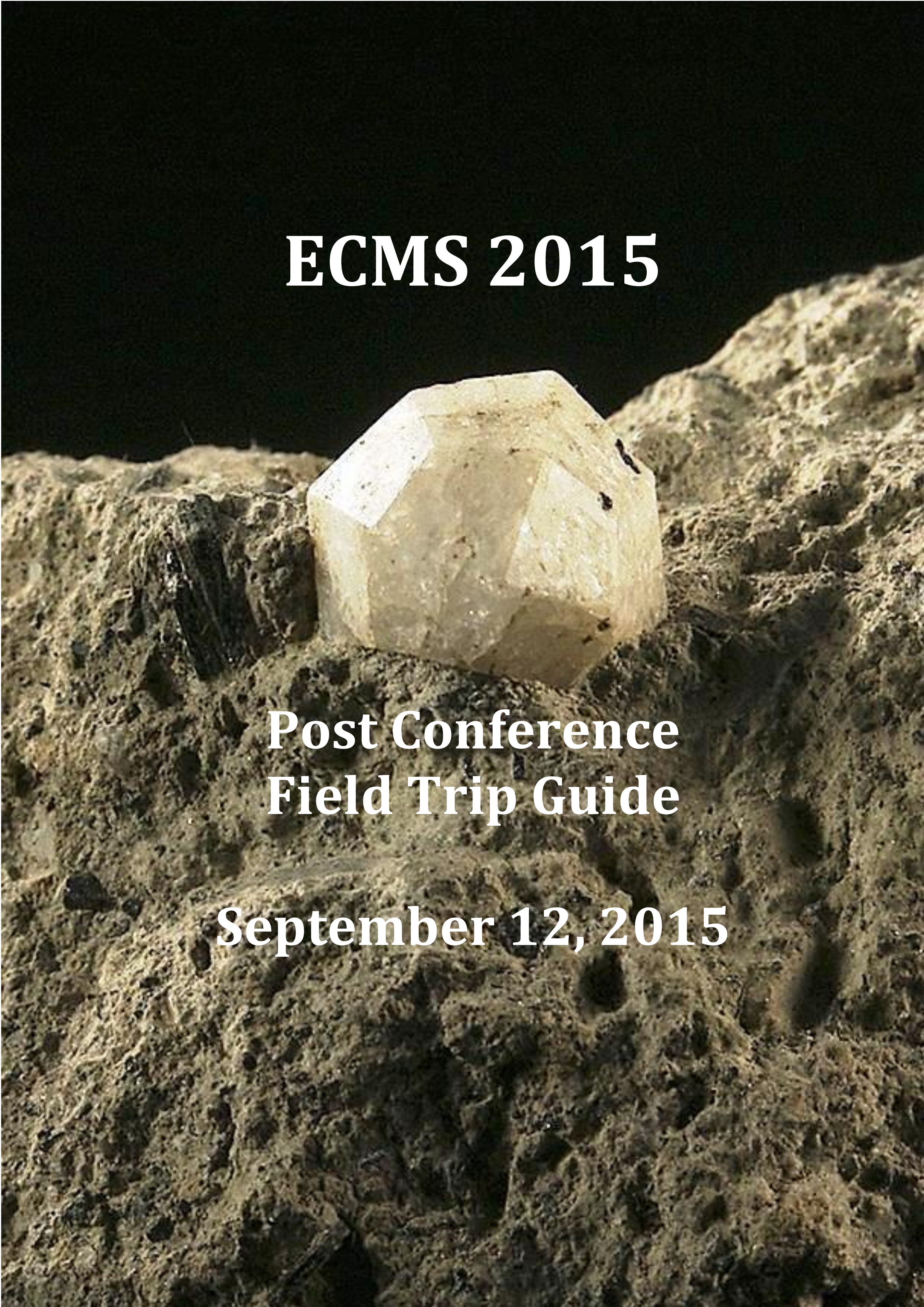
