several eruptive centers lie submerged beneath the lake. The 5-km-wide (3.1 miles) Volcano Island in north-central Lake Taal is the location of all historical eruptions. The island is composed of coalescing small stratovolcanoes, tuff rings, and scoria cones that have grown about 25 % in the area during historical time. Powerful pyroclastic flows and surges from historical eruptions have caused many fatalities. (GVP)
https://watchers.news/2021/02/15/increased-seismic-activity-and-main-crater-lake-changes-at-taal-volcano-philippines/

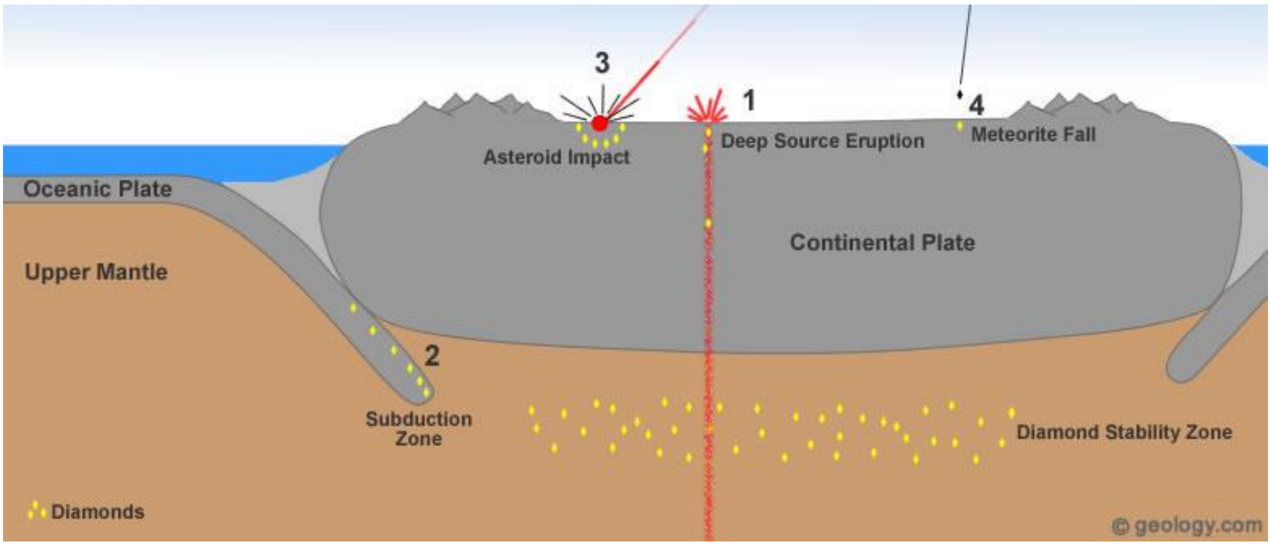
Exercise 2.

Make a glossary to this text (at least 25 terms).

Text 2

Exercise 1.

Read the text.



Diamond Formation in Earth's Mantle

Geologists believe that the diamonds in all of Earth's commercial diamond deposits were formed in the mantle and delivered to the surface by deep-source volcanic eruptions. These eruptions produce the kimberlite and **lamproite pipes** that are sought after by diamond prospectors.

Most of these pipes do not contain diamond, or contain such a small amount of diamond that they are not of commercial interest. However, open-pit and underground mines are developed in these pipes when they contain adequate diamonds for profitable mining. Diamonds have also been weathered and eroded from some of these pipes. Those diamonds are now contained in the sedimentary (placer) deposits of streams and coastlines.

The formation of natural diamonds requires very high temperatures and pressures. These conditions occur in limited zones of Earth's **mantle** about 90 miles (150 kilometers) or more below the surface, where temperatures are at least 2000 degrees Fahrenheit (1050 degrees Celsius) [1]. The critical temperature-pressure environment for diamond formation and stability is not present globally. Instead it is thought to be present primarily in the mantle beneath the stable interiors of continental plates [2].

Diamonds formed and stored in these "diamond stability zones" are delivered to Earth's surface during deep-source volcanic eruptions. These eruptions tear out pieces of the mantle and carry them rapidly to the surface [3]. See Location 1 in the diagram at the top of the page. This type of volcanic eruption is extremely rare and has never been observed by modern humans.

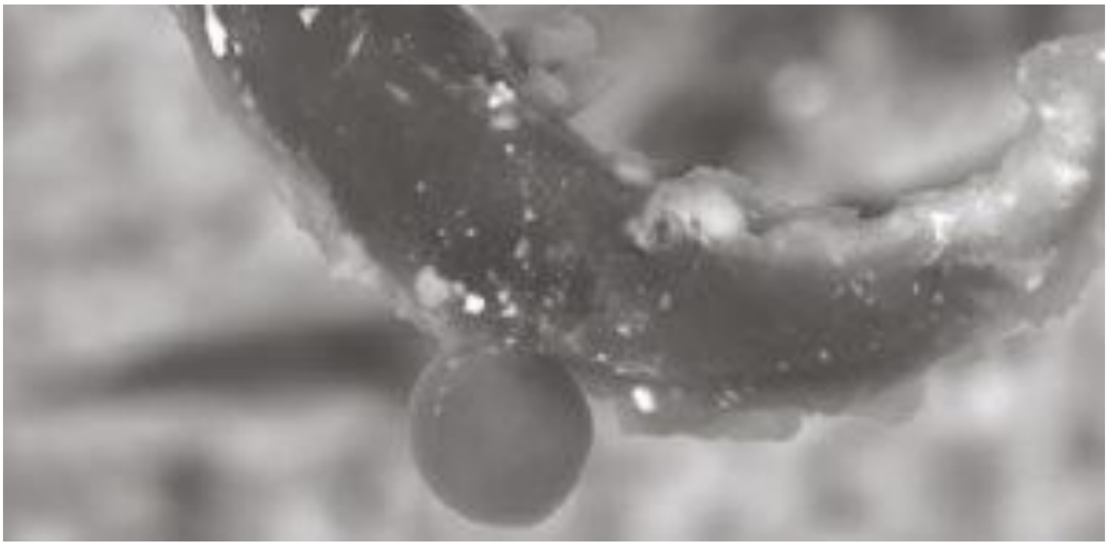
Is coal involved? Coal is a sedimentary rock, formed from plant debris deposited at Earth's surface. It is rarely buried to depths greater than two miles (3.2 kilometers). It is very unlikely that coal has been moved from the crust down to a depth well below the base of a continental plate. The carbon source for these mantle diamonds is most likely carbon trapped in Earth's interior at the time of the planet's formation or delivered to great depths by subduction.

https://geology.com/articles/diamonds-from-coal/

Exercise 2.

Make a glossary to this text (at least 25 terms).

Europe’s largest meteorite crater – home to deep ancient fungi
March 13, 2021



Fungi sample, hypha and sphere in a drill core sample from 540 m depth in the Siljan impact structure, scanning electron microscope image (width ~70 µm). Credit Henrik Drake.

Fractured rocks of impact craters have been suggested to be suitable environments for deep colonization of microbial communities. In a new study published in Communications Earth & Environment, a team of researchers shows that fungi has colonized deep parts of the largest impact crater in Europe, the Siljan impact structure, Sweden. Intriguingly, the fungi seem to have been fueling methane production in the crater.

At the scenic Swedish lake of Siljan, an impressive impact structure of more than 50 km in diameter formed almost 400 million years ago. In newly retrieved bore cores from drillings deep into the crater, a team of researchers have found fossil evidence of fungi.

The researchers examined an intensively fractured rock section at 540 depth level in the crater and noted fine filamentous structures in the vuggy rock. After closer examination in the laboratory, it became clear to them that the filaments were fossilized remains of fungi. Fungi that withstand the oxygen free environment at these depths.

The relative abundance of different isotopes of carbon and sulfur within minerals found in relation to fungi suggested to the researchers that the fungi were involved in methane- and sulfide-forming processes in relationships with other inhabitants of the deep biosphere – bacteria and archaea.

Henrik Drake, of the Linnaeus University, Sweden, and lead author of the study, explains the discovery:

-The findings suggest that fungi may be widespread decomposers of organic matter and overlooked symbiotic partners to other, more primitive, microorganisms, thereby capable of enhancing the production of greenhouse gases in the vast rock-hosted deep biosphere.

The first in situ finding

Radioisotopic dating of tiny calcite crystals formed following microbial methane formation revealed an age of the fungi fossils to around 39 million years ago, more than 300 million years after the meteorite impact.

-We propose that the anaerobic fungi decomposed organic bituminous material in the fractures and produced hydrogen gas that fueled methanogens. This would be the first in situ finding of ancient anaerobic fungi linked to methanogenesis at great depth in the continental crust, says Magnus Ivarsson, at the Swedish Museum of Natural History and co-author of the study.

The impact structure, with a ring zone of down-faulted Paleozoic sediments, has been optimal for deep colonization of fungi, because energy sources in the form of organics and hydrocarbons from overlying shales have migrated throughout the fractured crater.

- The preserved organic molecules that we could detect in the fungal remains give us additional evidence for a fungal origin and also for the proposed biodegradation pathway of shale-derived hydrocarbons, ultimately leading to production of methane at depth, adds co-author Christine Heim, of University of Cologne, Germany.

Henrik Drake summarizes:

- Microorganisms and their strategies for survival and colonization of Earth's most hostile environments continue to amaze and surprise us, and here we add another fungal piece to the deep biosphere jigsaw puzzle.

Reference:

The results are presented in the article "Fossilized anaerobic and possibly methanogenesis-fueling fungi identified deep within the Siljan impact structure, Sweden" in the Nature journal Communications Earth & Environment (published 18th of February 2021). DOI:10.1038/s43247-021-00107-9.

The article is available in full-length here: www.nature.com/articles/s43247-021-00107-9

Exercise 3.
Make a glossary to this text (at least 25 terms).

Test work.

1. Take a text in Geology. It should be authentic scientific text.
2. Find 25 terms.
3. Complete the table.

Term in English	**Part of Speech**	**Translation in Russian**	**Category in English**	**Definition in English + link**	**Term in the context+link**

PART III

Reading and Summarizing Information.
Making Summaries and Reviews.

A summary (an annotation) is a brief characteristic of the contents of the original or the manuscript. The main purpose of such a simplification is to highlight the major points from the original (much longer) subject, e.g. a text, a film or an event. The target is to help the audience to get the main idea in a short period of time. We will take into consideration a summary on the content of scientific literature.

There are different types of summaries. They are classified according to their aims of usage and their essence. The first type is a reference summary. Such summaries report the theme of the original, give some facts of it and don't express any opinion of the original work. The second type is a summary of recommendation. These summaries estimate the original and define a suitable class of readers. E.g. It's recommended for scientists. It's of great interest to technicians. There is another classification of summaries according to the quantity of the original contents. The first kind is a general summary. They give some general characteristics of the original document. These summaries are written to a wide circle of readers. The second one is a specialized summary. They show some special aspects of the original. They are written to specialists in a variety of sciences. Summaries usually have a clearly arranged structure and they are written in a logical, chronological and traceable manner.

In contrast to a résumé or a review, a summary contains neither interpretation nor rating. Only the opinion of the original writer is reflected – paraphrased with new words without quotations from the text. Unlike a retelling, a summary has no dramatic structure and is written in present tense or historic present. Because summaries should be significantly shorter than the original, minor facts have to be left out. However all major conclusions should remain.

In summaries only indirect speech is used and depictions are avoided. Summaries of books or dissertations present the major facts in common scientific language and should be about from a half up to one page long. A person has to do the following things to write s summary:

- To read the text attentively;
- To formulate the main statement;
- To reread the text and underline important ideas and arguments according to the main statement;
- To introduce the author and title of the work in the opening sentence;
- To mention the important facts in chronological order.

If a person is going to write a summary he has to know some requirements concerning writing them:

1) The volume of a summary is from 500 to 2000 symbols;

2) A logical structure should be kept.

It is also necessary to take the language peculiarities into consideration:

- To give the main ideas and facts of the original simply and in brief;
- To avoid repetitions;
- Not to repeat the title of the original;
- To use the same terms as in the original;
- To use the accepted abbreviations and shortenings;
- To avoid using adjectives, adverbs, introductive words a lot;
- To use word combinations helping to organize structure of summaries;
- To use key-patterns.

Each summary has a certain structure. It consists of several parts:

1. The introduction. It is the stage where a reader faces the problem.
2. The body. It expresses the main facts and problems of the original document.
3. The ending. It gives recommendations for a definite group of readers.

Usually a person begins to write a summary from the compression of information stated in the original. It's a difficult process which consists of three main steps:

1) It's necessary to express the main facts using the minimum of the original paper.

2) It's necessary to follow the main ideas of the original.

3) It's necessary to find some extra information about this problem.

The compression can be done in two ways. The first one is a process of diminishing the quantity of the original information. The second one is a process of keeping information completely. The first type of compression is divided into two variants:

1) The omission of details;

2) The generalization of the rest.

The second type of compression is divided into two types as well. The first one is a combination. A combination is a way of organizing the text when two or more sentences are combined in one short construction where the same components are used once.

E.g. 1. It takes only one number to describe a scalar quantity. It takes several numbers to describe a scalar quantity. It takes several numbers to describe a vector quantity. It takes only one number to describe a scalar quantity and several – a vector one.

The second one is a substitution. A substitution is a way of organizing the text when a part of the text is substituted by shorter one keeping the minimum of information of the original.

E.g. 1. He made up his mind to start the construction of another device. He decided to start…

2. The methods of multiplication of fractions in algebra are identical with those in arithmetics.

Compression of the original text is the first step of writing summaries. The next one is making a logical plan of the text. A person looks through the text and finds the most important sentences. It's also necessary to pay attention to the language of writing summaries. A mention should be made about key-patterns usually used while writing them. They perform different functions.

The key-patterns or speech models (stereotypes) make process of communication simpler, help not to waste reader's time and to organize his ideas better. There is a classification of key-patterns according to their tasks. It's built on the basis of notions. Usually there is a general notion and a lot of notions connected to them.

Key-patterns for writing summaries:

The article deals with . . .

As the title implies…

the article describes …

The paper is concerned with…

It is known that…

It should be noted that…

The fact that… is stressed.

A mention should be made…

It is spoken in detail about…

It is reported that

The text gives valuable information on…

Much attention is given to…

It is shown that…

The following conclusions are drawn…

The paper looks at recent research dealing with…

The main idea of the article is…

It gives a detailed analysis of…

It draws our attention to…

It is stressed that…

Exercise 1.

Read the text "Laser lidar" and study the summary to this text.

