

Italy: 'The five volcanoes tour' - Part 1 - Bay of Naples

Wednesday 10 April, 2002

The 32 strong FGS group, led by Dr Paul Olver, met at Gatwick Airport for the early evening flight to Naples. After an uneventful flight, there was an air of anticipation as we approached Naples to see the outline of Vesuvius obscuring the distant city lights far below. The Bay of Naples is the location of two active volcanoes, Vesuvius and the lesser known, low-lying crater of Solfatara. The geology of these volcanoes and their historical associations were to be the principal focus of the FGS visit to the Naples area, and are summarised in this article. At the end of a week, the party travelled south to investigate three more active volcanoes namely: Etna, Vulcano and Stromboli, and so complete the FGS 'Five Volcanoes Tour'. Details of this part of the tour are given in Part 2 of this report - see below.

Thursday 11th

Pompei

Pompeii is unusual in that the town is very well preserved after almost 2000 years of burial following the 79 A.D catastrophic eruption of Vesuvius. It was fascinating to be able to identify the leucite-phonolite and leucite-tephrite lavas cut into manageable blocks that were the major materials for most Pompeii buildings. The use of such a variety of different materials points to a mature town of continuous growth, perhaps due in no small part to its frequent destruction over-time. A good example of this is the Temple of Isis, which shows an assortment of materials from different stratified lava types used to rebuild the temple following the 63AD earthquake.

During the most violent degassing phases of the 79 AD eruption, Pompeii was subjected to a barrage of air-fall and surge deposits. Ash and grey pumice bombarded the town followed by a series of pyroclastic flows, which seemingly forced many inhabitants to abandon the town. This was followed by more gentle fine ash and lapilli fallout, perhaps during a lull in the main eruptive phases, only for the town to be engulfed finally by a devastating pyroclastic ground surge. For months after the event the Naples region must have been entirely laid to wasteland.

We left Pompeii at midday, in much sunnier conditions than we found it, in order to pay our respects to the brooding Mt Vesuvius whose menacing backdrop was ever present and a telltale reminder of a calamity that once befell a vibrant Italian city.

Mount Vesuvius

We had lunch at a restaurant half way up the mountain and very near to the Vesuvius Observatory. Here we had a splendid lunch before driving up to a coach park some 200m from the volcano's summit. In spite of its malevolent behaviour, Vesuvius is remarkably small, measuring ~1280m high with a ~15km circular base. It is by no means the highest point in the region. This belongs to Mt Avella, a limestone peak lying ~25kms to the NE having been squeezed upwards by localised tectonic compression. After lunch our intrepid group made their zigzagging way on-foot up to the crater rim. To ease the pain of the ascent Paul (Olver) frequently stopped at suitable junctures to explain the eruption stratigraphy and to identify particular rocks and minerals. Up until the 79AD eruption, the volcano overlooking Naples was called Monte Somma, the peak of which was twice the height of the current Vesuvius. It was not until the 79 AD eruption that Monte Somma effectively lost its place in history when its top violently exploded. Vesuvius then emerged as a new cone from inside the shattered rim of what was Monte Somma. Currently, some minor fumarolic activity can still be seen inside Vesuvius' crater, which is presumably remnant exertions from the 1944 eruption which damaged several villages nearby. In and around the crater consolidated pyroclastic ash deposits containing augite and pyroxene crystals together with fragments of olivine were found - at least by some. More difficult to find was the complex mineral vesuvianite, or idocrase, which is formed following contact metamorphism with localised impure limestones. As Paul was the first to find vesuvianite rocks, the free glass of local 'grappa' on offer at his bidding was no longer attainable.

We made a separate visit to the Observatory on Vesuvius, which is now a museum of Vesuvian history and a Vulcanology Centre. All monitoring of Vesuvius and the nearby Phlaeagraean Fields activity is today carried out at the University in Naples itself.

Friday 12th

Amalfi Coast

Sadly the sun remained hidden as our coach made its way across the Sorrentine Peninsula and on towards the spectacular Amalfi coastline. Here the limestone rocks of the Campania region (Campanian of the Upper Cretaceous) forms an anticline stretching through the peninsula for almost 40 km. Heights of ~1000ft were reached as our coach driver, Michel, negotiated the narrow and most precipitous public highway on earth en-route to Positano. One mountain after another appeared around every bend while the inverted limestone edifice plunged vertically into the deep blue sea. Positano is one of many cliff-top towns that were not too long ago only accessible by boat. This is one reason why Positano became a refuge for the arty set and a host of writers, the most famous being John Steinbeck, made their homes here. After a short stay we passed through the village of Praiano only to encounter our next near-death experience as our coach negotiated the Furore Gorge, passable only along the flimsiest of single-track roads. Michel drove gingerly around the gorge and upwards towards the ancient feudal town of Amalfi from where the coastline takes its name. Here we visited the beautiful 9th-12th century basilica built in an Arab-Norman style with its bronze doors cast in the portraits of Christ and the disciples. The cathedral's alters, walls and ceilings are resplendent in a variety of coloured marbles, gneisses and bronzes all indicative of a strong Roman Catholic influence, and not least, the town's mercantile heritage. Classical sarcophagi, medieval sculptures and coats of arms were on display in a whitewashed quadrangle in the oldest part of the church.