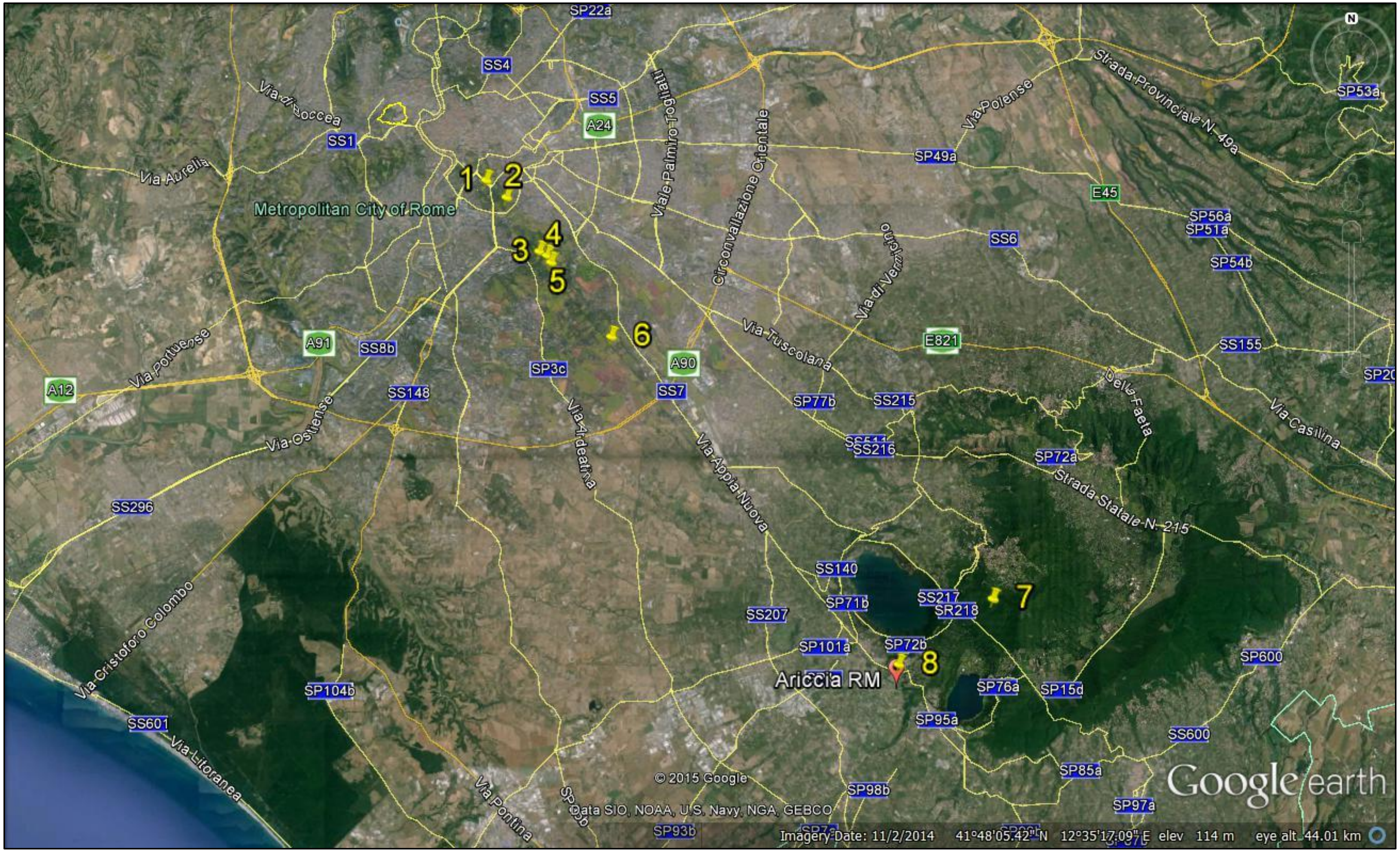