Laser lidar

Laser-based lidar (light detection and ranging) has also proven to be an important tool for oceanographers. While satellite pictures of the ocean surface provide insight into overall ocean health and hyperspectral imaging provides more insight, lidar is able to penetrate beneath the surface and obtain more specific data, even in murky coastal waters. In addition, lidar is not limited to cloudless skies or daylight hours. "One of the difficulties of passive satellite-based systems is that there is watersurface reflectance, water-column influence, water chemistry, and also the influence of the bottom", said Chuck Bostater, director of the remote sensing lab at Florida Tech University (Melbourne, FL). "In shallow waters we want to know the quality of the water and remotely sense the water column without having the signal contaminated by the water column or the bottom". A typical lidar system comprises a laser transmitter, receiver telescope, photodetectors, and range-resolving detection electronics. In coastal lidar studies, a 532-nm laser is typically used because it is well absorbed by the constituents in the water and so penetrates deeper in turbid or dirty water (400 to 490 nm penetrates deepest in clear ocean water). The laser transmits a short pulse of light in a specific direction. The light interacts with molecules in the air, and the molecules send a small fraction of the light back to telescope, where it is measured by the photodetectors.

Abstract (Summary).. Laser lidar. "Laser Focus World", 2003, v 46, №3, p45. 76 The text focuses on the use of laser-based lidar in oceanography. The ability of lidar to penetrate into the ocean surface to obtain specific data in murky coastal waters is specially mentioned. Particular attention is given to the advantage of laser-based lidars over passive satellite-based systems is obtaining signals not being contaminated by the water column or the bottom. A typical lidar system is described with emphasis on the way it works. This information may be of interest to research teams engaged in studying shallow waters.

Another popular form of secondary sources of information is a report or a review.

A report is a brief interpretation of the content of the original in a written form or orally. It also has particular features:

1. It gives a reader an objective idea of the original source.
2. It presents the main facts of the original.
3. It represents some peculiarities of it.
4. It shows many questions of the original.
5. It helps to get rid of making a full translation of the text.

Written reports are documents which present specific, focused contents – often the result of an experiment, investigation, or inquiry – to a specific audience. The audience may be public or private, an individual or the public in general. Reports are used in government, business, education, and science. Reports often use persuasive elements, such as graphics, images, voice, or specialized vocabulary in order to persuade that specific audience to undertake an action. One of the most common formats for presenting reports is IMRAD: Introduction, Methods, Results and Discussion. This structure is standard for the genre because it mirrors the traditional publication of scientific research and summons the ethos of that discipline. Reports are not required to follow this pattern, however, and some do use the problemsolution format. Additional elements often used to persuade readers include: headings to indicate topics, to more complex formats including charts, tables, figures, pictures, tables of contents, abstracts, summaries, appendices, footnotes, hyperlinks, and references. Some examples of reports are: scientific reports, recommendation reports, white papers, annual reports, auditor's reports, workplace reports, census reports, trip reports, progress reports, investigative reports, budget reports, policy reports, demographic reports, credit reports, appraisal reports, inspection reports, military reports, bound reports, etc.

With the dramatic expansion of information technology, and the desire for increased competitiveness in corporations, there has been an increase in the use of computing power to produce unified reports which join different views of the enterprise in one place.

Termed Enterprise Reporting, this process involves querying data sources with different logical models to produce a human readable report. A computer user has to query the Human Resources databases and the Capital Improvements databases to show how efficiently space is being used across an entire corporation. Enterprise Reporting is a fundamental part of the larger movement towards improved Business Intelligence and Knowledge Management.

While reports can be distributed in a printed form or via email, they are typically accessed via a corporate intranet. A technical report (also: scientific report) is a 70 document that describes the process, progress, and or results of technical or scientific research or the state of a technical or scientific research problem. It might also include recommendations and conclusion of the research. Unlike other scientific literature, such as scientific journals and the proceedings of some academic conferences, technical reports rarely undergo comprehensive independent peer review before publication. Where there is a review process, it is often limited to within the originating organization. Similarly, there are no formal publishing procedures for such reports. Technical reports are today a major source of scientific and technical information. They are prepared for internal or wider distribution by many organizations, most of which lack the extensive editing and printing facilities of commercial publishers. Technical reports are often prepared for sponsors of research projects. Another case where a technical report may be produced is when more information is produced for an academic paper than is acceptable to publish in a peerreviewed publication; examples of this include in-depth experimental details, additional results, or the architecture of a computer model. There is another classification of reports: an informative report and an indicative report. An informative report or a report – précis contains all the main ideas and facts concerning with the methods of research and an equipment used in this research. It's the most popular form of a report. An indicative report shows the ideas connected with the theme of the original.

Reports can be classified according to the quantity of the literature used for making reports. A monograph report is a report made on the basis of one original source. An illustrative report is a report made on the basis of three or more sources. A report has particular parts.

It consists of three parts.

1) The first part is a bibliographical description of the original source. When a report contains many abbreviations or acronyms, they may be listed with their definitions before the body of the report, even though they must be explained in the text when first appearing unless they are standard units of measurement. Only standard abbreviations shall be used since non-standard abbreviations can be extremely confusing.

2) The second part is the body of the report. The body or the core of the report shall be structured according to its content and complexity. The core of report represents the main part of the document and shall permit the reader to understand its content (theory, methods, results). Topics should be presented in logical sequence. The structure of the core depends on the type of the document itself (handbook, research protocol, progress report, etc.). The instructions to authors can show different levels for titles but it is up to the author to decide how to organize it. Figures and tables essential to the understanding of the text are included in the core of the report, but when information is too detailed (i.e. many tables or figures on the same subject) as to interrupt the flow of the text, it should be presented in appendices, which may 71 contain also extra or supplementary materials. The text usually repeats all the data included in the tables or illustrations.

3) The third part is the additional information and notices. Appendices are not essential in every report. They can be identified by consecutive letters (Appendix A, Appendix B, etc.). They are used to present material that is necessary for completeness which can interrupt the flow of reading if inserted in the core of report or material that is not of interest for the general reader, but only for a specialist in the definite field.

References in appendices are treated independently of those reported in the body of report and are listed separately at the end of each appendix.

Non textual material generally defined as illustrations (tables, graphs, maps, photographs, flowcharts, drawings, etc.) plays a significant part in the presentation of concepts explained in the text and should be carefully organized. Illustrations summarize and emphasize key points, improve clarity and reduce narrative length. They are both an integral and independent part of the text. They offer some useful visual aid to the reader and are a time-saving writing tool. In the text they may be defined as:

1) Tables (logically organized sequences of numbers or words);

2) Figures (every illustrative material that is not a table). The choice between tables or figures depends on which elements are intended to be focused (a table points out results, a graph promotes understanding of results and suggests interpretations of their meaning and relationships; graphs shall be used as an alternative to tables with many entries without duplicating data in graphs and tables).

Non textual material should be limited to that supporting the text and pertinent for the understanding of the study described. Each item can be numbered consecutively (Table 1, Figure 1) in the order of its first citation in the text, followed by a brief title. Illustrations can be cited in the text and placed soon after their citation (and not before) or included in appendices if they are so detailed as to interrupt the flow of reading. If data included in illustrations are from other published sources, permission can be obtained by the copyright owner (except for documents in the public domain) and the original source shall be fully acknowledged. Use of colours for illustrations should be checked carefully. Tables are used when the attention of the reader is focused on data and not on trends of data. They capture information concisely, and display it efficiently; they also provide information at any desired level of detail and precision. Including data in tables rather than text frequently makes it possible to reduce the length of the text. Oversized tables should be avoided. A table is a matrix containing rows and columns of data which must be homogeneous. Each column has a short heading guiding the reader in understanding the table content; each cell must contain data (in case of missing data it can be indicated by special marks or letters). Authors should place explanatory matter in footnotes (not in the heading), which might contain also the explanation of non standard abbreviations. Figures usually include relevant information needed for evidence, efficacy or emphasis. They should be made as self-explanatory as possible using legends, when necessary. Figures are suitable for printing (i.e. either professionally drawn and 72 photographed, or produced as photographic quality digital prints in JPEG or GIF formats). Although some organizations may help authors of technical reports to redraw figures, in most cases there is no editorial support and authors should be aware that the final printing quality depends on that of their original figures. Letters, numbers, and symbols should therefore be clear and even throughout. If photographs of people are used, either the subjects must not be identifiable or authors must obtain a written permission to use the photographs.

The text of the report has three parts:

1. The introduction. It shows the aim, the main tasks and the methods of research. It provides the context or background for the study and should state purposes, basic procedures, main findings, and principal conclusions. It emphasizes new and important aspects of the study or observations.

2. The descriptive part. It gives data of the subject of research, of its characteristics and peculiarities. It begins from the main idea of the original.

3. The conclusions. They give the results of research and represent the main deductions. Sometimes deductions of the writer are not represented. Conclusions represent the clear presentation of the deductions made after full consideration of the work reported in the core of the report. They may include some quantitative data, but not too many details. They may also contain recommendations for further actions as a direct result of the study described.

There are some rules for making reports:

1. The length of the report depends on the original source and is about 1/8 of information of the text.

2. Reports don't represent a lot of proofs and discussions.

3. They don't express person's estimation and his own opinion just fixes the information of the original.

4. Information is given briefly due to usage of terminological vocabulary, tables, figures, formulae.

5. The style of the original is kept. It means the necessity of using authour's language.

6. You should keep the simplicity of the interpretation.

7. It is necessary to keep the subject narrow.

8. Copying a sentence you should do it exactly using quotation marks around it.

9. It is necessary to interpret authour's ideas in logical order.

10. There are a lot of tables in technical reports. 11. A lot of key-expressions are used for writing reports.

Key-expressions for writing reports:

1) The general characteristic of the article is …

2) The paper (article) under discussion is intended to describe ….

3 The article is intended to explain the advantages of …

4) The paper under discussion is intended to examine …

5) The article surveys …

6) The tasks of the author …
7) The author outlines …
8) The author points out …
9) The writer reviews the problems of …
10) The authors review …
11) The value of the results …
12) The results obtained confirm…
13) The results show the importance of the problem of ...
14) The results lead to …
15) The paper summarizes…
16) In summing up to author…
17) At the end of the article the author sums up…

While making reports people should follow the definite sequence of actions:

1. You look through the text quickly to catch the main ideas.

2. Then you read the text more attentively to understand unfamiliar words according to the context or using a dictionary.

3. Then you analyze the text and divide your material into groups:

a) The main facts which are necessary to reprint in your report;

b) Secondary information interpreted in brief;

c) Unnecessary information.

4. You organize your ideas clearly beginning from making the plan of your report.

5. You end up your report with the bibliography.

While writing your bibliography keep a record of their titles. E. g. 1) (book) Henderson Richard, Sea Sense, N. Y., Association Press, 2002 (you can use an abbreviation for the name of the famous cities). 2) (magazine) Emmett I, "Watch the weather and the gas", Outdoor life, volume 153, April 2004 pp 36. 3) "Motorboats", Encyclopedia American, vol. 19, pp 518-519.

If a person uses both original sources in his own language and foreign ones, he has to begin his bibliography from the sources in Russian organizing them in alphabetical order. Foreign sources of information are usually given after that. People should avoid making typical mistakes in writing reports:

1) Not to use a lot of information of the original;
2) Not miss the main ideas and facts;
3) Not to change the facts;
4) Avoid using their own ideas;
5) Not to use a lot of adjectives and adverbs.

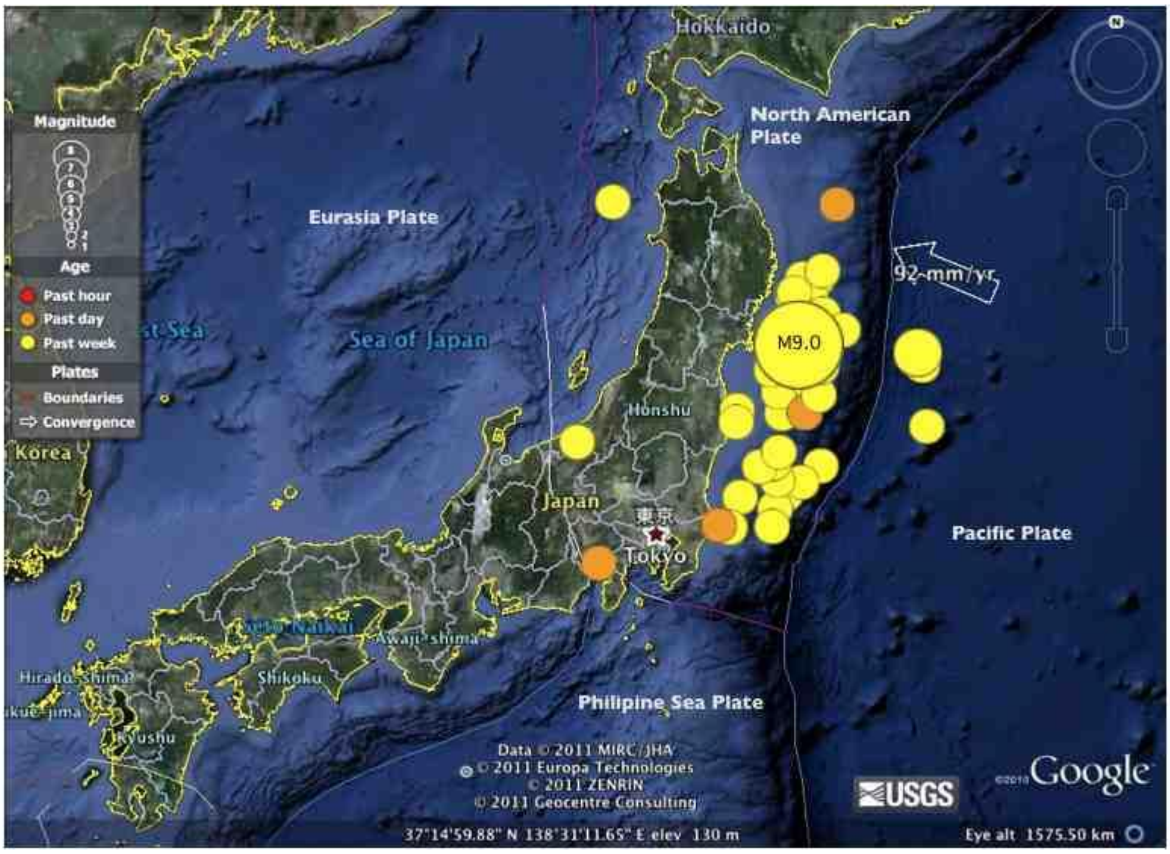
Reports should be easy to edit as well as easy to read and understand. Therefore producers are strongly recommended to issue instructions to guide authors in the production of a formally correct document – ready to be distributed – containing indications for formats and styles, illustrations, etc. Reports may be produced at 74 different levels, in some cases inside the institution there is an editorial office dealing with publications in general and therefore also with GL, in other cases reports are issued without editorial support. Instructions to authors should provide a standard report structure. Issuing organizations may also provide a checklist to help authors in the production of a correct document.

