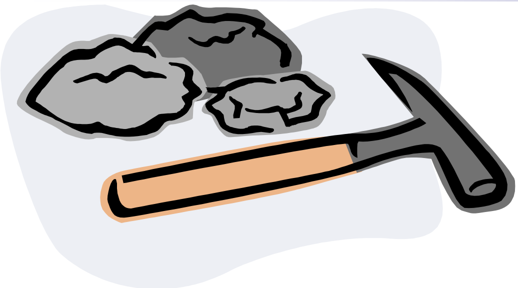
December 2013

Issue No 5
Page 1

P3A Geology Newsletter



"The earth is large and old enough to teach us modesty." — Hans Cloos

Paphos Third Age (P3A)
http://paphos3rdage.org/

Inside this issue:

Erupting Indonesia Volcano—Mount Sinabung

A volcano in western Indonesia erupted eight times in just a few hours, "raining down rocks" over a large area and forcing more than 15,000 residents to flee their homes. Mount Sinabung has been erupting on and off since September repeatedly spewing out red-hot ash and rocks up to eight kilometers (five miles) into the air. Mount Sinabung sits atop the "Ring of Fire," an earthquake and volcanic eruption-prone area that stretches across the Pacific Ocean due to unstable plate tectonics. It is just one of 129 active volcanoes in Indonesia.

Glaciers

A glacier is a persistent body of dense ice exceeding a surface area of 0.1 km² constantly moving under its own gravity; it forms where the accumulation of snow exceeds its ablation (melting and sublimation) over many years, often centuries. Glaciers slowly deform and flow due to stresses induced by their weight, creating crevasses, seracs and other distinguishing features. They also abrade rock and debris from their substrate to create landforms such as cirques and moraines. Glaciers form only on land and are distinct from the much thinner sea ice and lake ice. On Earth, 99% of glacial ice is contained within vast ice sheets in the polar regions, but glaciers may be found in mountain ranges on every continent, and on a few high-latitude oceanic islands. Glacial ice is the largest reservoir of freshwater on Earth. Glaciers are categorized by their morphology, thermal characteristics and behavior. Alpine glaciers or cirque glaciers, form on the crests and slopes of mountains. Glacial bodies larger than 50,000 km² are called ice sheets or continental glaciers. Tidewater glaciers are glaciers that terminate in the sea. Thermally, a temperate glacier is at melting point throughout the year, from its surface to its base. The ice of a polar glacier is always below freezing point from the surface to its base, although the surface snowpack may experience seasonal melting. A cold-based glacier is below freezing at the ice-ground interface and is thus frozen to the underlying substrate. A warm-based glacier is above or at freezing at the interface, and is able to slide at this contact. This contact is thought to a large extent to govern the ability of a glacier to effectively erode its bed. Glaciers erode predominantly by three different processes: abrasion/scouring, plucking and ice thrusting. Glaciers which are partly cold-based and partly warm-based are known as polythermal. A glacier originates at a location called its glacier head and terminates at its glacier foot or terminus.

Exploring the Earth's Magnetic Field– SWARM Satellites

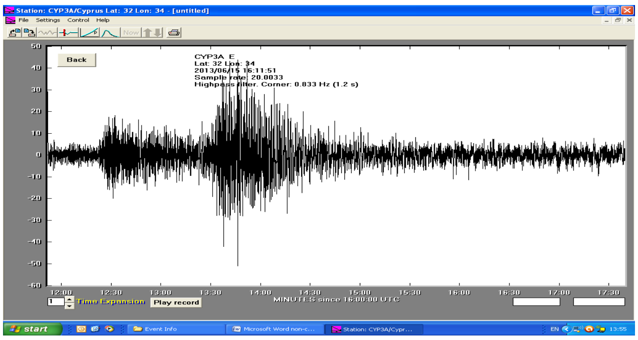
On 22 November 2013, three identical satellites were placed in earth orbit. They are designed to measure precisely the magnetic signals that stem from the Earth's core, mantle, crust and oceans, as well as its ionosphere and magnetosphere. SWARM is an ESA project. The three satellites fly in an optimized formation: two satellites (SWARM-A, SWARM-B) fly in an altitude of 450 kilometers with a distance of 150 kilometers alongside one another, the third (SWARM-C) ascends into a higher orbit at 530 km altitude. Carrying a host of sophisticated instruments which are key to measuring and separating the different sources of magnetism and to making models in unprecedented detail and accuracy. The satellites also offer a new way of studying the effect that solar particles have close to Earth and also provide details of solar weather.