ECMS 2015

Post Conference Field Trip Guide

September 12, 2015



Field trip itinerary: 1) Terme di Caracalla (Caracalla Baths); 2) Porta Appia (Appian Gate); 3) Basilica of Saint Sebastian and its Catacombs; 4) Villa di Massenzio (Villa of Maxentius); 5) Mausoleum of Cecilia Metella and the ruined Parish Church of Saint Nicola a Capo di Bove; 6) Villa dei Quintilii (Villa of the Quintilii); 7) Colli Albani (Alban Hills) Volcanic District; 8) Ariccia.

VIAGGI NEL TEMPO

"SE ASCOLTO, DIMENTICO. SE VEDO, RICORDO. SE FACCIO, CAPISCO."

I hear, I know. I see, I remember. I do, I understand (Confucius)

Ambienti di pietra - Stone Environments

An unusual trip along "via Appia Antica" (Appian Way), also known as *regina viarum* among Archaeology, History and Geology.

The Appian Way, the most important Roman road exhibits along its axis an impressive number of important monuments: the Appian Gate, the Basilica and Catacombs of Saint Sebastian, the Villas of Maxentius and of the Quintilii as well as various Mausoleums including the famous Cecilia Metella one, or historical cities such as Albano Laziale and Ariccia. The visit, in English language, will present the History and Cults that arose in connection with the cemeterial vocation of this road and the nearby presence of the Almone, the most sacred river for the Roman religion. Moreover, the visit will put in relief the major archaeological, architectural and urban structures that rise on the Appian Way.

Saturday, September 12

Field trip day

Start: Piazzale Aldo Moro (in front of the Sapienza University) at 8.30

1. **Terme di Caracalla (Caracalla Baths)**
2. **Porta Appia (Appian Gate)**
3. **Basilica of Saint Sebastian and its Catacombs (external visit)**
4. **Villa di Massenzio (Villa of Maxentius)**
5. **Mausoleum of Cecilia Metella and the ruined Parish Church of Saint Nicola a Capo di Bove**
6. **Villa dei Quintilii (Villa of the Quintilii)**

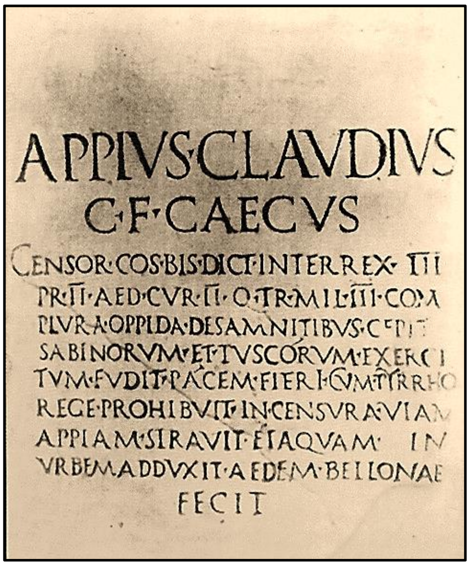
- **Stop for lunch (around 12.30, lunch box included)**

7. **Colli Albani (Alban Hills) Volcanic District: Monte Cavo with a panoramic view of the Alban Hills and the calderas of Albano and Nemi Lakes**
8. **Ariccia: visit to the Sanctuary of Santa Maria di Galloro; Piazza di Corte with view of Palazzo Chigi (Chigi Palace) and Colleggiata of Santa Maria Assunta (Church of the Assumption)**

- **Free time (about 1 h)**
- **Dinner at the Osteria "l'Aricciarola" (around 19.30, with typical Roman cuisine and traditional food)**
- **Return to Rome expected for 22.30**

Appius Claudius Caecus

(From Wikipedia, the free encyclopedia)



Memorial inscription of Appius Claudius C.F. Caecus, "Appius Claudius Caecus, son of Gaius"

Appius Claudius Caecus ("the Blind"; 340 B.C.-273 B.C.) was a Roman politician from a wealthy patrician family. He was dictator himself and the son of Gaius Claudius Crassus, who was briefly dictator in 337 B.C.

Life

He was a censor in 312 B.C. although he had not previously been consul. He sought support from the lower classes, allowing sons of freedmen to serve in the Senate, and extending voting privileges to men in the rural tribes who did not own land. During the Second Samnite War, he advocated the founding of Roman colonies (*colonia*) throughout Latium and Campania to serve as fortifications against the Samnites and Etruscans.