Exercise 2.
Read and analyze an example of a short review.

This work provides an overview of a wide range of exiting and compatible approaches to written text analysis. It includes the criticism of both classic and modern papers by distinguished scientists who share a common linguistic framework. The focus varies from their approaches to single words and individual expressions through their analyses of the organisation of paragraphs, sections and whole texts. The quotations are selected from both classic and specially commissioned papers.

Exercise 3.

Read the text and write a summary.



Tsunami | Geodynamics Weblog (wordpress.com)

On March 11, 2011, a magnitude 9.1 earthquake jolted the seafloor about 70 kilometers (45 miles) offshore of Japan's Tohoku region. It was the largest quake recorded in Japan and the fourth largest in the world since seismic recording began around 1900.

Within an hour, tremendous tsunami waves inundated much of the eastern Japanese coast, sending 5- to 10-meter walls of water into coastal towns and cities. In Miyako, Iwate Prefecture, the runup height from the tsunami—the maximum elevation that water moved upland from the shore—reached 40.5 meters (133 feet) above sea level. Near Sendai, flood waters penetrated 10 kilometers (6 miles) inland.

According to the U.S. Geological Survey, the earthquake moved Japan's main island of Honshu eastward by 2.4 meters (8 feet) and dropped about 400 kilometers (250 miles) of coastline by 0.6 meters (2 feet). The tsunami affected a 2000-kilometer stretch of coast and inundated more than 400 square kilometers of land in Iwate, Miyagi, and Fukushima prefectures.

Some of the worst devastation was observed at Rikuzentakata (Iwate). The images above were acquired in 2007, 2011, and 2021 by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), a joint Japanese and U.S. instrument on NASA's Terra satellite. The images combine infrared, red, and green wavelengths of light to make false-color images that distinguish between water, vegetation, and urban infrastructure. In the 2011 image, most of the areas in purple-blue were flooded or denuded.

The March 2011 tsunami killed more than 1,700 residents (about 8 percent of the population) of Rikuzentakata and destroyed 80 percent of its residential areas. More than 70,000 trees in the Takatamatsubara pine forest on the waterfront—planted in the 17th century as a tidewater control—were washed away. Flood waters sat for weeks on rice paddies and other agricultural land. Satellites captured scenes of the devastation just one day and three days after the event. On March 14, 2011, *The Mainichi Daily News* declared: "Rikuzentakata has been erased."

A decade later, the area is still rebuilding. A 12.5-meter (41-foot) high concrete seawall now stands along two kilometers of the waterfront in Rikuzentakata. (More than 430 kilometers/265 miles of seawalls have been built up and down the Tohoku coast.) Engineers and construction crews also carried in massive amounts of soil and rock to raise the level of the land by 10 meters before new buildings were constructed. And local officials launched a project in 2017 to plant 40,000 tree seedlings along the town's coastline.

According to the Japan Reconstruction Agency, nearly 400,000 buildings were destroyed or irreparably damaged and another 750,000 were partially destroyed across the country in March 2011. Nearly 16,000 people were killed and 2,500 are still listed as missing. The meltdown and explosions at the nearby Fukushima Daichi nuclear plant between March 12-15, 2011, added to the misery and displacement of Japanese citizens. More than 21,000 hectares of farmland were destroyed by flooding and by salt water; some has been reclaimed and some has returned to wildland. The World Bank estimated it to be the costliest natural disaster in world history. According to some estimates, Japan has spent nearly $300 billion (U.S) on rebuilding the region to date.

Visit our Tohoku/Sendai gallery to see twenty other images and stories from the days and months after the earthquake and tsunami.

NASA Earth Observatory images by Joshua Stevens, using data from NASA/METI/AIST/Japan Space Systems, and the U.S./Japan ASTER Science Team. Story by Michael Carlowicz.

[Ten Years After the Tsunami (nasa.gov)]

Exercise 4.
Read the text and write a summary.

Crushed Stone – The Unsung Mineral Hero
It is the geologic commodity upon which almost everything is built.
Article by: Hobart M. King, PhD, RPG

The Most Basic Mineral Commodity

Crushed stone is the world's most basic mineral commodity. It is abundant, widely available, and inexpensive. It is a material that people are familiar with in almost all parts of the world.

In 2017, the United States produced a total of about 1.33 billion tons of crushed stone [1]. That is an average of about four tons of crushed stone for each citizen. Most people have a hard time imagining how four tons of crushed stone were used in the past year for their benefit. That amounts to about twenty pounds of crushed stone per person per day for the entire year.

Most crushed stone is used in highway construction and building construction. In the construction of a two-lane asphalt highway, about 25,000 tons of crushed stone is used per mile. In building a small residential subdivision, about 300 tons of crushed stone is used per home [2]. Many other uses of crushed stone can be seen in the word cloud on this page. A larger list is included in the table near the bottom of the page.

Rock Types Used for Crushed Stone

Many different rock types are used to make crushed stone. The types used to make crushed stone in the United States during 2017 include the following: **limestone**, **granite**, **trap rock**, **sandstone**, **quartzite**, **dolomite**, **volcanic cinder and scoria**, **marble**, **slate**, **dacite**, shell, and calcareous marl [1]. Their relative importance is shown in the pie chart on this page. Each of these rock types is suitable for a number of uses and unsuitable for others. A brief description of the more important **rocks** for crushed stone is provided below.

Limestone

Limestone: Crushed limestone of various particle sizes, from top left going clockwise: coarse aggregate, crushed limestone, mine run limestone, and limestone fines.

Limestone is a rock composed of calcium carbonate ($CaCO_3$). It is the rock type most commonly used to make crushed stone in the United States. It holds this position because it is widely available and suitable for a greater diversity of uses than any other type of rock.

Limestone can be used to make cement. It is the primary ingredient of concrete. It is used as a base material for highways, rural roads, buildings, and railroad construction. It is used to make agricultural lime and for acid neutralization in the chemical industry. There are many products made from or using limestone that consume a small volume of material. These include poultry grit, terrazzo, glass, air pollution sorbents, mine safety dust, animal food supplements, cosmetics, dietary supplements, and blast furnace flux, whiting, among others.

In addition to its suitability for many uses, limestone is also used to make crushed stone because it breaks easily and is softer than the steel used in crushing equipment, classifying equipment and truck beds. Compared to harder rocks such as quartzite, limestone causes a lot less wear on the equipment that it comes in contact with.

As an example, imagine a truck loaded with 10 tons of crushed quartzite. Every piece of quartzite that is in contact with the bed and sides of the truck bed will have sharp points and edges. It will also have the pressure of all of the rock in the load above applied to it. When the driver raises the bed to dump the load, every piece of quartzite in contact with the truck bed will gouge a groove into the metal as it slides out the tailgate of the truck. The truck bed will become thinner with every load of rock that is dumped. Truck owners will not be happy when they have to repair or replace their trucks after a short time of use. Similar wear will occur on crushing equipment, screens, and every piece of equipment that contacts the stone. Now you know why mining companies would rather quarry limestone than quartzite.

Dolomite and Dolomitic Limestone

Dolomite (AKA "dolostone") and limestone are very similar rocks. Dolomite is a calcium magnesium carbonate ($CaMg(CO_3)_2$), while limestone is a calcium carbonate ($CaCO_3$). Limestone is more effective for making cement and for neutralizing acids. Dolomite has a **Mohs hardness** of 4 compared to limestone with a Mohs hardness of 3. This hardness difference makes dolomite distinctly more durable when the rock is subjected to abrasion.

Dolomite, dolomitic limestone, and limestone have similar appearances and often occur together in the rock units mined at a single quarry; however, they are rarely mined as separate products. A significant amount of the material reported as "limestone" in the pie chart above is actually dolomitic limestone and dolomite.

Most quarries sell their production as "limestone," which is acceptable to customers in the construction industry if the chemical composition of the rock is not important. Customers interested in rock for chemical, acid neutralization, blast furnace flux or agricultural purposes will probably demand rock that has the chemical composition of a very pure limestone or a very pure dolomite.

Granite and Trap Rock

Crushed rock: Crushed igneous rocks of various kinds, from top left going clockwise: trap rock, white granite, lava rock, and red granite

Granite is the layman's name used for any light-colored igneous rock that is used in construction. Granite, granodiorite, **diorite**, and **rhyolite** are a few of many light-colored igneous rocks that are called "granite" in the construction industry.

"**Trap rock**" is a layman's name used for any dark-colored igneous rock that is used in construction. **Basalt**, **peridotite**, **diabase**, and **gabbro** are examples of trap rock.

Granite and trap rock are the second and third most commonly used types of rocks for producing crushed stone. They are superior to limestone when used in acid waters or soils and when subjected to abrasion. They can substitute for limestone as a concrete aggregate and when a durable aggregate is needed.

Some geologists do not like how people in the crushed stone industry use the word "granite". That industry sells millions of tons of "granite" per year and has used the word "granite" in this way for generations. They are not going to change their terminology to satisfy a few picky geologists.

Sandstone and Quartzite

Uses of Crushed Stone	
Road Construction	Macadam
Riprap	Jetty Stone
Filter Stone	Concrete Aggregate
Bituminous Aggregate	Railroad Ballast
Concrete Sand	Graded Road Base
Unpaved Road Surfacing	Terrazzo
Exposed Aggregate Concrete	Fill
Roofing Granules	Agricultural Limestone
Poultry Grit	Mineral Food Supplements
Cement	Lime
Dead Burned Dolomite	Blast Furnace Flux
Chemical Stone	Landscape Stone
Glass Manufacture	Sulfur Oxide Removal
Mine Safety Dust	Traction Stone
Acid Neutralization	Asphalt Fillers
Whiting	Fillers and Extenders

Sandstone and **quartzite** are composed primarily of quartz, a very durable mineral, but each has its drawbacks in the construction industry that limits its use. Sandstone is generally composed of sand grains cemented together by **calcite**, clay, or silicate minerals that have precipitated between the sand grains. The cement usually does not completely fill all of the voids between the sand grains, leaving a porosity that typically ranges between 5 and 30 %. This pore space allows the rock to absorb water. That water will expand in volume by up to 9 % every time it freezes. Over the course of many freeze-thaw cycles, the forces of this expansion have the ability to dislodge grains and break the rock. This is why sandstone is not popular for long-term use in areas where freezing temperatures occur.

Quartzite is a sandstone that has been metamorphosed. The process of metamorphism heats and compresses the rock and often causes the sand grains to become welded together. This can produce an extremely durable rock that usually does not have the freeze-thaw concerns of sandstone. Quartzite can actually be so durable that it is difficult to mine, handle, and transport to construction sites.

Quartzite has a Mohs hardness of 7. That makes it harder than crusher jaws, loader buckets, sizing screens, truck beds, and other equipment used to handle and process the stone. As a result, it can quickly put very expensive wear and tear on essential equipment. For that reason, some of the most durable rock in the United States is avoided for construction use.

Volcanic Cinder and Scoria

Volcanic cinder and **scoria** are vesicular rocks, meaning they contain voids that formed when gas bubbles were trapped within the rock as it solidified from a melt. These voids decrease the load-bearing strength and freeze-thaw durability of the material. However, the voids make the rock lighter. The surface roughness of the stone helps it bind effectively when used as a concrete aggregate. These properties often make volcanic cinder and scoria good rocks for producing lightweight aggregate, lightweight concrete, and roofing granules.

The lower density of volcanic cinder and scoria makes them easier to handle when used in landscaping, planters, gas grills, saunas, and other similar uses. The high surface area of these rocks makes them suitable for filter stone in some sewage disposal and drainage applications. Their angular shape and low density makes them suitable for use as a traction material that is spread on snow-covered highways.

Marble

Fine-grained **marble** and dolomitic marble can be crushed and used for most of the same purposes as limestone. When coarsely crystalline, these rocks often break into pieces due to cleavage, which can reduce their durability.

Some white marbles are pure enough that they can be crushed, processed to remove impurities, and used as chemical-grade stone, whiting, fillers, extenders, and even in cosmetics and dietary supplements for humans and animals. These high-purity marbles make some of the most valuable crushed stone.

Gravel: These pebbles, with rounded shapes produced by water transport, are what geologists would call "gravel." However, most people use the word "gravel" interchangeably for either "gravel" or "crushed stone."
Crushed Stone: The Unsung Mineral Hero (geology.com)

Exercise 5.
Read the text and write a summary.

Lapis Lazuli
A metamorphic rock, gem material, and mineral pigment that obtains its blue color from the mineral lazurite.
Author: Hobart M. King, PhD, GIA Graduate Gemologist

Lapis Lazuli Gemstones: As a general rule, solid blue lapis or solid blue with a few grains of gold pyrite are the most desirable colors. In the photo above the bottom two cabochons approach that ideal. The large cabochon on the top right has a few thin veins of calcite and some calcite mottling. This stone is attractive and some people might prefer it, but the calcite reduces its desirability for most people. The top left cabochon has large patches of calcite that are intergrown with blue lazurite to yield a faded denim color. It also contains many visible grains of pyrite. For most people, it would be the least desirable stone in the photo; however, some people will enjoy it. Desirability in lapis varies from stone to stone and from person to person.

What is Lapis Lazuli?

Lapis lazuli, also known simply as "lapis," is a blue **metamorphic rock** that has been used by people as a **gemstone**, sculpting material, pigment, and ornamental material for thousands of years. High quality lapis lazuli can be a costly gem. The most desirable specimens have a rich, solid blue color and perhaps a few reflective pieces of gold **pyrite**.

Unlike most other gem materials, lapis lazuli is not a **mineral**. Instead, it is a rock composed of multiple minerals. The blue color of lapis lazuli is mainly derived from the presence of lazurite, a blue silicate mineral of the sodalite group with a chemical composition of $(Na,Ca)_8(AlSiO_4)_6(S,Cl,SO_4,OH)_2$.

Geologic Occurrence of Lapis Lazuli

Lapis lazuli forms near igneous intrusions where **limestone** or **marble** has been altered by contact metamorphism or hydrothermal metamorphism. In these rocks, lazurite replaces portions of the host rock and often preferentially develops within certain bands or layers.