Ravello, our next stop, is the second city along the Amalfi coastline. First, we walked a short distance to the landscaped gardens of The Villa Cimbrone, with its priceless views of the Amalfi coast. We then entered the Villa Rufolo - which, as fans of Richard Wagner might know, is none other than Klingsor's magic garden and the worldly, Faustian encounter of *Parsifal* of Germanic legend, for it was here the Wagner acquired his inspiration. The villa itself is a remarkable 11th century pleasure palace that was the temporary abode of various Norman kings. The gardens are quite spectacular as they are laid out in a subtropical paradise of trees, succulents and blooms all displaying incredible colours and hues. Tiered balconies inset with flowerbeds, exotic plants and water fountains overlook a distant harbour in a deep turquoise sea. This idyllic setting was further blessed with more than a little erudition, as many in our Society were most knowledgeable in the horticultural and botanical sciences.

Saturday 13th

Phlegraean Fields

This region, some 5Kms west of Naples, is a ~12km diameter caldera formed ~35000 years ago when ~80 cu km of fine pyroclastic ash was deposited throughout the region. The 'fields' are made up of many small volcanic cones, including parts of the seabed near to the coastal town of Pozzuoli (Sofia Loren's birthplace). Our first port of call was to the Caves of Sibyl at Cuma (Cumae). Thought to be a Greek and Roman garrison town initially, Cuma was sacked on many occasions by Arab raiders. Clearly they did a good job as only the foundations of the ancient acropolis remain. These ruins are set in phonolitic lavas on a steep-sided dome overlooking the sea and Cape Misenum. Below the summit lies the '*Cave of the Cumaean Sibyl*' discovered by accident in 1932 and said to be famous for Virgil's epic when Aeneas took refuge following the destruction of Troy. The trapezoidal galleries are sculpted into thick deposits (~15m deep) of localised yellow tuffs dated at ~11000 years, and where the Sibyls pronounced their oracles after inhaling deadly aromatic fumes from smouldering laurel over a sacred tripod.

Lake Averno

We left Cuma, via a still standing 3rd century Roman Viaduct and headed the short distance inland to Lake Averno (Lago d'Averno), referred to by the ancient Greeks as '*the mouth of hell*'. It is hard to

believe this near circular prehistoric lake is the mouth of a volcanic cone formed at sea-level, and was once known as 'the silent killer'. Evidently birds on the wing would plunge headlong into its depths as deadly carbon dioxide gases seeped from fissures beneath the still waters and hung like an invisible mist across its surface. Averno itself is formed by tuff material which encircles the lake and is dated at ~ 3700 years B.P. The tuff deposits here formed as a result of surge emissions issuing forth from a now plugged deep-seated conduit.

La Solfatara

Our next stop took us to the collapsed volcanic crater of Solfatara, where ones vital senses are alerted to the smell of rotten eggs. Solfatara is a ground-level volcano about half a kilometre in diameter, which emits hydrogen sulphide from fumarolic activity, as well as carbon dioxide, boiling water and super-heated steam. The largest fumarole is known as the Bocca Grande, where the temperature is ~200°C and oxidation of hydrogen sulphide emissions separate out sulphur and water molecules. The sulphur crystals are precipitated around the fumarole vents to give them their distinctive yellow colour. Associated with the sulphur are deposits of the reddish mineral realgar, a sulphide of arsenic (AsS) which is extremely poisonous. Most of our party came away with specimens - no doubt to be examined and discussed during the Winter months.