During his term as censor, he built the Appian Way (Latin: Via Appia), an important and famous road between Rome and Capua, as well as the first aqueduct in Rome, the Aqua Appia. He also published for the first time a list of legal procedures and the legal calendar, knowledge of which, until that time, had been reserved for the *pontifices*, the priests. He was also concerned with literature and rhetoric, and instituted reforms in Latin orthography.

He later served as consul twice, in 307 B.C. and 296 B.C., and in 292 B.C. and 285 B.C. he was appointed Dictator. According to Livy, he had gone blind because of a curse. In 279, he gave a famous speech against Cineas, an envoy of Pyrrhus of Epirus, declaring that Rome would never surrender. This is the earliest known manuscript of a political speech in Latin, and is the source of the saying "every man is the architect of his own fortune" (Latin: *quisque faber suae fortunae*).

Composing upon a verse of Greek model, Appius wrote a book called *Sententiae*. It was "the first Roman book of literary character".

Ambienti di pietra - Stone Environments

The Appian Way was begun in 312 B.C. by the censor Appius Claudius. It is the first and most famous of the ancient Roman roads, running from Rome to Campania and southern Italy.
For the first time a big communication route was named not after its function (as in the case of "via Salaria", which means "salt street") or its final destination (as in the case of "via Ostiense" that reaches Ostia), but after the person who built it.
At first the road-reached Capua; later in 268 B.C. it was prolonged to Benevento and finally, by 191 B.C., to Brindisi, thus becoming the main trade connection between Rome and the East.
The Appian Way follows a special route as it doesn't run in a valley but at the top of "Capo di Bove", a 270.000-year-old lava flow erupted from the "Colli Albani Volcanic District" (the Alban Hills), and stretching to the spot where today rises the Mausoleum of Cecilia Metella. This lava flow (a hard flint that was used to pave the Roman road) became the backbone of an almost-straight hill which connected the Alban Hills with Rome. Appius Claudius leveraged on of this sort of backbone to track the Appian Way.
Almost certainly, the first stretch followed the route of an ancient road that started from the Isola Tiberina and, through the valley of the Circo Massimo, reached Albalonga aiming at connecting Rome with Capua, Rome's great ally. At the time a road reaching Campania already existed, it was "via Latina" but it was very long, winding and dangerous. Appius Claudius tracked a new route, skirting the coast, faster and safer. It took two years to build the road. Probably at the very beginning the Appian Way was just a beaten track; in 296 B.C. it was paved, with stone slabs. The road was so important that two magistrates were in charge of it and even Julius Caesar was "curator Appiae".
The first graves began to border the road almost immediately. At the very beginning, the graves were "chambers" like the sepulchre of Scipios, of Servilii or Metelli but, at the end of the second century B.C., an almost uninterrupted double line of graves of various shapes followed the route of the Appian Way. There were family graves or collective ones known as "columbaria" which – in the Christian era - became the renowned catacombs.
In ancient times the Appian Way started from "Porta Capena" near the Circo Massimo, but today it starts from Appian or Saint Sebastian Gate. The road was used until the 6th century A.D., and then it was heavily damaged by invasions and struggles between the noble Roman families.
As time went by the Appian Way became a pilgrimage route run to visit catacombs and to reach Brindisi, where pilgrims embarked for the Holy Land. A slow recovery began only during the Renaissance, thanks to the efforts of archaeologists and historical scholars who transformed it into an extraordinary "memorial".

The tour aims at illustrating the History of the Appian Way and the Cults that arose along its course; a pullman will leave at 8.30 from P.za Aldo Moro – in front of the Sapienza University – and patented English-speaking tourist guides will show you the following monuments:

1. Caracalla Baths

The *Thermae Antoninianae,* one of the largest and best-preserved ancient thermal complexes, were built in the southern part of the city under the initiative of Caracalla, who dedicated the central building in 216 A.D. The rectangular plan is typical of the "great imperial Bathhouses". The Baths were not just a building for bathing, sports and the care of the body but also a place for walking and for study. Four doors on the northeastern facade were the entrance to the main part of the building. On the central axis may be observed, in sequence, the *calidarium*, *tepidarium*, the *frigidarium* and the *natatio*, and, on the sides of this axis, other environments arranged symmetrically around the two *palaestras*.