Afghanistan is the world's leading source of lapis lazuli. Some parts of the country have been actively mined for thousands of years. Other countries that produce notable amounts of lapis lazuli include **Chile**, **Russia**, **Canada**, **Argentina**, and **Pakistan**. In the **United States** small amounts of lapis lazuli have been produced in **California**, **Colorado**, and **Arizona**.

Lapis Lazuli – The Rock: This photo shows a specimen of marble in which small patches of lazurite and abundant crystals of pyrite have formed. This is a beautiful rock specimen, but its usefulness as a rough for cutting high-quality lapis lazuli cabochons or beads is limited because the amount of lazurite present at any location within the rock is lower than optimal. However, this type of rock can be dyed to look like reasonable quality lapis. This image copyright iStockphoto / Epitavi.

Composition and Properties of Lapis

In addition to lazurite, specimens of lapis lazuli usually contain **calcite** and **pyrite**. **Sodalite**, hauyne, wollastonite, afghanite, mica, **dolomite**, **diopside**, and a diversity of other minerals might also be present. To be called "lapis lazuli," a rock must have a distinctly blue color and contain at least 25 % blue lazurite.

Calcite is often the second most abundant mineral present in lapis lazuli. Its presence can be very obvious, appearing as white layers, fractures, or mottling. It can also be finely intermixed with lazurite to produce a rock with a faded denim color.

Pyrite usually occurs in lapis lazuli as tiny, randomly spaced grains with a contrasting gold color. When abundant, the grains can be concentrated or intergrown into distinct layers or patches. It can occasionally occur as a fracture-filling mineral.

As a rock, lapis lazuli is composed of several minerals, each with its own hardness, cleavage/fracture characteristics, specific gravity, and color. Hardness ranges from a Mohs 3 for calcite to the 6.5 of pyrite. The hardness of the material depends upon where you test it.

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Banded Lapis: A piece of rough lapis lazuli showing distinct calcite banding and pyrite on a fracture face. Image copyright iStockphoto / J-Palys.

Lapis Lazuli History

Lapis lazuli has been popular through most of recorded human history. Mining for lapis occurred in the Badakhshan Province of northeastern Afghanistan as early as 7000 BC. The lapis was used to make beads, small jewelry items and small sculptures. These have been found at Neolithic archaeological sites dating back to about 3000 BC in Iraq, Pakistan, and Afghanistan.

Lapis lazuli appears in many Egyptian archaeological sites that date back to about 3000 BC. It was used in many ornamental objects and jewelry. Powdered lapis was used as a cosmetic and a pigment

https://geology.com/gemstones/lapis-lazuli/

Exercise 6.
Read the text and write a resume.

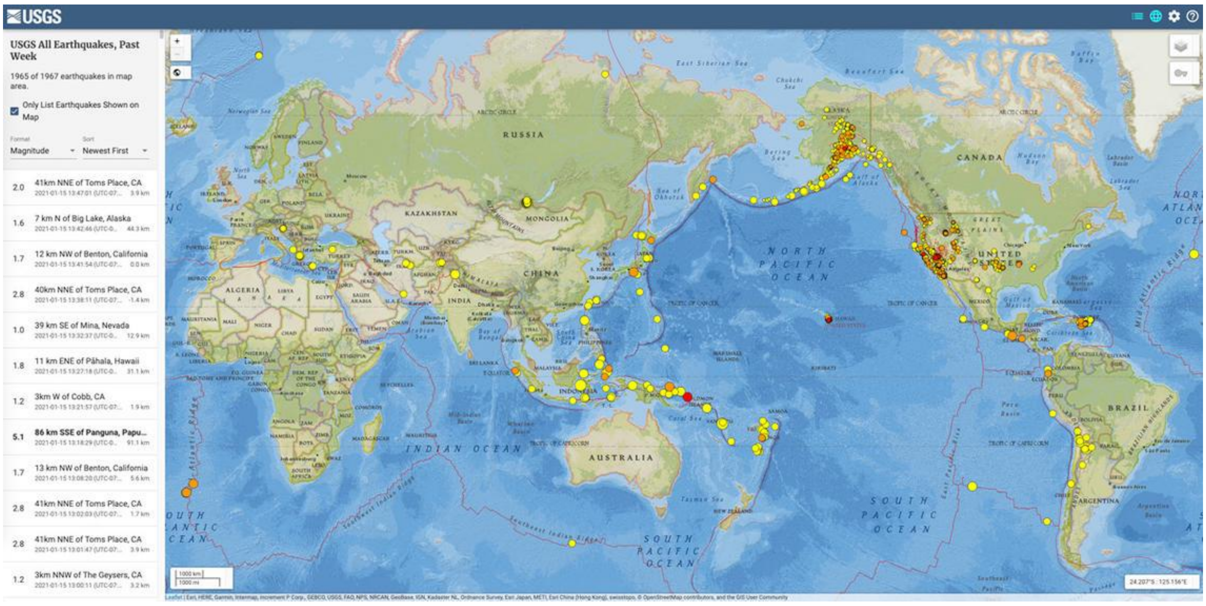
Improving Earthquake Monitoring with Deep Learning

Overview (active tab)

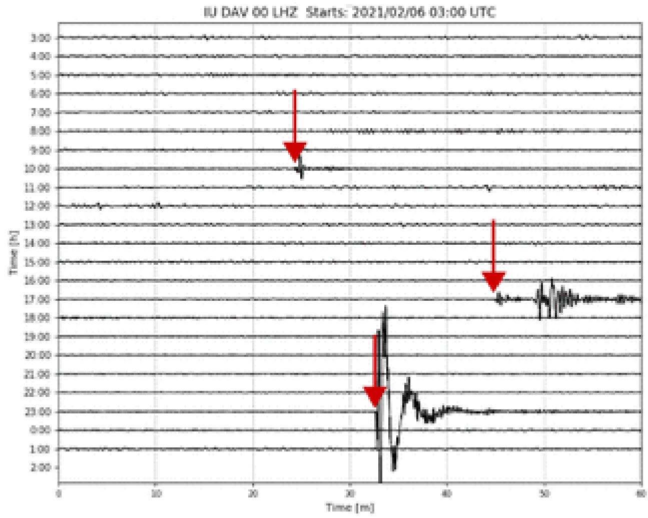
On January 20, 2021 at 8:32am light shaking interrupted breakfast customers at a local coffee shop south of downtown Los Angeles, California. Everyone paused briefly while they waited to see if it was going to stop… or start shaking harder.

A few mobile phones pinged a couple of minutes later with the information that a magnitude 3.5 (M3.5) earthquake a few miles away in Inglewood was what they had felt. Ideally, earthquake information would always arrive so quickly, but that’s not always the case. And information about moderate to large earthquakes in some locations can take 15-20 minutes to arrive in the hands of those who want or need it. Larger earthquakes mean more data from more seismic stations, and that means a longer processing time for the monitoring system and the seismologist reviewing it.

Only a few decades ago, this same information would’ve taken several days to determine. Drive to the seismic station, retrieve the photographic film, bring it back to the lab, process it. With several earthquake recordings in hand and a ruler, measure the height of the wiggles and the time between the wiggles recorded at each station, and then triangulate on a location and estimate a magnitude. Today’s computer and communication technologies have mostly automated this process and made it much faster. Even so, seismologists manually review automated earthquake locations and magnitudes to make corrections when warranted because sometimes computer programs make mistakes. In a recent study, Yeck’s research team explored deep learning as a way to improve the automated earthquake monitoring program used by the National Earthquake Information Center (NEIC) so that there would be fewer mistakes and ultimately reduce the need for manual reviews.



The Latest Earthquakes webpage on the USGS Earthquake Hazards Program website publishes earthquakes processed by the NEIC monitoring system (as well as those contributed by cooperating regional seismic networks) in near real-time, within minutes after earthquakes occurs (Public domain.)

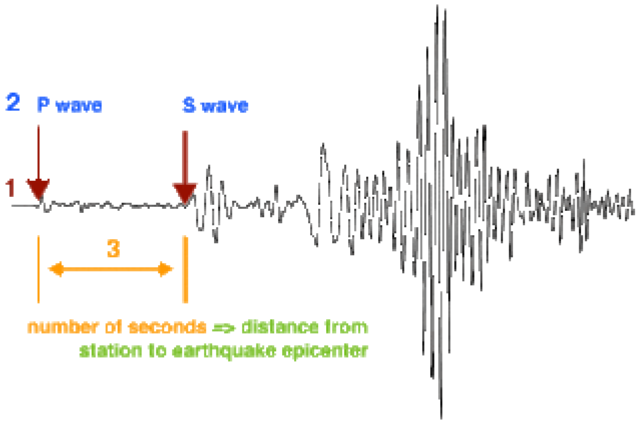


An example of a continuous seismic signal recorded at the Global Seismographic Network (GSN)/USGS station DAV (Davao, Philippines). An STA/LTA detector will tag the 3 arrival times indicated by the red arrows since the signals following those times are different than the background signal. (Public domain.)

The NEIC processes M2.5+ earthquakes in the U.S. and M4.5+ earthquakes across the globe. This amounts to about 30,000 earthquakes each year. NEIC's automated processes continuously monitor signals from seismic stations around the world to detect changes that look different than the background noise using what is called a short-term average/long-term average (STA/LTA) detector. The system tags the detection times of seismic wave arrivals at each station and tries to associate the detections from individual stations into a single dataset for a possible earthquake. The system then identifies the type of seismic wave, determines the location of the earthquake, and estimates the earthquake's magnitude. Seismologists validate the automated arrival times to make corrections and adjustments to improve the accuracy of the earthquake location and magnitude before the earthquake information is distributed to mobile phones, sent to email addresses, and published to the USGS Earthquake Hazards Program website.

One of the most common problems with this type of system is unwanted associations. STA/LTA detectors don't just detect earthquakes; they also detect other signals generated by things such as wind, cars, trains, and other sources of seismic vibrations. The association process can combine these non-seismic signals into false events. In addition, poor estimates of seismic wave arrivals can result in poor earthquake locations. A seismologist must then spend a fair amount of time cleaning up the false events and poor arrival times. Reducing the amount of human intervention needed could potentially shave minutes off the time between the earthquake happening and the earthquake being reported.

The NEIC monitoring system is a perfect candidate for deep learning because it processes large amounts of data, and that's where deep learning excels. What is deep learning? In the most general terms, deep learning is a computer process that can take in large amounts of data and learn from it. This exercise is referred to as "training", and the outcome is a model that contains useful information. A model is a mathematical approximation of a real thing that can be used to represent that thing in computations.

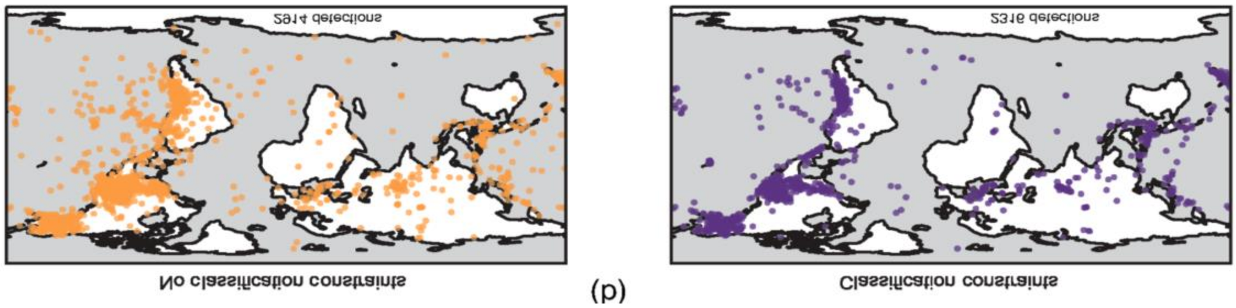


In this example of an earthquake recording, the three deep-learning models focus on 1) finding the arrival times of the seismic waves, 2) identifying the P-waves and S-waves, and 3) determining the distance from the station to the earthquake epicenter from the number of seconds between the P-wave and S-wave arrival times. (Public domain.)

Yeck and his research team sought to find out if a deep-learning approach could perform better than NEIC's traditional STA/LTA data processing methods to get more accurate earthquake locations and magnitudes. Instead of throwing out the current STA/LTA system and replacing it with a fully deep-learning-based system, the researchers set out to see if the information from deep-learning models could be fed back into the conventional STA/LTA system as additional data that might improve the processing results. NEIC researchers trained a machine-learning algorithm using a dataset from of about 1.3 million seismic wave arrival times for 136,716 earthquakes that occurred during 2013 to 2019. Three different models were created from the data, including: 1) the seismic wave arrival times, 2) the type of seismic signal (P-wave, S-wave, or noise), and 3) the distance between the earthquake and the seismic station.

The model results were compared to a test dataset of cataloged earthquakes considered to be the "ground-truth" in order to evaluate the performance of the models. The results gave a mean error of 0.57 seconds for the pick arrival times, 92.8 % accuracy for the signal types, and 82.4 % accuracy on the earthquake to station distances. The models were almost as good as the automatic results that had been checked and adjusted by seismologists!

Next, the scientists tested the three models by incorporating them into a copy of the NEIC processing system running in parallel with NEIC's operational system. The test system produced fewer unwanted associations, detected a similar but slightly higher number of earthquakes overall, and calculated more accurate earthquake locations and magnitudes. Altogether this means the system using deep-learning data resulted in far fewer errors for a seismologist to spend time fixing, which means the earthquakes could be reported faster. Success!



Both images show earthquakes as dots on a world map. The earthquake locations on the left are those from the NEIC's automatic SLA/LTA detection system, and those on the right are after the addition of the deep-learning model data. Less scatter in the locations on the right indicate more accurate earthquake locations. (Public domain.)

One of the challenges of using deep learning for global earthquake monitoring is that very large earthquakes occur relatively infrequently and therefore are underrepresented in the training data. That means these models work best for the more common smaller events, while traditional detection methods may be best for larger, rare, events. The USGS scientists plan to explore ways to incorporate more deep-learning models into NEIC's automatic earthquake processing system to address the infrequent large events and make further improvements in the future. Maybe some day all earthquake information, regardless of location or magnitude, will be available in only a few minutes, or even seconds, after the shaking stops.

- written by Lisa Wald, USGS, March 12, 2020

https://www.usgs.gov/natural-hazards/earthquake-hazards/science/improving-earthquake-monitoring-deep-learning?qt-science_center_objects=0#qt-science_center_objects

Exercise 7.
Read the text and write a resume.

Download Google Earth Free
Learn what you can do with Google Earth!

What is Google Earth?

Google Earth is a free program from Google that allows you to "fly" over a virtual globe and view the Earth through high-resolution graphics and satellite images. It is greatly superior to **static maps** and **satellite images**. Google Earth gives you a drone's eye view of the world below.