Sunday 14th

Herculaneum

With the Mediterranean weather improving all the time our next excursion took us to the modern town of Ercolano, which is built above the 79 A.D. archaeological site of Herculaneum. During Pompeii's destruction, Herculaneum was also subjected to a series of pyroclastic surges. The town was much closer both to the sea and the volcanic centre itself and it was thought therefore that Herculaneum was deluged by lahars (mud flows). Many guidebooks still indicate this to be the case, but the major ash deposits identified during geological research now show them to be an assortment of tuff and lapilli. Such deposits completely engulfed the buildings before finally sealing the town under ~20m of ash. Because Herculaneum was situated on the coastline, as well as its close proximity to the eruption, the sea was in turmoil and inundated the town with seawater. Pliny's report to Tacitus confirms this as the fleet, anchored in the bay close to the island of Ischia, was unable to sail because of the eruptive power of the sea. The presence of seawater may have hastened consolidation of the ash-flow deposits leading to cementation over-time, and which conceivably gave rise to the lahar theory. Herculaneum is about a third of the size of Pompeii and was a seaside resort for the rich and famous in Roman times. Like Pompeii and Cuma, Herculaneum was discovered by accident (in 1700 by Prince Elbeuf - a Bourbon) but work on its excavation only began under Mussolini in the late 1930s. In fact many of its buildings and artefacts are much better preserved than those at Pompeii.

Pozzuoli Amphitheatre

To complete our archaeological tour the group visited the impressive 5th century Roman Amphitheatre at Pozzuoli built by the Emperor Vespasian (he also built the Coliseum in Rome) for aid given by the town during the civil war that finally saw him become emperor. The amphitheatre was so sophisticated during its day that even water pipelines were installed in order to flood the arena floor for mock naval battles to take place. Because of its size, it could hold 40,000 spectators, as many as 60 gates were situated at strategic points around the amphitheatre to enable spectators, gladiators and beasts to enter and leave without impediment - perhaps they had traffic/queuing problems in those days too !.

Serapeum

For centuries the townsfolk of Pozzuola were proud of their ancient Serapeum, a temple to the Egyptian god Serapis. That is until archaeologists finally proved that this splendid 'temple' was in fact an upmarket *macellum*, or market place. Only the 5th century foundations and Corinthian style pillars remain in a communal park close to the harbour. The Serapeum is currently below sea level and as a consequence it floods regularly. Sadly, time did not allow all of the party to visit Serapeum, but I and

one or two others undertook a rapid photo-shoot of the lavish *macellum* - and returned hotfoot to the waiting coach!

An earthquake city, Pozzuoli has suffered from earthquakes for centuries; the last major event was in the early 1980's when water in the harbour drained away leaving vessels marooned. Apart from these more catastrophic events, there is a regular series of seismic events that are like '*slow-earthquakes*' and have been given the name '*Bradeyism*'. This phenomenon is thought to result from convection movements within a localised magma chamber. It is interesting to note that Charles Lyall did research on this topic when he was advancing the theory of '*gradualism*' in relation to changing sea levels.

Monday 15th

Capri

As the hydrofoil approached Capri's main harbour (Marina Grande) it became evident that Capri had at some time in the geological past broken away from the Sorrentine Peninsula. The inverted Campanian limestone reaches precariously upwards to ~1500 feet, and is similar to the exposures seen along the Amalfi coastline. After landing, we ascended the vertical cliffs in a tiny coach to the town of Anacapri, situated on a rock plateau ~1000ft above the harbour. From the Piazza Vittoria (main square) we walked the short distance to Villa San Michelle built by a Swedish doctor and sometime archaeologist named Axel Munthe (1857-1949). He is said to have been one of the finest physicians of his day and a leader in the new science of psychiatry, and is perhaps most famous for his best-selling autobiography '*The Story of San Michel*' to which the villa owes its name. This exquisite house contains Roman, Arabic and Greek artefacts discovered on Capri which are displayed in rooms throughout the villa.

A few minutes walk from the piazza and past the church of Santa Sofia to the west facing side of the island are the Gardens of Augustus founded by Caesar himself. A magnificent array of trees and plants grow along the fertile terraces overlooking the most beautiful views on earth. In these glorious gardens, our expert on plants and all things green, David Caddy, was in his element as he eulogised enthusiastically over various types of plants, trees and blooms. David was frequently observed head buried in foliage or pointing to and uttering the affix of some strange flora. Seen from a belvedere balcony, a narrow road with extraordinarily tight hairpin bends wound its way down the cliffs from a sumptuous villa to the Marina Piccola far below. This villa was owned by the German arms manufacturer Alfred Krupp (1907-67), who had the road especially built so that he could descend to the rocky shoreline to study *lamprey larvae* in his spare time. Today his only son Arndt owns the villa.

Sadly my trip to the Bay of Naples was at an end and the next day, after a day-long wait in an empty airport lounge due to a sudden countrywide strike, I returned to the UK while the rest of the group journeyed south for new adventures around Sicily and the Aeolian Islands.