2. Appian or Saint Sebastian Gate

The real name of this monumental gate, one of the largest and best conserved in the Aurelian Walls, was Appian Gate, from the name of the road. In the Middle Ages the name was corrupted into Daccia and Dazza, over which the name Saint Sebastian Gate eventually prevailed, in honour of the Christian martyr buried in the church on the Appian Way not far from the walls.
The present appearance of the gate is the result of many architectural transformations, which succeeded each other through the course of the centuries.

3. Basilica of Saint Sebastian and its Catacombs (external visit)

This cemetery, named after the martyr Saint Sebastian buried here, was originally called "ad catacumbas". According to the widely acknowledged explanation, the name signifies "near the hollows", because of the mines of tuff located in this area. The name was later used generally to indicate all subterranean Christian cemeteries. Another ancient name of the cemetery was "Apostolic Memorial" (Memoria Apostolorum). The name derives from the liturgical celebrations, dedicated to the Apostles Peter and Paul, which took place here for a limited period in the first centuries.

4. Villa of Maxentius

This villa complex, one of the most evocative archaeological areas in the Roman countryside, extends between miles I and II of the Ancient Appian Way. It comprises three main buildings – the palace, the circus and the dynastic mausoleum, designed in an integral architectonic unit to celebrate the Emperor Maxentius, Constantine the Great's unfortunate adversary in the Battle of Ponte Milvio in 312 A.D.
The design of the circus is linked to the Imperial Palace, a feature that had already been adopted in other palaces during the Tetrarchy, and it was further enriched by the addition of a dynastic mausoleum, commonly known as the Tomb of Romulus, which in fact became the core of the entire complex.

5. Mausoleum of Cecilia Metella and the ruined Parish Church of Saint Nicola a Capo di Bove

The mausoleum was built at the third mile of the Appian Way in the years 30-20 B.C., on a dominant position overlooking the road, just at the final point of a leucite lava flow ejected 260000 years ago from the Alban Hills Volcanic Complex. It is a monumental tomb erected for a Roman noblewoman whose degrees of kinship are known, albeit only partially, thanks to the inscription, still preserved. Her father was Quintus Caecilius Metellus, consul in 69 B.C., who, between 68 and 65 B.C., conquered the island of Crete; her husband was, in all probability, Marcus Licinius Crassus, who distinguished himself among Caesar's retinue on the campaign in Gaul and was the son of the celebrated Crassus, member of the First Triumvirate along with Caesar and Pompey. The imposing tomb is, therefore, to be interpreted both as an homage to the deceased and as a celebration of the glories, riches and prestige of the client family.

6. Villa of the Quintilii

Property of the State only since 1986, the Villa of the Quintilii was the largest and grandest residence of the Roman *Suburbium* (environs). The original nucleus belonged to the Quintilii brothers, consuls in 151 A.D., and it was expanded after the Villa became imperial property under the Emperor Commodus. Commodus loved to reside in it, because of the tranquility of the countryside and of the benefits of the thermal baths housed inside the Villa. It spans the area between "Appia Antica" (the ancient Appian Way) and "Appia Nuova" (the modern Appian Way), and is built around a big square. The most imposing nucleus of the building is the one consisting of the environments for the owners and those for the servants: a circular building, a series of rooms and the two large thermal chambers of the *calidarium* and the *frigidarium*, each 14 meters tall, with spacious windows and polychrome varieties of marble. The monumental complex faces through a series of terraced levels the Roman *Campagna* and offers a view that over time inspired many celebrated artists.

- **Lunch break**

7. Colli Albani (Alban Hills) Volcanic District: Monte Cavo with a panoramic view of the Alban Hills and the calderas of Albano and Nemi Lakes

Panoramic view of the Colli Albani; Nemi Lake (left) and Albano Lake (right)

Leucite, Alban Hills (courtesy of R. Pucci)

Haüyne, Alban Hills (courtesy of R. Pucci)

See later for more information about the Colli Albani Volcanic District and associated mineralogy.