Google Earth is the world's most detailed globe and one of the most frequently downloaded programs in the history of the internet. Within minutes you will be zooming in on your hometown and taking visual excursions to our planet's most visited or most remote places.

The images are detailed enough that in most populated areas you can clearly see your house, objects in your yard, and often recognize your car parked along the street. A digital elevation model within Google Earth allows you to view the landscape of many geographic areas in 3D.

Recent Images, Updated Regularly

Most of the images in Google Earth were acquired within the past three years, and Google is continuously updating the image set for different parts of the Earth. Large cities generally have more recent and higher resolution images than sparsely inhabited areas.

A misconception exists among some people that the images displayed in the Google Earth program are live-updated directly from satellites. This is not the case. The images are acquired by satellites, processed by commercial image providers or government agencies, and then updated to the Google Earth image database in batches.

However, Google and its image providers do have the ability to rapidly integrate new images into the program. This is sometimes done in emergency situations - such as when an area has been hit by a natural disaster and new images would be of valuable assistance to the recovery and relief efforts.

A Free Download

Google Earth is a free downloadable program that you install on your Windows, Mac, or Linux desktop or laptop computer. The program requires very little space on your hard drive because the images are stored on Google's servers and streamed to your computer upon demand.

Google Earth is also available as a browser plug-in and as a mobile app. Google has been offering the program for free and improving it regularly since 2005. It has been downloaded over one billion times.

Did You Know? Most people don't realize that Google Earth works on Android and iOS devices (iPhone and iPad). The Android version can be downloaded from the Google Play Store. The iOS version can be downloaded from the App Store or iTunes. Image copyright iStockphoto / Savcoco

- **High-resolution satellite images.**
- **Recent images for most locations.**
- **Easy & safe to download and install.**
- **Do fly-overs of anywhere on Earth.**
- **Use on desktop, tablet or phone.**
- **Zoom in on your house!**
- **Free, easy to use.**

Download Google Earth ▶

The button above takes you to the Google website where you can download Google Earth software for free. We frequently use Google Earth for research, learning, and fun! We receive no compensation from Google for recommending their service. We are simply enthusiastic users of the Google Earth product. Hope you enjoy!

Find Your Car! Google Earth images are so detailed that you might be able to spot your car in the office parking lot! But, keep in mind that the data is not live-updated from satellites. The image might show where you were parked last month or last year!

Easy-to-Install

Google Earth will install on most computers with just a few clicks. Most people are surprised to learn that Google Earth will even work on their tablet computer or phone. Take it with you while traveling to check out beaches, neighborhoods, fishing locations, hiking areas, and much more.

Easy-to-Navigate

When you launch the Google Earth program on your computer or mobile device it will display an image of the Earth from space. You can easily use the controls to "fly" down and find your location. However, if you are in a hurry, you can simply search for an address or the name of a landmark or the geographic coordinates. Google Earth will quickly "fly" you right to your destination.

Seldom-Seen Places: Some people believe that Google Earth provides too much information about important buildings, which might lead to security concerns. Others believe that Google Earth allows close-up views of their property which violate their privacy.

Developed for the CIA?

Google Earth was originally called "Earth Viewer 3D." It was developed by Keyhole, Inc., a company funded by the Central Intelligence Agency (CIA). The software was developed to be a program for "browsing the earth" - and that is exactly what it does.

Google purchased Keyhole in 2004, and with that acquisition it obtained Earth Viewer 3D, which it improved and distributed free to the public starting in 2005. Get your free copy of Google Earth using the blue button below.

https://geology.com/google-earth/

Exercise 8.

Read the text and write a resume.

Mount Etna – Italy

Article by Jessica Ball

Mount Etna night eruption: A night photo of Mount Etna producing an eruption of glowing ejecta in 2008. These spectacular eruptions can be seen from many parts of Sicily. Image copyright iStockphoto / Frizi.

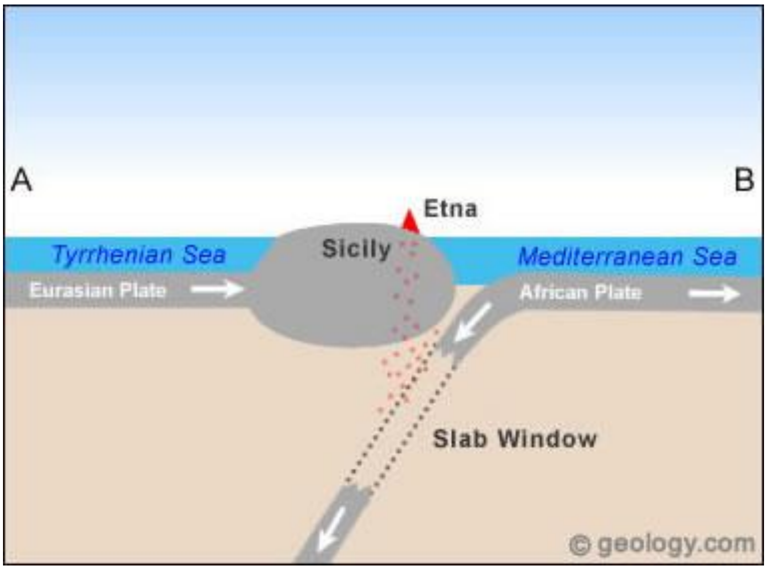
Mount Etna: Introduction

Mount Etna is the highest and most active **volcano** in **Europe**. Towering above the city of Catania on the island of Sicily, it has been growing for about 500,000 years and is in the midst of a series of eruptions that began in 2013.

Etna has displayed a variety of **eruption styles**, including violent explosions and voluminous **lava flows**. More than 25 % of Sicily's population lives on Etna's slopes, and it is the main source of income for the island, both from agriculture (due to its rich volcanic soil) and tourism.

Where is Mount Etna? Map showing the location of Mount Etna on the east coast of Sicily. Map by Geology.com and MapResources.

Nearby Volcanoes: Stromboli, Vesuvius



Simplified plate tectonics cross section showing how Mount Etna is located above a subduction zone formed where the Eurasian and African plates collide. In this subduction zone, a window has torn in the subducting slab.

Mt. Etna: A view of snowcapped Mount Etna. Image copyright iStockphoto / Domenico Pellegriti.

Mount Etna: Plate Tectonic Setting

Mount Etna is associated with the subduction of the African plate under the Eurasian plate, which also produced **Vesuvius** and Campi Flegrei, but is part of a different volcanic arc (the Calabrian rather than Campanian). A number of theories have been proposed to explain Etna's location and eruptive history, including rifting processes, a hot spot, and intersection of structural breaks in the crust. Scientists are still debating which best fits their data, and are using a variety of methods to build a better image of the Earth's crust below the volcano.

Ruins of a small house partially buried by volcanic debris from Mount Etna. Image copyright iStockphoto / Peeter Viisimaa.

-- In 122 BC, when an explosive eruption rained so much ash and lapilli onto the town of Catania that many of its buildings were destroyed by roof collapses, the town's inhabitants were exempted from paying taxes to Rome for ten years.

-- There have been two attempts to control the path of lava flows threatening to destroy the town of Catania. The first was in 1669, and the second was in 1992. During the 1992 attempt, the United States Marines worked with Italian volcanologists to develop "Operation Volcano Buster", in which they used explosives to blast a hole in a lava tunnel on Etna's flank and then dropped large blocks of concrete into the hole to try and stem the flow of the lava. Like the 1669 attempt, however, this plan was ultimately unsuccessful.

Mount Etna Geology and Hazards

Mount Etna consists of two edifices: an ancient shield volcano at its base, and the younger Mongibello stratovolcano, which was built on top of the shield. The **basaltic** shield volcano eruptions began about 500,000 years ago, while the stratovolcano began forming about 35,000 years ago from more trachytic lavas. The volcano's slopes currently host several large **calderas** which formed when the roofs of magma chambers collapsed inward, including the east-facing, horseshoe-shaped Valle de Bove.

Etna's current activity consists of continuous summit degassing, explosive Strombolian eruptions, and frequent basaltic lava flows. **Ash clouds** from the explosive eruptions are especially hazardous to aircraft, since ash that is pulled into a jet engine can melt, coat moving parts with a layer of glass, and cause the engine to shut down. These dangerous ash clouds are often visible from space.

Facts About Mount Etna

Location:	Island of Sicily, Italy
Coordinates:	37.734ºN, 15.004ºE
Elevation:	3,330 m (10,925 ft)
Volcano Type:	Stratovolcano
Last Eruption:	Ongoing
Nearby Volcanoes:	**Stromboli** **Vesuvius**

Etna has also produced pyroclastic flows, **ashfalls**, and mudflows, but the lava flows are the most immediately hazardous type of activity, especially to the city of Catania.

The lava flows themselves usually do not move fast enough to threaten humans, they can cover large areas and destroy crops and buildings. In the event of a large flank (fissure) eruption, evacuating the inhabitants of towns and cities near the volcano would be a huge challenge.

Mount Etna ash plume: An oblique photograph of Mount Etna looking to the southeast taken by astronauts onboard the International Space Station on October 30, 2002. The dark plume rising from the top of the volcano is an ash cloud. The broad white cloud streaming from areas of lower elevation is smoke produced by forest fires ignited as a hot lava flow moved through a pine forest. The ash and smoke caused air traffic to be diverted and forced the closing of roads, schools and businesses. Larger Image.

Mount Etna ash plume: An oblique photograph of Mount Etna on the west coast of the island of Sicily. This photo is looking to the southeast with the Mediterranean Sea in the background and was taken by astronauts onboard the International Space Station on October 30, 2002. The scene shows the ash plume from the eruption being carried by wind across the Mediterranean Sea to Libya, over 350 miles away. Larger Image.

A Sicilian vineyard growing in the shadow of Mount Etna. The inhabitants of Sicily must balance the advantage of rich volcanic soil with the dangers of losing their crops and farms to an eruption from the still-active volcano. Image copyright iStockphoto / Domenico Pellegriti.

Mount Etna: Eruption History

Etna's eruptions have been documented since 1500 BC, when phreatomagmatic eruptions drove people living in the eastern part of the island to migrate to its western end. The volcano has experienced more than 200 eruptions since then, although most are moderately small. Etna's most powerful recorded eruption was in 1669, when explosions destroyed part of the summit and lava flows from a **fissure** on the volcano's flank reached the sea and the town of Catania, more than ten miles away. This eruption was also notable as one of the first attempts to control the path of flowing lava.

The Catanian townspeople dug a channel that drained lava away from their homes, but when the diverted lava threatened the village of Paterno, the inhabitants of that community drove away the Catanians and forced them to abandon their efforts.

An eruption in 1775 produced large lahars when hot material melted snow and ice on the summit, and an extremely violent eruption in 1852 produced more than 2 billion cubic feet of lava and covered more than three square miles of the volcano's flanks in lava flows. Etna's longest eruption began in 1979 and went on for thirteen years; its latest eruption began in September 2013, and is still ongoing.

More Etna Information

Smithsonian Institution Global Volcanism Program: **Etna page**.

Gates, A.E. and Ritchie, D., 2007, Encyclopedia of Earthquakes and Volcanoes, Third Edition: New York, NY, Checkmark Books, 346 p.

Chester, D.K., 1985, Mount Etna: The Anatomy of a Volcano: Stanford, CA, Stanford University Press, 404 p.

Instituto Nazionale di Geophisica e Vulcanologia, Sezione di Catania (National Institute of Geophysics and Volcanology, **Catanian Section**)Italy's Volcanoes: **The Cradle of Volcanology Website** "**Zafferana Etnea Journal**: It's Plug Up Mt. Etna or Go the Way of Pompeii." New York Times article, April 25, 1992.

About the Author

Jessica Ball is a graduate student in the Department of Geology at the State University of New York at Buffalo. Her concentration is in volcanology, and she is currently researching lava dome collapses and pyroclastic flows. Jessica earned her Bachelor of Science degree from the College of William and Mary, and worked for a year at the American Geological Institute in the Education/Outreach Program. She also writes the **Magma Cum Laude blog**, and in what spare time she has left, she enjoys rock climbing and playing various stringed instruments.

https://geology.com/volcanoes/etna/

Exercise 9.
Read the text and write a resume.

What is a Geyser?

Article by: Hobart M. King, PhD, RPG

Old Faithfu geyser of Yellowstone National Park blasts water about 150 feet into the air. copyright iStockphoto / Zuki.

What is a Geyser?

A geyser is a vent in Earth's surface that periodically ejects a column of hot water and steam. Even a small geyser is an amazing phenomenon; however, some geysers have eruptions that blast thousands of gallons of boiling-hot water up to a few hundred feet in the air.

Old Faithful is the world's best-known geyser. It is located in Yellowstone National Park (USA). Old Faithful erupts every 60 to 90 minutes and blasts a few thousand gallons of boiling-hot water between 100 and 200 feet into the air.

Conditions Required for a Geyser

Geysers are extremely rare features. They occur only where there is a coincidence of unusual conditions. Worldwide there are only about 1000 geysers, and most of those are located in Yellowstone National Park (USA).

Conditions Required for Geysers
1) hot rocks below
2) an ample groundwater source
3) a subsurface water reservoir
4) fissures to deliver water to the surface

El Tatio: Geysers of El Tatio, northern Chile. Image copyright iStockphoto / Rob Broek.

Lady Knox: Eruption of Lady Knox Geyser, New Zealand. Image copyright iStockphoto / Halstenbach.

Where are Geysers Found?

Most of the world's geysers occur in just five countries: 1) the **United States**, 2) **Russia**, 3) **Chile**, 4) **New Zealand**, and 5) **Iceland**. All of these locations are where there is geologically recent volcanic activity and a source of hot rock below.

Geysers in the United States
Umnak Island, Alaska
Kanaga Island, Alaska
Lassen Volcanic National Park, California
Long Valley Caldera, California
Hot Creek and Little Hot Creek, California
Morgan Springs, California
Salton Sea, California (extinct)
Beowawe Geyser Field, Nevada (extinct)
Black Rock Desert, Nevada
Great Boiling Springs, Nevada
Steamboat Springs, Nevada (extinct)
Mickey Hot Springs, Oregon

Countries With Active Geysers
1) United States - Yellowstone National Park
2) Russia - Dolina Geiserov
3) Chile - El Tatio
4) New Zealand - Taupo Volcanic Zone
5) Iceland - Many locations

Strokkur Geyser is one of Iceland's most famous. It erupts to heights of seventy feet every ten to twenty minutes. Image copyright iStockphoto / Tetra2000.

Map of Active Geyser Fields

Map showing the location of world countries with active geyser fields.

Yellowstone's Old Faithful: YouTube video of Old Faithful Geyser in eruption at Yellowstone National Park. Note how many people are present to witness the eruption!

