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Answers Questions about Mt Vesuvius
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- In general terms, describe Vesuvius for me ... where is it, what does it look like, what kind of volcano is it?
 - From Naples, it appears as prominent, nearby (6 mi) mountain
 - It's only 4200 feet tall, so it doesn't really tower over the city
 - Unlike say Mt Fuji in Japan it has two humps, not a single peak
 - the lower one Mt Somma is forested, an older volcano
 - the newer one, covered with grey volcanic ash is newer, Vesuvius
 - Vesuvius is stratovolcano, alternating layers, ash & lava
 - geologically, an arc volcano assoc w/ Calabrian subduction zone
 - collision of the African and Eurasian plates
- What makes Vesuvius different from other volcanoes?
 - difference is location – near a major city, Naples
 - no so different from other arc volcanos, Krakatau, St. Helens, Pele
 - very different from hotspot volcanos such as in Hawaii and Iceland
 - more explosive
 - youngish for a volcano, 18ka
- Why should it be considered dangerous?
 - It demonstrably is dangerous. Check out the 1000+ bodies in Pompeii
- Will Vesuvius erupt again?
 - Absolutely
- Can we tell when it will erupt next or what type of eruption it will be?
 - We cannot predict either the date or size of the next eruption
 - We can say something about the probabilities by studying the pattern of past eruptions
 - five large (VEI 5) eruptions in last 18 thousand years, so one every 3600 years, on average. Last was Pompeii, 2000 years ago
 - many smaller eruptions, VEI 4's in 1631 and 1944
- Can you talk about the volcanic activity in the area? Are there other volcanoes?
 - the Campi Flegrei is a huge volcanic complex just north of Naples
 - it lacks the dramatic cone-shaped mountain, more like Crater Lake in Oregon
- In particular, can you tell me about Campi Flegrei?
 - Supervolcano, like Yellowstone in the US
 - Truly huge eruptions, VEI 7, 40ka and 12ka ago left layers of ash 50 feet thick
- Describe subduction for me. How would you explain the process? What causes the formation of a volcano? Why did Vesuvius form where it did?
 - When two continents collide, something has to happen to the floor of the ocean – the rock of the oceanic crust - that initially separates them

- Typically, the oceanic crust is shoved into the deeper part of the earth, along a gigantic fault – that’s the subduction zone
- The fault usually has gigantic earthquakes
- We can detect the sinking crust to about 400 miles deep in the earth
- Seawater is dragged down into the earth, too, and it lowers the melting point of the rock, creating magma
- thus arc volcanos form, typically 100 miles behind the SZ
- What were some of the warning signs that people missed before the 79 AD eruption?
 - We know very little about that eruption. We don’t know for sure that there were warning signs, although since most eruptions have them, there probably were.
- Tell me about the 62 AD earthquake. Was it a precursor?
 - Tacitus wrote about it
 - It was probably related to the Calabrian Subduction zone, not Vesuvius
 - Southern Italy is very active, seismically
 - Maybe similar to the Calabrian EQ of 1980, mag 6.9, 2700 deaths
- Is it common for seismic and volcanic activities to be related?
 - Link is mostly in the public imagination, the unquiet earth
 - most volcanic eruptions cause small earthquakes,
 - moving magma causes changes in pressure in the earth
 - changes in pressure cause faults to move – EQ’s
 - arc volcanos are near subduction zones, and subduction zones have wopping EQ’s
 - 2004 Sumatra Earthquake on subduction zone
 - good statistical evidence that big earthquake can sometimes trigger the eruption of a nearby volcano (within a few weeks)
- What is “tufo” or tuff? Can you talk about how Naples is built on layers of tuff.
 - explosive eruption generates volcanic ash (tephra), pulverized rock
 - a little like snow, but heavier
 - ash when exposed hardens into rock – tuff
 - Romans used ash to make concrete, tuff building stone
 - layers easily recognizable, can be traced out over wide areas
 - used for dating – above one layer, below another
- Describe the 79 AD eruption for me. What stages did it go through?
 - you got to let me read a few lines of Pliny here!
 - Plinian phase: 18 hours, huge plume above volcano,
 - cloud probably reached 30,000 ft in height
 - 9 ft layer of ash laid down
 - Pelean Phase: pyroclastic flows
 - buried Pompeii and Herculaneum
 - very hot – 1500 F in places, but probably cooler at Pompeii
 - small tsunami in bay of Naples