8. Ariccia: visit to the Sanctuary of Santa Maria di Galloro; Piazza di Corte with view of Palazzo Chigi (Chigi Palace) and Colleggiata of Santa Maria Assunta (Church of the Assumption)

- **Sanctuary of Santa Maria di Galloro -** Going along the New Appian Way, on the road to Genzano, one finds the sanctuary of Saint Mary of Galloro, legacy to the veneration of *an image of Virgin Mary* , which according to local tradition, was found in 1621 by Sante Bevilacqua, a boy from Tuscany living in Ariccia. The cult of the Virgin of Galloro went beyond the local diocese and reached Rome, provoking a great affluence of pilgrims and devout people. Prince Paul

Savelli, Gentleman of Ariccia, decided to construct a church dedicated to the Immaculate Conception.

- **Chigi Palace -** The ducal palace of Ariccia is a unique example of a baroque home which has remained virtually unchanged in its environment and with its original furnishings, and testifies the great wealth of one of the most important Italian papal lines: the Chigi family. The family was also the owner of the Chigi Palace in Rome which today houses the offices of the Council of Ministers of Italy.
- **Church of the Assumption -** Pope Alexander VII Chigi lived in Ariccia for quite some time, and it is thanks to him that the town received a completely new layout with the work of Bernini, through the construction of the Church of the Assumption, and the public square which lies in front of the Chigi Palace. Bernini's plans were inspired by the architectural structure of the Pantheon and he used a circular shape for his church in Ariccia. To flank the church, two buildings called Casino del Governatore and Casino del Ministro (Houses of the Governor and the Minister) were constructed. They are connected to the church through a theatrical exedra in the rear part of the church. In Piazza di Corte there is a building which once was the site of the famous "Martorelli Inn" (Locanda Martorelli), famous above all for the cycle of wall paintings executed by Polish painter Thaddeus Kuntze. They are of great importance for the history of Ariccia insomuch as they illustrate the origins and the mythology of the area. It was an obligatory stop for all those who undertook the *Grand Tour d'Italie*, and became its own painting academy "en plein air", since the greatest landscape painters of the century stayed there: from Turner to Corot, to the Russian Ivanov, drawn there above all by the Chigi Park, which was the epitome of their romantic ideals.

- **Dinner at the Osteria "l'Aricciarola" with typical Roman cuisine and traditional food**

- **Return to Rome**

Colli Albani Volcanic District

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Introduction

The Colli Albani Volcanic District (CAVD) is part of the Roman Province (e.g. Peccerillo, 2005, Conticelli et al., 2010), a volcanic chain emplaced in the Mediterranean area along the Tyrrhenian Sea margin of the Italian peninsula during middle/late Pleistocene. This area experienced a complex tectonic history that affected the composition of the upper mantle (Carminati et al., 2012). The ultrapotassic magmatism of the Roman Province is thought to originate from a phlogopite-bearing peridotite mantle source, previously metasomatized by subduction-related melts (Peccerillo, 2005 and references therein).
In particular, the CAVD ultrapotassic rocks, mainly classified as K-foiditic rocks, are characterised by a monotonous mineralogical assemblage made up of ubiquitous clinopyroxene and leucite crystals and homogenous major element concentrations (Gozzi et al., 2014 and references therein). Conversely, products show a steady, time-dependent decrease of the $^{87}Sr/^{86}Sr$ ratios (Gaeta et al., 2006). This feature has been interpreted to reflect the progressive depletion of the metasomatised mantle source, evidencing that each of the main eruptive cycles at the CAVD was fed by a new batch of magma with renewed geochemical signature (Gaeta et al., 2006; 2011).