John Gahan

FGS trip to Italy: 'The five volcanoes tour' - Part 2 - Sicily & the Aeolian islands

The journal editor originally asked me to write a social report on the society's trip to the volcanoes of southern Italy, the Aeolian Islands and Sicily. There were, as I then understood it, to be two separate geological reports on the trip. The first, covering the first week when the party was visiting Vesuvius and the Phlegrean Fields, written by John Gahan, was included in the October Newsletter. Very foolishly I volunteered to extend my brief to cover the geology of the remainder of the trip, that is the Aeolian Islands and Mount Etna. As John has largely covered all aspects, including the non-geological, of the first week, my report has little to add to his.

The article that follows is in two parts. The first is a footnote to John's report and is intentionally limited to the non-geological excursions and visits with hardly a mention of volcanoes, lavas, breccias

and suchlike. The second part is a diary and commentary on the second week during which we visited Vulcano, Lipari and Mount Etna.

1 Social report on the first week

Thirty four of us, including three Herefordians, gathered at what seemed to be an empty Gatwick on the afternoon of Wednesday 10th April. Here Paul (Olver) distributed "Song sheets" and Dorcas (Cresswell) handed out flight tickets. Hugh Agnew was there both to see us off and to wave an advertisement for a far cheaper flight to Sorrento! When Dorcas started to distribute the tickets, in alphabetical order, Hugh stepped forward with "Agnew" - for a brief moment Dorcas's face was a picture. We left him behind still chuckling.

On arrival in Naples we were met by our coach and our bubbly guide Wendy Viney. She comes from the Lake District and has been living in the Naples area for more than twelve years. She gave us a running commentary most of the way to Sorrento.

The next morning we set off in our coach for a 2 hour visit to Pompeii, where we met our guide Hugo. The excavated site is huge (with still more to uncover) so we could only see some of it. Despite most of the finds being in the Archaeological Museum in Naples the site is fascinating. Much has been restored so one can begin to visualise what it must have been like. Some of the wall paintings are still in place and the plaster casts of the voids where the bodies were drowned in ash are far too lifelike for comfort. We do not even have to imagine what the eruption must have been like as Pliny the Younger sent two letters to Tacitus giving an eyewitness account of the catastrophe. After lunch, at a restaurant high on the slopes of Vesuvius, we climbed to the rim of the volcano.

Friday was given over to sightseeing. The coach, with Wendy in attendance, took us on a tour of the Amalfi peninsular. We stopped at Positano, Amalfi and Ravello where we saw the Villa Rufolo Gardens, all as described in John's report. Wendy is an amusing guide, not least when describing the strained relationships in her Italian partner's family.

Saturday, off again in our coach to the Phlegrean Fields. Most of the day was serious geology but we started in Cumae where, in Roman times, the Sybil resided. The Sybil was a "Wise Woman" who acted as a soothsayer. Pauline instantly volunteered being sure she was wise enough *"voice from the back row "Not another Sybil Servant!"*. We finished the day with a visit to the Roman amphitheatre at Pozzuoli.

Sunday morning by coach again, this time to the Vesuvius Observatory which is now a Museum both of Vesuvian history and of the equipment used to study tremors. It is only open to the public on Sunday afternoons. The Museum contains a fascinating collection of seismographs. After lunch we visited the archaeological site at Herculaneum. As much of the ancient site is underneath modern Ercolano, only a small fraction can be excavated. This is very sad as Herculaneum was far better preserved by the pyroclastic flow than Pompeii, where the initial ash deposits collapsed the roofs. At Herculaneum the pyroclastic flow completely filled the houses so the roofs did not collapse; it did however char the woodwork.

Monday began with an early start down to the port in Sorrento to take the hydrofoil to Capri where we were met by Gino, our guide for the day. He took us to visit the villa San Michele, the idyllic home of Axel Munthe, after which we had free time to look round Anacapri and find some lunch. During the lunch break some of us were lucky enough to find the church of San Michele with its magnificent mosaic majolica tile floor depicting Adam and Eve in the Garden of Eden with its wonderful wild animals and then their expulsion. After lunch Gino took us on a boat trip round the east end of the island.

Tuesday was a day of travel, first by coach south along the all but deserted autostrada to Villa S. Giovanni (about 5 miles north of Reggio) where we left the coach to walk on to the ferry to Messina in Sicily. Here we met our new guide Cinzia Maiorana. Then on in a new coach to Milazzo and dinner in the hotel.