- What do you think people were thinking at the time when they started to see the volcano erupt? Did they know what was happening?
 - Pliny's the only eyewitness account. He says people were terrified.
 - Eruptions and geothermal activity at Stromboli, Etna, Campi Flegri
 - probably some people has seen small eruptions before
 - Volcanos, EQs, hurricanes: Long time between disasters
 - people forget the last tragedy

What is a pyroclastic flow?

Super heated ash and gas, hot enough to melt glass

- What make Pompeii and Herculaneum so unique? Why are they so studied today?
 - The pyroclastic flow covered the towns quickly, creating a sort of snapshot of Roman life
 - the ash protected them till modern times
- What is "bradyism"?
 - short-term (days, weeks, months) changes in elevation
 - inflation/deflation of the ground due to changes in pressure in the magma chamber
 - can be very dramatic, dry our harbors
 - 2 meters of inflation since the 1970's at Campi Flagri
- Can you describe the different types of eruptions that Vesuvius is capable of?
 - Plinian eruptions (huge burps of ash), as in 79
 - sub-Plinian eruptions (smaller burps of ash) as in 1631
 - lava flows, as in 1944
 - no reason to exclude Mt St Helens style explosions or any other eruptive styles common in arc settings
- Can you talk about the more recent Vesuvius eruptions (1944, 1631)? What were the consequences? How were they different than the 79 AD eruption?
 - 1631 was a sub-plinian eruption
 - erupts ash, but not huge column
 - had lava flows and torrents of boiling water, too
 - about 3000 people killed
- Can you talk about the Avellino eruption? How did that volcano change what we know about a "worst-case scenario"?
 - oh, Avellino, 4ka, wasn't worse case.
 - But it was important – twice as big as 79 – because it covered the region that was to become Naples in ash
 - Skeletons of bronze-age people have been found.
 - An identical eruption today would damage – but not utterly destroy – the city
 - However, pyroclastic flows did flow out as far as 10 miles, but not in the direction of Naples. But it does shows Naples is in range.
- Is Naples at risk if Vesuvius experiences another Plinian eruption like the Avellino eruption?
 - Yes.

- What kind of monitoring is going on today at Vesuvius?
 - Its heavily instrumented with
 - seismographs to detect small EQs assoc w/ magma movement
 - GPS to detect uplift of the ground assos w/ magma movement
 - Chemical testing of fumeroles and ground water
 - changes in temperature, pH, sulfur content
- What are scientists watching for? What warning signs? (Seismic activity, increases in SO₂, swelling of ground, magma chamber...). Can you walk me through how changes in various conditions could be red flags? How are they monitored?
 - Warning signs
 - increase in rate of small EQs, especially getting shallower
 - "Long-Period" EQs, assoc w/ magma movement
 - inflation (bulging out) of the flanks of the volcano
 - ground getting hotter
 - increased sulfur emissions
 - small eruptions!
 - Naples evacuation plans assumes 2-weeks of pre-eruption activity
 - so early detection of pre-eruptive activity important
- How can we use what was left behind from various eruptions to understand the volcano better today? (example: rock samples...)
 - dating, mapping area, measuring thickness of ashes and tuffs
 - very useful in understanding volcano's past
- How are computer models used to better understand the volcano's behavior? What are current models showing?
 - European seismologists have been able to image the magma beneath the volcano, using technology that's essentially a scaled-up version of medical imaging.
 - We know quite a bit about the internal structure of the volcano.
 - How that translates into knowledge about the behavior of Vesuvius is less clear
 - CT Scan of the brain doesn't get you information about how a person thinks.
- What research are you doing now?
 - I am preparing for a cruise to the Lau Spreading Center
 - Pacific Ocean northeast of Australia
 - a region of submarine volcanism
 - my colleagues & I will deploy seismometers on the ocean floor
 - goal is to understand the origin of magma
- What are some examples of scientific processes that can be performed to understand Vesuvius better?
 - I think that's the wrong way to put it.
 - It's like an eighteenth century physician being asked what kinds of studies could be performed on George Washington to better predict his risk of cancer. Physicians back then did just did not understand