Stratigraphic and geochemical framework

The eruptive activity of the CAVD (Figs. 1 and 2) spans the interval 608-36 ka. This activity, despite marked changes in the eruptive style and energy, is tightly clustered in eleven geochronologically distinct eruptive cycles, regularly separated by dormancy periods of about 40 kyr (Marra et al., 2004). The CAVD activity was traditionally subdivided into three phases generally characterized by a trend of decreasing erupted volumes (cfr. De Rita et al., 1988; 1995; Giordano et al., 2006). However, more recent studies have distinguished five phases on the basis of their diverse eruptive style and energy (Figs. 1 and 2): the Early Tuscolano-Artemisio Phase and the Late Tuscolano-Artemisio Phase, characterised by a caldera-forming explosive activity (608-351 ka); the Monte delle Faete Phase, characterised by intermediate strombolian-effusive activity (309-241 ka); the Late Hydromagmatic Phase (204-142 ka) and the Albano Phase (69-36 ka) (Marra et al., 2009). A notably inversion in the trend of decreasing volume and energy occurred during the Albano Phase (69-36 ka) which is, indeed, characterized by a more magmatic and energetic eruptive style with respect to the previous Late Hydromagmatic Phase (Freda et al., 2006; Giaccio et al., 2007; 2009). On this basis, it has been suggested that the Albano Phase should represent a rejuvenation of the CAVD volcanic activity. The ~70 kyr dormancy that preceded the Albano Phase, longer than the typical CAVD dormancy (~40 kyr, Marra et al., 2004), and the marked change in the $^{87}Sr/^{86}Sr$ ratio of the products erupted in the early stages of this phase (69 ka), strengthen this hypothesis (Karner et al., 2001a; Freda et al., 2006; Gaeta et al., 2011).
The CAVD products are characterized by rather homogeneous geochemical compositions, plotting mainly within the foiditic and the phonotephritic fields of the total alkali-silica (TAS) diagram (Trigila et al., 1995; Freda et al., 1997; 2006; Gaeta 1998; Gaeta and Freda 2001; Palladino et al., 2001; Marra et al., 2003; 2009; Gaeta et al., 2006, 2011; Boari et al., 2009; Gozzi et al., 2014). Even the most differentiated products are characterized by low SiO_2 content (≤45 wt.%) and display a modal composition consisting of clinopyroxene and leucite crystals. Feldspars are generally absent. In particular, plagioclase occurs only in the groundmass of the most primitive lava flows, whereas Ba-rich sanidine occurs only in differentiated glassy scoriae due to the low silica activity induced by the

Si+K=Al+Ba reaction (Gaeta, 1998). Moreover, in the groundmass of the more differentiated lava flows, calcite and melilite also occur (Gozzi et al. 2014).
Geochemical and experimental studies have demonstrated that the CAVD liquid line of descent towards differentiated K-foiditic magmas is mainly due to magma-carbonate interaction (Freda et al., 1997; 2008; Dallai et al., 2004; Gaeta et al., 2006; 2009; Iacono Marziano et al., 2007; Laurora et al., 2009; Mollo et al., 2010; Peccerillo et al., 2010; Di Rocco et al., 2012; Cross et al., 2014; Gozzi et al., 2014). Different evolutionary models have been also proposed. In these models, products from the Tuscolano-Artemisio phases (also called pre-caldera period) are explained by processes occurring under closed-system conditions (i.e., negligible role of crustal assimilation processes). Conversely, products emplaced after the Tuscolano-Artemisio phases (also called post-caldera period) are thought to be characterized by several different liquid lines of descent, basically driven by AFC processes involving a $CaCO_3$-poor siliciclastic sedimentary contaminant (e.g., Boari et al. 2009; Conticelli et al 2010). However, macroscopic and microscopic evidences (i.e. cored bomb and magmatic calcite, respectively) clearly demonstrate the occurrence of magma-carbonate interaction in both pre- and post-caldera activity (Freda et al., 2011; Gozzi et al., 2014). Moreover, it has been recognised that CAVD rocks are characterized by a steady, time-dependent decrease of the $^{87}Sr/^{86}Sr$ ratio that is independent from the carbonate-assimilation process and it is related to modifications of the magma mantle source (Gaeta et al., 2006; 2011).