Increased seismic activity in the Aegean Sea area—Article by: Keith Adair

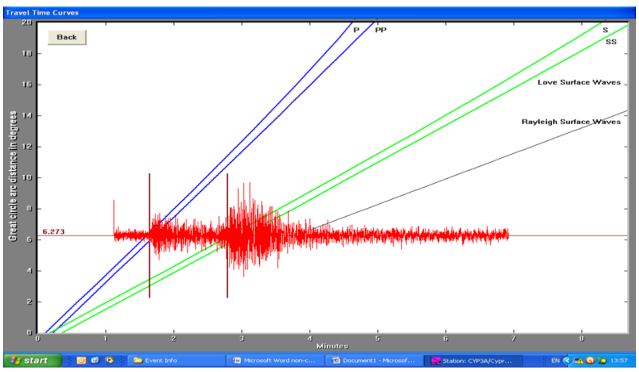
Our seismograph is recording a sharp increase in seismic activity in an area south of Crete. Over the weekend 15/16th June 2013 there were two large shocks of >M6.0 and many aftershocks between M4.0 and M4.5.

Screen 1 is our record of the M6.2 on 15th. This typical earthquake image shows the first seismic waves to arrive, the P waves, followed by the stronger S waves.

Screen 1 (below)



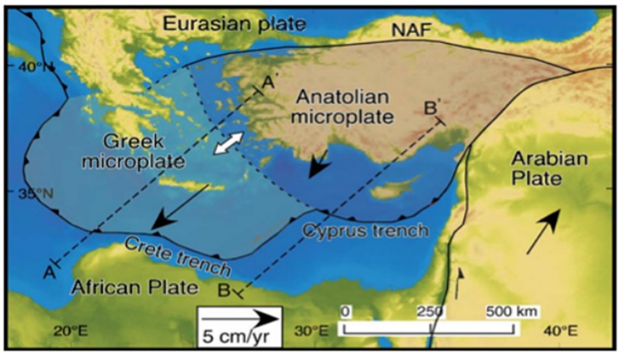
Screen 2 (below) - the 'Travel Time Curve'



Marking the respective P and S arrival times on a travel time curve allows us to calculate the distance we are from the focal point of the earthquake. Magnitude (M), as a $\log_{10}$ value, is calculated using values derived from the curve along with our knowledge of the depth of the focal point..

Seismicity of the area around Crete

The earth's lithosphere beneath the eastern Mediterranean constitutes a broad boundary region between three major tectonic plates, the Eurasia, Africa, and Arabia plates. The motions of the major plates drive smaller plates and it is the shapes and motions of these smaller plates that determine the locations and focal mechanisms of most earthquakes in the region.



The seismo-tectonics of southern Greece are governed primarily by the motion of the Africa plates with respect to the relatively small Aegean Sea plate. The Aegean Sea Plate (also called the Hellenic Plate) is a small tectonic plate located in the eastern Mediterranean Sea under southern Greece and far western Turkey. Its southern edge is a subduction zone south of Crete, where the African Plate is being swept under the Aegean Sea Plate.

In the twentieth century, the largest shallow-focus earthquakes to have occurred near the Hellenic-arc plate boundary had magnitudes of about 7.2. Historical sources and archaeological studies suggest that earthquakes centred near Crete in 365 AD and 1303 AD may have been much larger than any Hellenic arc earthquake of the twentieth century.