Iceland's "Strokkur Geysir": YouTube video of Iceland's Strokkur Geyser in eruption. Strokkur erupts to heights of up to 70 feet about every 10 to 20 minutes.

Steamboat Geyser of Yellowstone National Park. A rare eruption photo taken in 1961 by E. Mackin, National Park Service.

Yellowstone Geysers Eruption Intervals, Duration, Heights			
Location	**Average Interval**	**Duration**	**Height (ft)**
Old Faithful	65 or 92 min	1.5-5 min	106-184
Artemisia	irregular	5-25 sec	30
Aurum	2-4 hours	70 sec	20
Baby Daisy	35-55 min	3 min	25
Beehive	12-18 hours	5 min	150+
"Boardwalk"	irregular	5-10 min	20
Castle	12.5 hours	15-20 min	75
Daisy	2.5 hours	3.5 min	75
Depression	5-9 hours	6 min	10
Echinus	irregular	3-5 min	30+
Fan & Mortar	6-10 days?	45 min	100+
Fountain	5.5 hours	9 min	78
Giant	last eruption 9/28/15	1 hour	200+
Giantess	last eruption 1/30/14	4-48 hours	150+
Grand	8.5 hours	8-12 min	160+
Great Fountain	12.5 hours	45 min	70-200+
Lion - initial to initial	about 8 hours	1-7 min	60

Lion - within series	about 90 min	3-5 min	30
Little Cub	about 55 min	10 min	5
Plate	3.5-4 min	4 min	5
Plume	recent periods of dormancy	1 min	25
Riverside	6.25 hours	20 min	75
Steamboat	recently, several days	10+ min	300+
Data from National Park Service (Measurements done in 2002)			

How Often Do Geysers Erupt?

Most geysers erupt irregularly and infrequently. However, a few are known for regular eruptions. The most famous, named "Old Faithful" in recognition of its regular eruptions, is located in Yellowstone National Park (USA) and erupts about every 60 to 90 minutes. More details on the eruption intervals of Yellowstone geysers are given in the table below.

Old Faithful is Getting Slower

Research done at the United States Geological Survey suggests that long-term drought conditions in the Yellowstone area have lengthened the time interval between Old Faithful's eruptions. The delay is thought to be caused by a smaller water supply.

California's Old Faithful: The United States has two "Old Faithful" geysers, both of which produce predictable eruptions. This one is near Calistoga, California. Image copyright iStockphoto / Stephan Hoerold.

Old Faithful Hasn't Always Been Faithful

Old Faithful Geyser was named in the late 1800s when people observed that it erupted on a predictable schedule. Its eruption schedule has changed little since the name was given.

However, the geyser might not have erupted at all during parts of the 13th and 14th centuries. This was discovered after pieces of **mineralized wood** were found embedded in Old Faithful's geyser mound. Trees do not grow on active geyser mounds, so the wood indicated a period of geyser inactivity. The wood was dated by the United States Geological Survey to have lived between 1233 and 1362 CE.

Tree-ring records of the Yellowstone area reveal a severe drought during the 13th and 14th centuries. This suggests that gaps in Old Faithful's eruption history were caused by drought. [1]

Great Fountain: Great Fountain Geyser at sunset, Yellowstone National Park. Image copyright iStockphoto / Geoff Kuchera.

Which Geyser is the World's Largest?

The tallest active geyser in the world is **Steamboat Geyser** in Yellowstone National Park. Some of its eruptions blast water as high as 400 feet into the air. Steamboat Geyser has been extremely active since 2018, with only days between eruptions (rather than years). If you want to see the world's tallest geyser in action, there has never been a better time to visit Yellowstone!

Waimangu Geyser in New Zealand used to be the tallest geyser in the world. Its eruptions were spectacular, blasting jets of water up to 1600 feet in the air.

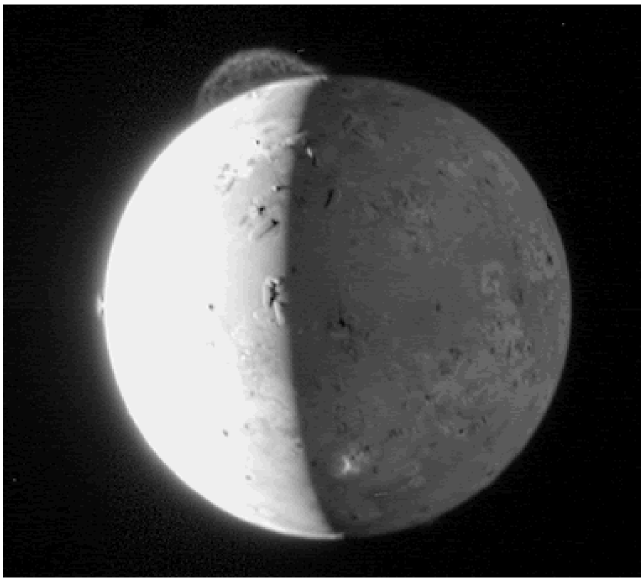
Unfortunately, a landslide altered the hydrology around Waimangu, and it has not erupted since 1902.

Geyser Strokkur erupts: a sequence of three photos showing an eruption of Geyser Strokkur, Iceland's most famous geyser. Image copyright iStockphoto / Christoph Achenbach.

How Do Geysers Work?

To understand how a geyser works, you must first understand the relationship between water and steam. Steam is a gaseous form of water. Steam is produced when water is heated to its boiling point. When water converts into steam at surface conditions, it undergoes an enormous expansion because steam occupies 1600 times as much space as the original volume of water. The eruption of a geyser is powered by a "steam explosion" when boiling-hot water suddenly expands into the much more voluminous steam.

To summarize: a geyser erupts when superheated groundwater, confined at depth, becomes hot enough to blast its way to the surface.



Geyser-like eruption on Jupiter's moon, Io: Eruption of Tvashtar, a "geyser" on Jupiter's moon, Io. NASA Image.

Here's what happens in the ground...

Cool groundwater near the surface percolates down into the earth. As it approaches a heat source below, such as a hot **magma chamber**, it is steadily heated towards its boiling point. However, at the boiling point the water does not convert into steam. This is because it is deep below the ground, and the weight of cooler water above produces a high confining pressure. This condition is known as "superheated" - the water is hot enough to become steam - it wants to become steam - but it is unable to expand because of the high confining pressure.

At some point the deep water becomes hot enough, or the confining pressure is reduced, and the frustrated water explodes into steam in an enormous expansion of volume. This "steam explosion" blasts the confining water out of the vent as a geyser.

Geyser Information

[1] **A Time When Old Faithful Wasn't So Faithful**: An article on the website of the United States Geological Survey, published October 12, 2020.

Lost Russian Geysers

The "Valley of Geysers", located on the Kamchatka Peninsula of far eastern Russia, is the world's second-largest concentration of geysers. It is located in one of the most volcanically active areas of the world, and nearby **volcanoes** serve as a heat source for the geyser activity.

The Valley of Geysers originally had nearly 100 geysers and dozens of hot springs, in a valley less than four miles long (6.4 kilometers). It is part of the UNESCO "Volcanoes of Kamchatka" World Heritage site. The geysers and thermal features of this spectacular area have been poorly studied because the southern end of the Kamchatka Peninsula is so remote and hard to access. Very few people have been there to see the geysers.

Unfortunately, on June 3, 2007, a large **mudflow** overran about half of the valley, covering many of the geysers, hot springs, thermal pools, and waterfalls. Debris from the landslide blocked the flow of the Geysernaya River. A thermal lake, fed by the flow of hot springs from nearby volcanoes, is now located on the upstream side of the landslide dam.

https://geology.com/articles/geyser.shtml

Test

Task 1.

Find the scientific text in your specialty and write a summary.

Task 2.

Find the scientific text in your specialty and write a resume.

VOCABULARY

aligned rows – ровные ряды

array – массив

aside –- в сторону

bedded – пластовой

beds –- пласты

belch up –- изрыгать

belt – пояс

bleak -– мрачный

bulge –- выпуклость

bump – врезаться

burp – извержение, выброс

burst – взрыв

butt up – соединять впритык

campfire – походный костер

carbonate –- карбонат

carve –- отрезать

charred –- обугленный

chromium –- хром

clastic sediment – обломочные отложения

compounds – соединения

core – ядро

craft – мастерить

debris – развалины

denudation – обнажение

descending – нисходящий

detrital rock – обломочная порода

diagenesis – диагенез

dip – провал

dissolution – растворение

dissolved constituent – распущенный состав

distinctive – выраженные

drift – сдвиг

Earth's crust – земная кора

effusive – экспансивный

elastic wave – упругая волна

enabling – позволяющий

entire – весь

erosion – эрозия

fault-related hazard – опасность, связанная с неисправностью

faults – недостатки

faux amphibolite – искусственный амфиболит

fixed – неподвижный

flank – сторона

fluffy – пушистый

folds – складки

Geochemistry – геохимия

geodesy – геодезия

geological unit – геологическая единица

geomorphology – геоморфология

greenstone – нефрит

Growth faulting – недостаток роста

halite – галит

heed – прислушиваться

horseshoe-shaped zone – подковообразная зона

IET graduate – Выпускник института

igneous – магматический

igneous rock – магматическая порода

imminent – неизбежный

infamous – печально известный

inhale – вдыхать

inorganic – неорганический

internal – внутренний

kernel density distribution map – карта распределения плотности ядра

lahar – лахар

large-scale groundwater withdrawal – крупномасштабный забор подземных вод

Late Imbrian – Поздний Имбриан

lava – лава

lead – свинец

limestone – песчаник

lithification – литификация

lithify – литифицировать

magma – магма

mare area – общая площадь

maturity – зрелость

metamorphic – метаморфический

metamorphic rock – метаморфическая порода

mineralogy – минералогия

molten rock – расплавленная порода

mudflow – сель

nuclear density map – карта ядерной плотности

outage – перерыв

overdue – запоздалый

pending eruption – ожидание извержения

plate boundaries – границы плиты

plate tectonics – тектоника плит

plunge – погружение

pose – представлять

post-eruption – после извержения

precipitation – осадок

precise – точный

race -– гонка

ratio calculation – расчет коэффициента

reawaken – пробудиться

rock cycle – цикл горных пород

runny – текучий

salt dome – соляной купол

sediment – осадок

sedimentary – осадочный

sedimentary rock – осадочная порода

shale -– сланец

shape index – индекс формы

shatter –разбить вдребезги

shovel away – отгребать подальше

slumbering – дремлющий

solid – твердый

solvent – сольвент

spatial point –пространственная точка

stalactite – сталактит

stalagmite -– сталагмит

stir – мешать

stratigraphy – стратиграфия

subduction – субдукция, поддвиг; движение по разломам

subduction zone – зона движения по разломам

subduction zone – зона субдукции

successive intervals – последовательные интервалы

swell – раздуться

technical synergism – технический синергизм

thrive – процветать

tick by – протекать

tip – совет

to be composed of – состоять из

to elucidate – разъяснять

to yield – уступать

unconsolidated – рыхлый

uplift – подъем

vent – выходное отверстие

viscous – вязкий

wearing down – износ

weathering – выветривание

weathering – выветривание

wipe out – уничтожать

KEYS

Unit 1

Exercise 1.

1. e
2. i
3. a
4. b
5. h
6. j
7. f
8. c
9. g
10. d

Exercise 2.

1. c
2. j
3. a
4. e
5. g
6. b
7. i
8. d
9. f
10. h

Exercise 3.

1. f
2. c
3. e
4. a
5. j
6. d
7. b
8. g
9. i
10. h

Exercise 4.

1. Modern geology uses a wide range of traditional and technological methods, making it even more accurate and able to produce more data, faster and more accurately than ever before.

2. Stratigraphy: Used in a wide variety of Earth Sciences / Geosciences, stratigraphy is the study of the layers that make up a geological topography.

3. Each sequence in a layer generally came after the one beneath it.

4. A stratigraphic layer does not represent a period of time, merely a place in a sequence.

5. Remote sensing and satellite imagery: Another tool used in many Earth Sciences and not just geology, it's the use of technology to define and locate features and to map locations over a broad area.

6. They collect data, sometimes through images, sometimes through heat signatures, resistance signatures (for material density - suggestive of metal ore deposits).

7. Geophysics: Looking beneath the surface of the Earth without physical investigation, geophysical survey is similar to remote sensing, but it works on a much smaller scale.

8. Geographic Information Systems: Also known as GIS, this applied science of using information technology with any geographical data allows for visual representation such as digital maps and statistical analyses using database information taken over small or large areas.

9. Geological modelling: Using such tools as information taken from geodesy, remote sensing, geophysical survey, GIS, geologists in most subdisciplines are able to build up digital profiles of a small or large geological area for most applications.

10. It integrates many areas of geology and subdisciplines to create an integrative information source.

Exercise 5.

1. Geology is the study of the Earth's physical structure, its history and the processes that act on it.
2. Geologists are scientists that are trying to learn about the history of the earth through studying the rocks that make it up and understand the changes that the planet is undergoing.
3. There are three categories: sedimentary, metamorphic and igneous rocks.
4. They are called the rock cycle.
5. We can watch the formation of igneous rocks in real time.
6. There are over 1500 volcanoes.

7. The major parts of the Earth are the crust, the mantel and the core.
8. We can see the formation of the igneous rocks on the big island of Hawaii.
9. Basalt is a common rock.
10. Granit is a kind of igneous rock. It takes a long time to cool and its crystals are large.

Unit 2

Exercise 1.

1. k
2. i
3. b
4. f
5. h
6. a
7. j
8. g
9. d
10. l
11. n
12. o
13. e
14. m
15. c

Exercise 2.

1. e
2. j
3. g
4. a
5. i
6. b
7. d
8. c
9. f
10. h

Exercise 3.

1. g
2. c
3. a
4. d
5. b
6. j
7. e
8. h
9. f
10. i

Exercise 4.

1. Sedimentary rocks are formed on or near the Earth's surface, in contrast to metamorphic and igneous rocks, which are formed deep within the Earth.
2. The most important geological processes that lead to the creation of sedimentary rocks are erosion, weathering, dissolution, precipitation, and lithification.
3. Erosion and weathering include the effects of wind and rain, which slowly break down large rocks into smaller ones.
4. Erosion and weathering transform boulders and even mountains into sediments, such as sand or mud.
5. Dissolution is a form of weathering—chemical weathering.
6. Precipitation and lithification are processes that build new rocks or minerals.
7. With this process, water that is slightly acidic slowly wears away stone.
8. Precipitation is the formation of rocks and minerals from chemicals that precipitate from water.
9. For example, as a lake dries up over many thousands of years, it leaves behind mineral deposits; this is what happened in California's Death Valley.
10. Lithification is the process by which clay, sand, and other sediments on the bottom of the ocean or other bodies of water are slowly compacted into rocks from the weight of overlying sediments.