2 Diary of the second week



Wednesday morning we left the hotel early to catch the 7.25am hydrofoil to Lipari where we checked into the hotel and immediately returned the few hundred yards on foot down to the port to catch a ferry to Vulcano. On arrival we set off to walk up to the rim of the crater looking for spindle shaped breadcrust bombs on the way. The fine black ash from the 1888-90 eruptions gave way near the top of the crater edge to pink compacted very fine ash from old material also thrown out during 1888-90. Walking round the rim to the north west we found the fumaroles (see photograph) gently blowing with their rims of reduced sulphur. We returned down to the

port for lunch at one of the local hostleries. Some of the party inspected the warm mud pool just behind the jetty. Then back to Lipari which we immediately toured by coach. The real highlight of this tour for me was the large obsidian outflow on the north side of the island close to the large pumice quarries. The pumice is chuted down to a jetty (much as coal is on the banks of the Yangtze gorges in China) to be taken away by boat. Further round on the north west overlooking the island of Salina we stopped to examine some basaltic-andesite pyroclastics (Brown Tuff). The car park also had a group of stalls selling almonds, honey and the local brand of firewater rather like sweet Madeira. Our hotel in Lipari was excellent and the island is so beautiful that I plan to go back for a longer stay.

Thursday - planned trip to Panarea and Stromboli. We set off again down to the port to purchase a picnic and board the boat to Panarea. The sea was fairly rough so, on arrival, there was a discussion with the ship's captain on the inadvisability of going on to Stromboli. We used the time to eat our picnic on the foreshore behind the port area (see photograph). With the cancellation of the trip to Stromboli, Paul took us to see the 14th-13th century BC archaeological site of a bronze age settlement at the south end of the island. This was on the flat top of a high rock that was all but disconnected from the rest of the island, a perfect defensible site. We then returned to Lipari with time to visit the Cathedral and the Archaeological Museum. Paul took a few people round the "Closed for Restoration" Geological Museum. That evening we split up to eat out in various restaurants round the town.



Friday, another early start to take the 7.50 hydrofoil back to Milazzo and board our coach for the journey to Giardini Naxos and book into the hotel Kalos. We left the hotel immediately for Aci Castello with our new guide Guiseppe. After visiting the Norman Castle (c1076) - see photograph below- perched on a huge basalt rock (made up of vertical pillow lava) sticking out to sea on another very fine defensive site, we went down onto the volcanic foreshore to eat a picnic lunch. Then, still on the foreshore, we studied a lava outcrop overlaying clay and a fault with dyke before returning to the hotel for dinner.



Saturday, a day given over to visiting the splendid 6th - 5th century BC Greek temples at Agrigentum and the superb Roman villa at Piazza Armerina. However there was some geology out of the coach windows on the way. Tertiary yellow clays underlying

massive tertiary limestones with extensive erosion. The coach kindly dropped us at the top of the ridge, strangely called the Valle di Templi, and left us to walk up to the first temple and then down past the others to be picked up at the far end. Then on to see the late 2nd – early 3rd century AD villa/palace (the experts are not in full agreement over the exact date or the original occupant). Here are some wonderful mosaics, the well known bikini ladies and I think even better the long – Ambulatory of the great hunt – illustrating the loading of African and Indian wild animals into and out of their naval transports, a Roman Noah’s Ark. There are many more mosaics almost any one of which alone would justify a visit.

Sunday by coach up to the bottom of the now defunct funicular on Etna at about 2000 metres. Here Guiseppe took us for a walk to look more closely at the various lavas and to show us a cavern in the lava where ice was stored in winter and then used in summer to freeze lemon water ice. It is claimed that this lemon ice was invented in Catania at the foot of Etna, no doubt using ice from this cavern. Guiseppi was also exceedingly knowledgeable about the flora. The party then split, Paul taking some for a local cinder cone walk, while the rest took a ride in a massive four-wheel bus further up to look at a fumarole and see the smashed remains of the top funicular station half buried in a lava flow. It is difficult to describe the sheer size of Etna, even at 2000 metres one is still a long way from the top (over 3300 metres) not just vertically, but much much further horizontally (see photograph). By the time we had returned to the hotel the top of Etna was covered with snow and during a brief glimpse looked very beautiful.



Monday and the start of our journey home. We visited Taormina with its fine amphitheatre almost hanging off the steep slope above the town. After time to wander in the old town we set off for Palermo where we had a few hours to enjoy the city before catching the overnight ferry to Naples and dinner on the boat.

Tuesday we arrived very early in Naples harbour where Wendy was waiting to take us to find breakfast from a range of cafe stalls behind the fishing port. After this she took us on a short coach tour above Naples before dropping us in the middle for few minutes final shopping. And so to the airport and home to Gatwick. Overall it was a superb trip thanks to the excellent planning of both Paul and Dorcas. Thank you both very much

Geoffrey Levett