'World's largest volcano discovered beneath Pacific

Scientists have discovered the single largest volcano in the world, deep beneath the Pacific waves.

The 310,000 sq km (119,000 sq mi) Tamu Massif is comparable in size to Mars' vast Olympus Mons volcano - the largest in the Solar System. The structure topples the previous largest on Earth, Mauna Loa in Hawaii.

The massif lies some 2km below the sea.

It is located on an underwater plateau known as the Shatsky Rise, about 1,600km east of Japan.

Physical Properties of Minerals *continued*—Crystal Structure

In mineralogy and crystallography, crystal structure is a unique arrangement of atoms or molecules in a crystalline liquid or solid. A crystal structure is composed of a pattern, a set of atoms arranged in a particular way, and a lattice exhibiting order and symmetry. Patterns are located upon the points of a lattice, which is an array of points repeating periodically in three dimensions. The points can be thought of as forming identical tiny boxes, called unit cells, that fill the space of the lattice. The lengths of the edges of a unit cell and the angles between them are called the lattice parameters. The crystal structure of a material (the arrangement of atoms within a given type of crystal) can be described in terms of its unit cell. The unit cell is a small box containing atoms arranged in 3-dimension. The unit cells stacked in three-dimensional space describe the bulk arrangement of atoms of the crystal. Chemistry and crystal structure together define a mineral. Minerals of different chemistry may have identical crystal structure. In contrast, polymorphs are groupings of minerals that share a chemical formula but have a different crystal structure. Differences in crystal structure and chemistry greatly influence other physical properties of the mineral e.g. carbon allotropes diamond and graphite have vastly different properties; This difference is accounted by differences in crystal bonding.

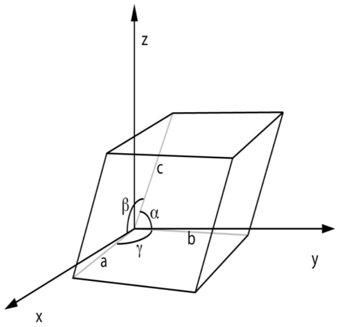


Image of a crystal unit cell definition. a, b, and c are unit cell lengths. alpha is the angle between b and c, beta is the angle between a and c, and gamma is the angle between a and b.

Crystal family	Lengths	Angles	Common examples
Isometric	a=b=c	α=β=γ=90°	Garnet, halite, pyrite
Tetragonal	a=b≠c	α=β=γ=90°	Rutile, zircon, andalusite
Orthorhombic	a≠b≠c	α=β=γ=90°	Olivine, aragonite, orthopyroxenes
Hexagonal	a=b≠c	α=β=90°, γ=120°	Quartz, calcite, tourmaline
Monoclinic	a≠b≠c	α=γ=90°, β≠90°	Clinopyroxenes, orthoclase, gypsum
Triclinic	a≠b≠c	α≠β≠γ≠90°	Anorthite, albite, kyanite

Volcanic Lightning

Volcanic lightning is spectacular but not well understood and is the subject of ongoing studies. This lightning may be the product of what is termed a *'dirty thunderstorm'* with activity similar to that found in conventional thunderstorms. Volcanic eruptions release significant amounts of water, which may help fuel these dirty thunderstorms. It is believed that electric charges are generated when rock fragments, ash and ice particles in the plume collide to produce static charges—in much the same way that ice particles collide to create charges in regular thunderstorms. Electrostatic charge can also be created when particles separate, either after a collision or when a larger particle breaks up. A difference in the aerodynamics of these particles causes the positively charged particles to be systematically separated from the negatively charged particles. Lightning is the electrical flow that results when this charge separation becomes too great for air to resist the flow of electricity. Some of the lighting strokes can be at least 2 miles long.