Exercise 5.

1. to understand how rocks form today
2. a technical word geologists use to describe a rock fragment
3. the individual feldspar minerals
4. by transportation agents such as streams
5. during the dust bowl era of the 1930s

6. the dark surface on the Reid Glacier in Alaska
7. conglomerate forms from rounded gravels
8. to precipitate out of seawater
9. such as corals, clams and oysters
10. in environments such as lagoons and groundwater systems

Unit 3

Exercise 1.

1. F
2. T
3. F
4. F
5. T
6. T
7. F
8. F
9. F
10. T

Exercise 2.

1.c
2.g
3.b
4.j
5.a
6.e
7.d
8.i
9.f
10. h

Exercise 3.

1. Metamorphosis
2. Sedimentary
3. Igneous
4. Pressure
5. Liquid
6. Magma

7. Lava
8. Earth
9. Crust
10. Plate

Exercise 4.

1. a
2. b
3. c
4. a
5. a
6. b
7. b
8. c
9. c
10. a

Exercise 5.

1. e
2. b
3. c
4. g
5. f
6. a

Exercise 6.

1. e
2. a
3. i
4. b
5. d
6. g
7. c
8. h
9. f
10. j

Exercise 7.

1. a
2. b
3. c
4. a
5. a
6. b
7. b
8. c
9. c
10. a

Unit 4

Exercise 1.

1. Геологическое строение Земли
2. Чтобы жизнь процветала
3. Взрывная сила
4. унылые пейзажи
5. плодородные почвы
6. считается потенциально активным
7. взрывные извержения
8. активность расплавленных пород
9. Эффузивные извержения
10. Запереть газы

Exercise 2.

1. Creation – создание
2. Foundation – основание
3. Liberation – освобождение
4. Flourishment – процветание
5. Eruption – извержение
6. Escape – побег
7. Formation – образование
8. Subduction – субдукция
9. Continuation – продолжение
10. Building – строение

Exercise 3.

1. b
2. d
3. c
4. e
5. h
6. a
7. g
8. f

Exercise 4.

1. They've created more than 80 percent of our planet's surface, laying the foundation that has allowed life to thrive.

2. There are volcanoes on every continent, even Antarctica.

3. The majority of volcanoes in the world form along the boundaries of Earth's tectonic plates—massive expanses of our planet's lithosphere that continually shift, bumping into one another.

4. As the descending landmass sinks deep into the Earth, temperatures and pressures climb, releasing water from the rocks.

5. Some 75 percent of the world's active volcanoes are positioned around the ring of fire, a 25,000-mile long, horseshoe-shaped zone that stretches from the southern tip of South America across the West Coast of North America, through the Bering Sea to Japan, and on to New Zealand.

6. This region is where the edges of the Pacific and Nazca plates butt up against an array of other tectonic plates. Importantly, however, the volcanoes of the ring aren't geologically connected.

7. One particular danger is pyroclastic flows, avalanches of hot rocks, ash, and toxic gas that race down slopes at speeds as high as 450 miles an hour. Such an event was responsible for wiping out the people of Pompeii and Herculaneum after Mount Vesuvius erupted in A.D. 79.

Similarly, volcanic mudflows called lahars can be very destructive. These fast-flowing waves of mud and debris can race down a volcano's flanks, burying entire towns.

Ash is another volcanic danger.

8. Unlike the soft, fluffy bits of charred wood left after a campfire, volcanic ash is made of sharp fragments of rocks and volcanic glass each less than two millimeters across.

9. It's impossible to say exactly when, or even if, any given volcano will erupt.

10. Warning signs include small earthquakes, swelling or bulging of the volcano's sides, and increased emission of gasses from its vents.

Exercise 5.

1. A
2. B
3. C
4. A
5. A
6. B
7. B
8. C
9. C
10. A

Exercise 6.

Your commentator is Robert Stevenson.

Vesuvius explodes Italy's historic volcano bursts into the most fearsome and devastating eruption in 70 years over the fiery crater a great ball of smoke and lava dust spirals into the sky. A giant specter of endless grief for the Italian people suffering under many years of brutal fascism then German occupation then Allied bombing then the devastation of battle now it is Vesuvius.

At least once in every century of the Christian era it is hurl disaster. The city of Pompeii was buried when the huge mountain first thundered into volcanic life in the year 79 AD. Thousands of Italians perish excavations have revealed their tragic story. This was a pleasure resort of wealthy Romans almost nineteen hundred years ago rising four thousand feet above the fertile plain of Campania.

Vesuvius lazily pours for for harmless curtain of smoke. Naples 10 miles from the slumbering peak lies in comparative safety except for the deluge of volcanic ash that will blanket the city. Then with a few warning rumbles the Silvius belches fire flame and molten rock and a fearsome spectacle thumbs of ashen cinders are borne skyward while fiery lava streams now near to the doomed valleys. The overflowing crater erupts with a mounting temperature of liquid steel close to the summit which carries its fiery heat long after it loses incandescent.

The Italian people are stuffed the crushing mass of lava moves relentlessly for towns in the valley. An all-consuming force from 30 to 90 feet high throwing off terrific heat and sulfurous fumes as it ignites everything combustible in its path venture.

Some youngsters linger too long in the danger zone and have to run for it. A wall of lava sweeps on frightened Italians fry barricades of brush hoping to check the cooling edge of the flood until it may solidify and build up a dam but man's weak efforts against this monstrous force or hopeless mushrooming into the sky.

The enormous gray black pall of smoke fills the air with cinders for miles around from fiery regions far deeper in the earth than any mine ever dug by man. A hot lava is a reminder that the earth was once just such a molten mass gradually cooling until it formed an outer shell.

This phenomenon is simply a weak spot in the shelf from the flaming depth the liquid rock is forced to the surface by the pressure of the Earth's crust as it boils from the crater of Vesuvius.

Lava may have a temperature of more than 2,000 degrees Fahrenheit and in this major eruption it blows carries the terrific heat far down the slopes of the mouth. It carries a crushing weight that doom cities in town. So there no 17 miles away is buried in lava dust three feet.

In Devon an Army bulldozer helps to clear streets and soldiers aided by the people labor to enable military traffic to move a costly disaster is soon apparent. The people of San Sebastiano are warned to leave their homes as the moving wall of molten rock grinds to the very edge of the city. There is time only to save a few pitiful possessions the burning mass is already threatening to engulf them as it comes on at 3 feet a minute and nothing stops the flow. The revered image of San Sebastiano später and saved his best tuned with offerings the faithful may leave worldly things behind but not a blessed statue.

So long as the eruption continues the catastrophe grows with ever the chance that new rivers of fire will flood from the crater. The moving mass is gathering its forces now to engulf the city. No puny structures built by man can slow the tempo of it's crushing mark.

Already smoke and dust from crashing balls are seen as fire spread with the flow of the lava tied into the heart of the city itself. It's people are appalled. These are their home hoping against hope. Others wait until it's imperative to move up.

War has seared much of Italy with half the land of battlefield but as tricking people see before them. Forces of destruction more devastating than the worst that man has ever devised or people are ordered to evacuate.

The eruption continues swelling the lava flow and all throughout the second day dense clouds of stifling black smoke dust billow upward heavily laden with hot cinders. People in another doom town are born to get out the molten rock.

Sears everything it touches now the destruction spreads to Masada summer. It buys with war for diabolical supremacy. Orphans of war hardened to bombing and shelling our phenom by this new terror but so were their elders as they watched the drama of a perishing city. The unyielding tired of molten rock is accompanied by the continuous rumble of crashing walls. Mace's reflect the tragic scene. Rowen spread throughout the city built within two miles of a volcano's peak and ignoring its tragic history. They moved to safe havens but they'll come back.

Each generation seems to forget this horror though once in every century the cycle of the volcano's activity seems certain to reach a period of unpredictable danger. The crater pours forth its blackish. Paulding giant clouds of lava dust but it covers the land with precious hash. That makes the earth fertile and grapes will grow again to produce a wealth of wine so the people will return and defiantly rebuild their homes on the slopes of the threatening volcano. They call the slopes the happy land and all little T prays that happier days will come once more with the end of this devastating eruption of Mount Vesuvius.

Lecture 5

Exercise 2.

1. Noun
2. Noun
3. Noun
4. Noun
5. Noun
6. Noun
7. Noun
8. Noun
9. Noun
10. Noun

Exercise 3.

1. Недостаток роста
2. крупномасштабный забор подземных вод
3. водоносный пласт
4. распущенный состав
5. сольвент
6. БЕТКС
7. соляной купол
8. технический синергизм
9. опасность, связанная с неисправностью
10. Выпускник института

Exercise 4.

1. Syndepositional or syn-sedimentary extensional faults that initiate and evolve at the margins of continental plates
2. freshwater taken from ground or surface water sources, either permanently or temporarily, and conveyed to a place of use.
3. a layer of rock, sand, or earth that contains water or allows water to pass through it
4. one of the parts that a substance or combination is made ofdissolved constituents
5. a liquid that dissolves a solid, liquid, or gaseous substance.
6. BETX
7. a type of structural dome formed when a thick bed of evaporite minerals (mainly salt, or halite) found at depth intrudes vertically into surrounding rock strata, forming a diapir.
8. causing or involving synergy (= the combined power of working together that is greater than the power achieved by working separately)
9. a danger or risk
10. university alamnies

Lecture 6

Exercise 2.

1. Noun
2. Noun
3. Noun
4. Noun
5. Noun
6. Noun
7. Noun
8. Noun
9. Noun
10. Noun

Exercise 3.

№	Term	Translation
1	ratio calculation	расчет коэффициента
2	maturity	зрелость
3	shape index	индекс формы
4	mare area	обширная территория
5	geological unit	геологическая единица
6	Late Imbrian	Поздний Имбриан
7	spatial point	конкретная точка
8	nuclear density map	карта ядерной плотности
9	kernel density distribution map	карта распределения плотности ядра
10	core	ядро

Exercise 4.

№	Term	Category
1	ratio calculation	Types of calculation
2	maturity	General geology
3	shape index	Geological indexes
4	mare area	General geology
5	geological unit	General Geology
6	Late Imbrian	Astrogeology
7	spatial point	General Geology
8	nuclear density map	Maps
9	kernel density distribution map	Maps
10	core	General Geology

Exercise 5.

№	Term	Translation
1	ratio calculation	Relation in degree or number between two similar things.
2	maturity	the quality of behaving mentally and emotionally like an adult
3	shape index	a single valued measure of local curvature, derived from the eigen values of the Hessian, defined by Koenderink & van Doorn 1
4	mare area	Influence of trace mineral intake of mares on the trace mineral status of their foals.
5	geological unit	a volume of rock or ice of identifiable origin and age range that is defined by the distinctive and dominant, easily mapped and recognizable petrographic.
6	Late Imbrian	In the Lunar geologic timescale, epoch occurred between 3800 million years ago to about 3200 million years ago.
7	spatial point	relating to the position, area, and size of things:
8	nuclear density map	an interactive world map showing all civil nuclear power plants and radioactive waste repositories with key information on each site.
9	kernel density distribution map	The map of kernel density estimation (KDE), a non-parametric way to estimate the probability density function of a random variable.
10	core	the centre of a planet

Tests

Test 1.

№ 2

1. A geyser is a hot spring with the intriguing habit of tossing underground water into the air.

2. Water falling as rain or snow seeps through porous layers of rock. Eventually that water comes into contact with extremely hot rocks that have been heated by a large body of molten material, called magma, underneath the park. This hot water then rises through a series of cracks and fissures underneath the surface of the Earth

3. A geyser is the equivalent of a giant pressure cooker; even though the temperature of water deep down may be well above boiling, the weight and pressure of the water above prevents that boiling from happening.

4. Eventually, though, the pressure builds enough to push the water in the upper reaches up and out, causing an overflow. That overflow, in turn, relieves the pressure on the super-heated water below, causing it to flash into steam.

5. Hot springs let off enough heat by boiling or surface evaporation to avoid the kind of steam explosions common to geysers.

6. Some of Yellowstone's hot springs take the form of quiet pools. Others are flowing.

7. The waters of many of this latter type, such as those at Mammoth Hot Springs, become charged with carbon dioxide while underground, creating a mild carbonic acid.

8. Fumarole is also called steam vent.

9. A fumarole is a vent in the Earth's crust.

10. The supply of water around fumaroles is not as plentiful as in hot springs and geysers.

№ 3.

1. интригующая привычка
2. бросание
3. расплавленный материал
4. трещины
5. поверхностное испарение
6. паровые взрывы
7. слабая углекислота
8. подземные известняковые породы
9. паровое отверстие
10. спешите наверх

№ 4.

1. heat
2. deapth
3. boiling
4. push
5. escapation
6. dissolution
7. opposing
8. suppliment

9. rush
10. break

№ 5.

Exercise 1.

1. e
2. i
3. a
4. b
5. h
6. j
7. f
8. c
9. g
10. d

№ 6.

1. f
2. a
3. j
4. b
5. i
6. d
7. h
8. c
9. g
10. e

№ 7.

1. горячий источник с интригующей привычкой
2. Вода, падающая в виде дождя или снега
3. вступать в контакт
4. эквивалент гигантской скороварки
5. давление возрастает настолько, что вода
6. посылает воду, стреляющую в воздух
7. во избежание подобных паровых взрывов
8. тихие бассейны
9. заряжаться углекислым газом
10. растворяет подземные известняковые породы

VIDEO TAPE SCRIPTS

Video 1.

On April 30th 2014, astronauts aboard the International Space Station finished installing high definition cameras pointing down at planet Earth the project is known as the high definition earth viewing experiment, and shortly after is becoming operation NASA began streaming in real time. These pictures down to Earth through the Internet for anyone to see.

These are some of the most amazing videos that I have ever seen of the planet. And it's kinda crazy to think that everything we care about like our families, our culture, our history, our technology, our knowledge; they are all intimately related to the history of this planet.

But how exactly do we study the Earth? The branch of science dedicated to understanding the planet is called Geology. And it's the study of the Earth's physical structure, its history and the processes that act on it.

Geologists are scientists that are trying to learn about the history of the Earth through studying the rocks that make it up and understand the changes that the planet is undergoing.

Since the surface of the Earth is constantly changing through time, learning about how rocks change can allow scientist to better understand our home.