people's health well enough to make close scrutiny of Washington useful.

- We earth scientists just don't understand volcanoes well enough to ask the right questions of Vesuvius. While we understand the processes that make magma, we still don't really understand why it suddenly erupts. Indeed, there may be several different reasons. Why did Vesuvius erupt in 79? No one has a clue!
- We need to learn a lot more about volcanoes in general.
- Some experts have suggested that Vesuvius may be on a 2000-year cycle. Do you agree?
 - No.
 - The word 'cycle' implies predictability. But 2000 years is a reasonable number for the average time between large eruptions.
 - Our ability to find all the past eruptions, date them, and most importantly measure their size is just too poor to spot cycles,
- How much warning do you think people will have before an eruption?
 - A week or two, if we're lucky
- Can you talk about the emergency evacuation plan? What are your thoughts on the current strategy? Is the government doing enough?
 - Based on a moderate VEI 4 eruption, like 1944
 - Expectation that only areas near Vesuvius need evacuation, not all of Naples
 - Expectation of about two weeks of premonitory activity
 - People to be evacuated to other parts of Italy
 - I think that the transportation network needs to be improved to handle a short-notice evacuation of all of Naples, and should include the possibility of an Campi Flegri eruption, too.
- What are the so-called "red zones"? How many people would have to evacuate before an eruption?
 - the region where one can expect devastation, especially in this case from pyroclastic flows, and need to be evacuated.
 - 600,000 people
- Do you think the people living in this area are in danger/at risk? Do you think they understand the risk involved with living so close to Vesuvius?
 - Some do, some don't.
 - There's been quite a lot of press coverage about Vesuvius and the Naples evacuation plan. Many scientists have been openly critical of it, saying it underestimated the danger.
- Can you talk about the program the government tried where they would pay families \$40,000 to move? Why wasn't it successful?
 - Because houses cost more than \$40,000!
- Why has the current safety strategy become a bit of a controversy or debate between scientists and government officials?
 - I think the problem is that Naples is so unique in having a volcano problem. Very few cities in the world do, or at least not as bad.

- It's a lot better with natural disasters such as earthquakes and hurricanes, which are more widespread. For earthquakes and hurricanes, an engineering community has developed that helps to translate scientific language into public policy – practical things like building codes and risk assessments. That missing in the volcano risk debate.
- Describe Naples as a city.
 - Naples is a port city, on the southwestern coast of Italy.
 - The city itself has a population of 1M, 3M if you include the suburbs
 - It has mostly low-rise and medium-rise buildings, that range from Roman in vintage to very modern.
 - Its street plan is pretty irregular, though it does have several modern divided highways (autobahn)
 - its known for its traffic jams – a quick evacuation would be a problem
- What is the worst-case scenario in terms of a Vesuvius eruption?
 - Naples is gone.
- What is the greatest challenge in understanding Vesuvius?
 - All the action is occurring deep underground and at a rate that is slow compared to a human life-span.
- What do you think is the most important thing for people to know about Vesuvius?
 - Little eruptions are much more frequent than big eruptions, by perhaps a factor of ten. So the chances are that the next eruption at Vesuvius will NOT be a repeat of 79. The key thing that has to happen is that people need to learn from the experience of that eruption how to improve Naples' disaster preparedness, to get ready for the really big one. Getting through a little one should not be a reason for feeling complacent. The big eruption will occur, it's just a question of when.