Much of the electrical activity appears in the volcanic plume but some small flashes have been observed for the first time going from the top of the volcano up into the cloud. The lightning itself may come in many shapes and forms including St. Elmo's fire (ball lightning), bolt lightning, sheet lightning or a combination of these. During the eruption of Mt. St. Helens in 1980 several people witnessed volkswagen sized St. Elmo's fire bouncing and rolling on the ground nearly 25 miles from the volcano.

'Diamond rain' falls on Saturn and Jupiter.

New atmospheric data for the gas giants indicates that carbon is abundant in its 'diamond' crystal form.

Lightning storms turn methane into soot (carbon) which as it falls hardens into chunks of graphite and then diamond.

These diamond "hail stones" eventually melt into a liquid sea in the planets' hot cores,

Acknowledgements:

BBC

Wikipedia

Geology.com

British Geological Survey

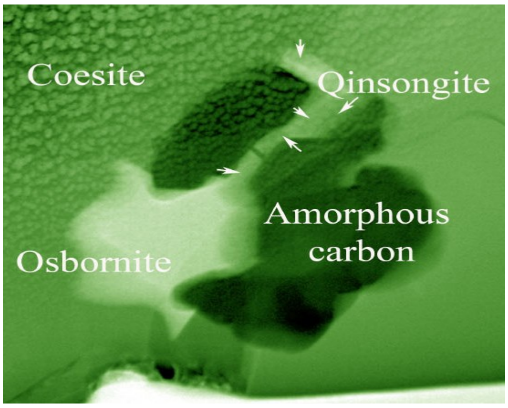
Volcano World

Sci-News.com

[Link to worldwide Volcano webcams]

Qingsongite: New Mineral from Tibet Hard as Diamond

The International Mineralogical Association has officially approved Qingsongite as the name for a new mineral, cubic boron nitride (CBN). Qingsongite is the first boron mineral that was found to be formed at extreme conditions in deep Earth. All other known boron minerals are found at Earth's surface. The mineral cubic boron nitride was discovered in the southern Tibetan mountains of China within the chromium-rich rocks of the paleo-oceanic crust that was subducted to a depth of 190 miles and recrystallized there at a temperature of about 1300 degrees Celsius. About 180 million years ago, the rocks were returned back to shallow levels of the Earth by plate tectonic processes. The laboratory version of CBN is considered one of the greatest technological advancements for grinding hardened ferrous and superalloy materials, and is classified as a "super abrasive.



Glossary: *To continue in the next issue*

E

Eccentricity — The Earth's orbit around the sun changes from being almost circular to elliptical in shape every 100 000 years.

Enhanced Greenhouse effect — 'Greenhouse gases' are actually crucial to keeping our planet at a habitable temperature, without them the Earth would be about minus 17 degrees! Anthropogenic or human release of carbon dioxide is what is contributing to an additional or enhanced greenhouse effect.

Erosion — Erosion is the wearing away of the Earth's surface by the sea, rivers, glaciers and wind. The important point to remember is that erosion causes the breakdown of the rock and then the transportation of the rock fragments. Weathering processes do not involve transportation.

Erratic — A block of rock that has been eroded by a glacier, transported by the ice to a distant locality and then dumped as the glacier retreated. Erratics may have been carried many kilometres. In this way a boulder of one age may be found resting on rocks of a different type and a different age. An older block might be found on top of a younger rock.

Escarpment — A long hill, or ridge, composed of gently dipping beds of rock. One side of the hill is gently sloping ('dip-slope') and the other side of the hill is very steep (scarp-slope).

Estavelles — A sink hole where water disappears below ground during part of the year, but from which water issues during storms and winter floods (when the underground drainage system exceeds its capacity).

Eustasy — A global change in sea level. Compare with Isostasy.

Evolution — The change in the characteristics of living organisms over successive generations, it occurs through the mechanism of natural and sexual selection.