So, let's start with the basics. Every rock on the planer will fall into one of three categories that is: sedimentary, metamorphic and igneous. And it is these three rocks types that make up something called the rock cycle. That is just a process that by which new rocks are formed and old rocks are broken down on Earth.

But for this video I am only going to focus on igneous rocks because we can actually watch their formation in real time, and understanding their formality will give us a good foundation in Geology.

The word «igneous» is derived from the Latin word «ignis» meaning «fire». That's because igneous rocks begin their lives as molten rock or lava below the surface and given enough time that lava can be brought to the surface of the Earth by way of volcanoes like these ones.

Now keep in mind that isn't the only way igneous rocks can form but is the easiest for us to see and conceptualize.

There over 1500 volcanoes active on the Earth today, and many more ancient inactive volcanoes. Igneous rocks are constantly being recycled and forms in the rock cycle and this gas been going on since the beginning of Earth history.

We kinda think of the planet as this static place in terms of human life. It appears that way to us but, actually, the Earth is really dynamic the planet is.

So, it seems pretty straightforward how rocks form. Molten lava comes out a volcano, cools to form new rocks. But there is actually a lot more going on below the surface than we realize.

The Earth is divided up into three major parts, that is crust where we live and build our homes, for example; the mantel where rocks get heated and pressurized and turned into something a little bit more like silly putty a plastic and the core. And it's these three parts that interact that cause, the Earth to have a rock cycle. It's because of this rock cycle that rocks aren't used up. They are recycled through the planet.

And Geology is trying to understand all these processes that are controlling the rock cycle, the Earth, the changes it has undergone and its history.

The rock cycle exists because the Earth has three dynamic parts: the Crust, the Mantel and the Core. You can see them here in this diagram. And because of the interaction of these three parts, igneous rocks can be formed from volcanic eruptions.

One place to see this happen in real time is Hawaii. This lava flowing out of a volcano cools to form brand new igneous rocks.

The igneous rocks in this picture are called basalt and that is because they are reach in elements like magnesium and iron. It gives them that dark color.

Basalt is a really common kind of rock. You can find it all over the world just like these stones in the rock wall behind me. They are the same kind of rock as the lava flow that we saw in Hawaii. But there is no active volcanoes in Arizona, so how did they get here? Well, these pieces of basalt are millions of years old. They came out of an ancient volcano eruption just like we saw in Hawaii. And one thing we can begin to understand when we learn about Geology, is that the Earth is really old. And it is kinda amazing to think that these rocks have survived for millions of years and the rocks that were formed new in Hawaii, will be around for millions of years. It is all about the rock cycle.

So, I'm standing here, on a large piece of granite in the Santa Catalina mountains in Southern Arizona, and granite is a different kind of igneous rock than basalt. Granite takes a long time to cool, and so the crystals are larger unlike basalt, like the lava we saw in Hawaii, which cooled rapidly. The crystals are very fine and small, and you can see them very well with your eye.

Granite, on the other hand, takes a long time to cool. And so the crystals become much larger. That is the textural difference between this rock and the basalt.

Being curious about the world around us is the heart of Geology. It is about the understanding the planet that we live on and what makes it up.

In this video we learned the basics of Geology, the three rocks types and the rock cycle, how igneous rocks are formed, the three parts of Earth, some of the differences between two types of igneous rocks, basalt and granite. In the next video we will learn about sedimentary rocks.

If you have any questions about igneous rocks, feel free to ask them in the comments below.

Thanks for watching and stay curious about the natural world.

Video 2.

Sedimentary rocks form in a variety of environments on Earth surface. Geologists study modern environments to understand how rocks form today and to use these data to better interpret ancient environments as preserved in the rock record. We can read these rocks to decipher past climates, reconstruct former landscapes, and predict where to search for oil and gas resources.

This lesson has two learning objectives, we will describe the three major classes of sedimentary rocks, discuss their formation and explain where they are forming today on or near the earth surface.

There are three classes of sedimentary rocks; clastic, chemical and biochemical sedimentary rocks. We can differentiate them on the bases of the materials that compose the rock and the processes by which they form.

Let's look at the first category, the clastic sedimentary rocks. There are three steps involved in the formation of clastic sedimentary rocks. Clastic sediments are composed of fragments of rock. In fact, «a clast» is a technical word geologists use to describe a rock fragment. These fragments weathered from pre-existing rocks to form sediment of various sizes. This sediment is then transported away from its source area and, finally, is deposited and converted to form a new rock through lithification.

Rocks break down on earth surface to form sediment. This sediment may be composed od the rocks constituent minerals, which may then be physically or chemically broken up further to form even smaller grains or other minerals. We can see the individual feldspar minerals weathering out of this igneous rock and notice the grains of sediment at the base. Now we need to erode4 it or transport it away from its source.

Sediment is eroded by transportation agents such as streams, for example, this river in Alaska is carrying a high sediment load as reflected by the muddy color of the water and the sand and gravel bars in the stream channel.

Sediment is also eroded by the winds. Much of the topsail of western

Oklahoma and northern Texas was blown away during the dust bowl era of the 1930s. And we see similar dust storms known as haboobs today in draught stricken western states. Elsewhere, dust and sediment from the Saharan desert may be transported across the Atlantic Ocean to Central and North America.

Finally, sediment of all sizes can be transported by glaciers. For example, the dark surface on the Reid Glacier in Alaska reflects the sediment that is exposed as the ice melts. If we look closely at the glacier, we can see layers of sedlearned today to recognize that different types of iment encased in the ice.

So sediment is first weathered from rocks during the breakdown phase. Next it is eroded and transported and finally it is dumped or deposited in some location. Sediment is deposited when rivers enter the ocean or when wind velocity decreases or when glacier melt. As more and more sediments build up, the material at the base of the pile is compacted. Compaction squeezes and spaces between grains and pushes the grains closer together. Finally, chemicals precipitate out of water, to cement the grains together and form a rock.

Each size of clastic sediment produces a different type of sedimentary rock. Sometimes length between sediment and rock are obvious. Such as the lithification of sand to form sandstone. Other times the names of the sediments and the resulting sedimentary rock are quiet different. For example, conglomerate forms from rounded gravels and day sized particles are consolidated to form shale.

The second major category of sedimentary rocks are the chemical sedimentary rocks. Imagine that your left a pan of salted water on the stove for long enough. The water would evaporate away leaving the salt behind. Essentially, the same thing, happens in nature as water evaporates, leaving any dissolved mineral behind. For example, ancient Lake Bonnevile covered much of Utah 10,000 years ago. Most of the lake dried up, leaving the flay lake bed covered in a layer of salt. Most chemical sedimentary rocks, form as a result of precipitation from seawater. But minerals are also dissolved in lesser concentrations in groundwater, freshwater lakes and rivers and are also concentrated in hot waters associated with thermal features such as hot springs and geysers. Travertine is a type of limestone, forms when minerals precipitate in places where warm chemical rich waters come to the surface.

Biochemical sedimentary rocks also result from precipitation, but this precipitation occurs due to the actions of organisms - typically, marine organisms, think, shellfish, for example. They form their shells by causing minerals to precipitate out of seawater. The same process can happen for microscopic marine organisms like coccolithophores. Coccolithophores are composed of tiny plates known as coccoliths. Even though, you couldn’t see one of these with your naked eye if you get enough of them together you can create spectacular chalk cliffs such as those along the southeast coast of England.

Other marine organisms, such as corals, clams and oysters also build shells that eventually form biochemical sedimentary rocks. Plants can also end up as rocks. For example, the vegetation in tropical swamps can be compacted and compressed to form coal.

Finally, we can summarize what we have learned today to recognize that different types of sedimentary rocks leave clues to past environments on Earth. Clastic sedimentary rocks such as conglomerates, shale and sandstone can form in environments such as mountains, streams, swamps, deltas, deserts and beaches.

Chemical sedimentary rocks are formed in environments such as lagoons and groundwater systems. Biochemical sedimentary rocks such as limestone or chalk form in marine environments, while coal indicates the former presence of tropical wetland conditions.

We had two objectives for today’s lessons. How confident are you that you could complete both of these tasks?

Okay, that is it for us. We're of to use some dead coccolithophores to write some stuff on chalk boards.

Video 3.

Your commentator is Robert Stevenson.

Vesuvius explodes Italy's historic volcano bursts into the most fearsome and devastating eruption in 70 years over the fiery crater a great ball of smoke and lava dust spirals into the sky. A giant specter of endless grief for the Italian people suffering under many years of brutal fascism then German occupation then Allied bombing then the devastation of battle now it is Vesuvius.

At least once in every century of the Christian era it is hurl disaster. The city of Pompeii was buried when the huge mountain first thundered into volcanic life in the year 79 AD. Thousands of Italians perish excavations have revealed their tragic story. This was a pleasure resort of wealthy Romans almost nineteen hundred years ago rising four thousand feet above the fertile plain of Campania.

Vesuvius lazily pours for for harmless curtain of smoke. Naples 10 miles from the slumbering peak lies in comparative safety except for the deluge of volcanic ash that will blanket the city. Then with a few warning rumbles the Silvius belches fire flame and molten rock and a fearsome spectacle thumbs of ashen cinders are borne skyward while fiery lava streams now near to the doomed valleys. The overflowing crater erupts with a mounting temperature of liquid steel close to the summit which carries its fiery heat long after it loses incandescent.

The Italian people are stuffed the crushing mass of lava moves relentlessly for towns in the valley. An all-consuming force from 30 to 90 feet high throwing off terrific heat and sulfurous fumes as it ignites everything combustible in its path venture.

Some youngsters linger too long in the danger zone and have to run for it. A wall of lava sweeps on frightened Italians fry barricades of brush hoping to check the cooling edge of the flood until it may solidify and build up a dam but man's weak efforts against this monstrous force or hopeless mushrooming into the sky.

The enormous gray black pall of smoke fills the air with cinders for miles around from fiery regions far deeper in the earth than any mine ever dug by man. A hot lava is a reminder that the earth was once just such a molten mass gradually cooling until it formed an outer shell.

This phenomenon is simply a weak spot in the shelf from the flaming depth the liquid rock is forced to the surface by the pressure of the Earth's crust as it boils from the crater of Vesuvius.

Lava may have a temperature of more than 2,000 degrees Fahrenheit and in this major eruption it blows carries the terrific heat far down the slopes of the mouth. It carries a crushing weight that doom cities in town. So there no 17 miles away is buried in lava dust three feet.

In Devon an Army bulldozer helps to clear streets and soldiers aided by the people labor to enable military traffic to move a costly disaster is soon apparent. The people of San Sebastiano are warned to leave their homes as the moving wall of molten rock grinds to the very edge of the city. There is time only to save a few pitiful possessions the burning mass is already threatening to engulf them as it comes on at 3 feet a minute and nothing stops the flow. The revered image of San Sebastiano später and saved his best tuned with offerings the faithful may leave worldly things behind but not a blessed statue.

So long as the eruption continues the catastrophe grows with ever the chance that new rivers of fire will flood from the crater. The moving mass is gathering its forces now to engulf the city. No puny structures built by man can slow the tempo of it's crushing mark.

Already smoke and dust from crashing balls are seen as fire spread with the flow of the lava tied into the heart of the city itself. It's people are appalled. These are their home hoping against hope. Others wait until it's imperative to move up.

War has seared much of Italy with half the land of battlefield but as tricking people see before them. Forces of destruction more devastating than the worst that man has ever devised or people are ordered to evacuate.

The eruption continues swelling the lava flow and all throughout the second day dense clouds of stifling black smoke dust billow upward heavily laden with hot cinders. People in another doom town are born to get out the molten rock.

Sears everything it touches now the destruction spreads to Masada summer. It buys with war for diabolical supremacy. Orphans of war hardened to bombing and shelling our phenom by this new terror but so were their elders as they watched the drama of a perishing city. The unyielding tired of molten rock is accompanied by the continuous rumble of crashing walls. Mace's reflect the tragic scene. Rowen spread throughout the city built within two miles of a volcano's peak and ignoring its tragic history. They moved to safe havens but they'll come back.

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REFERENCES

1. Earthclips.com
https://www.eartheclipse.com/geology/formation-types-and-examples-of-sedimentary-rocks.html

2. Encyclopedia Britannica
a. https://www.britannica.com/science/geology
b. https://www.britannica.com/science/metamorphic-rock/Pressure

3. Geology.com
https://geology.com/rocks/metamorphic-rocks.shtml
https://geology.com/articles/diamonds-from-coal/
https://geology.com/articles/crushed-stone/
https://geology.com/gemstones/lapis-lazuli/
https://geology.com/google-earth/
https://geology.com/volcanoes/etna/
https://geology.com/articles/geyser.shtml

4. Geology: Examining the Planet's Physical Processes
https://www.environmentalscience.org/geology

5. GeoScience Videos. Youtube channel.
https://www.youtube.com/watch?v=uozyWZ6XQzM&feature=emb_logo

6. Media.wired.com
https://media.wired.com/photos/5926605ef3e2356fd800909d/191:100/pass/EruptingVolcanoHP_GettyImages-142924771.jpg

7. Nasa.gov.
Ten Years After the Tsunami (nasa.gov)

8. National Geographic
a. https://www.nationalgeographic.org/encyclopedia/sedimentary-rock/
b. https://www.nationalgeographic.org/encyclopedia/metamorphic-rocks/
c. https://www.nationalgeographic.com/environment/natural-disasters/volcanoes/

9. National Geographic YouTube. Com
https://www.youtube.com/watch?v=vt3eiaduSnw

10. Nature.com
www.nature.com/articles/s43247-021-00107-9

11. Scieon.org

a. http://sciaeon.org/articles/Growth-Faulting-and-Subsidence-in-the-Houston-Texas-Area-Guide-to-the-Origins-Relationships-Hazards-Potential-Impacts-and-Methods-of-Investigation-An-Update

b. http://sciaeon.org/articles/Analysis-of-Temporal-and-Spatial-Distribution-Characteristics-of-Lunar-Mare-Craters.pdf

12. slideplayer.com
https://slideplayer.com/slide/6383638/

13. Stephan Hlohowskyj. Youtube channel.
https://www.youtube.com/channel/UC2Ll7XQGD6ocecdNI5OZi-Q

14. https://www.usgs.gov
https://www.usgs.gov/natural-hazards/earthquake-hazards/science/improving-earthquake-monitoring-deep-learning?qt-science_center_objects=0#qt-science_center_objects

15. https://watchers.news
https://watchers.news/2021/02/15/increased-seismic-activity-and-main-crater-lake-changes-at-taal-volcano-philippines/

16. wordpress.com
Tsunami | Geodynamics Weblog (wordpress.com)

17. https://www.yellowstonenationalpark.com
https://www.yellowstonenationalpark.com/geology.htm

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