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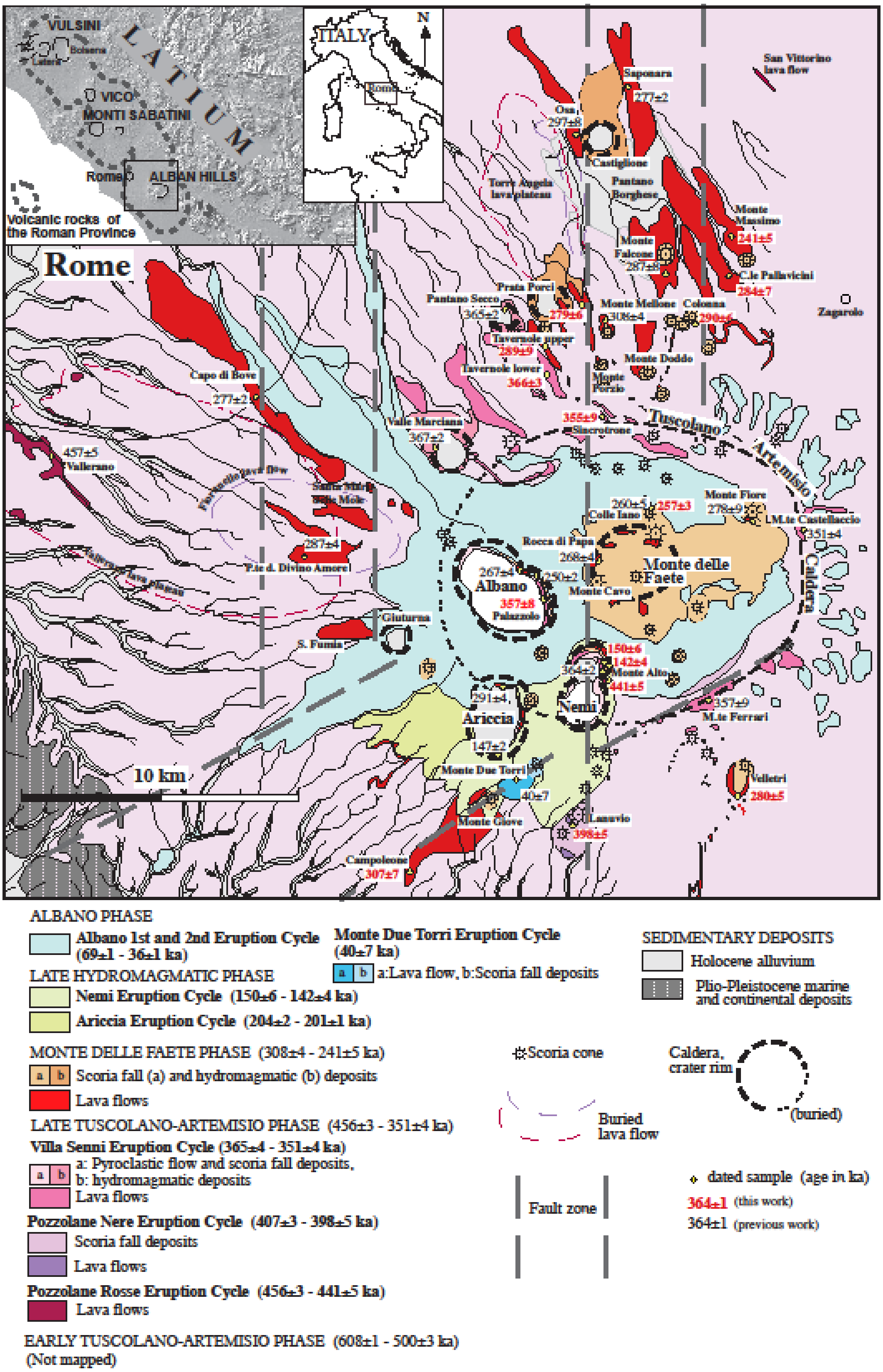


Figure 1. Geologic map of the Colli Albani Volcanic District based on Fornaseri et al., 1963; De Rita et al., 1988, Giordano et al., 2006. The map has been modified according to $^{40}Ar/^{39}Ar$ geochronology data newly obtained for in this work (in red) and to data already published (in black; Karner and Renne, 1998; Karner et al., 2001b; Marra et al., 2003; 2009; Freda et al., 2006; Giaccio et al., 2007; Gaeta et al., 2011).

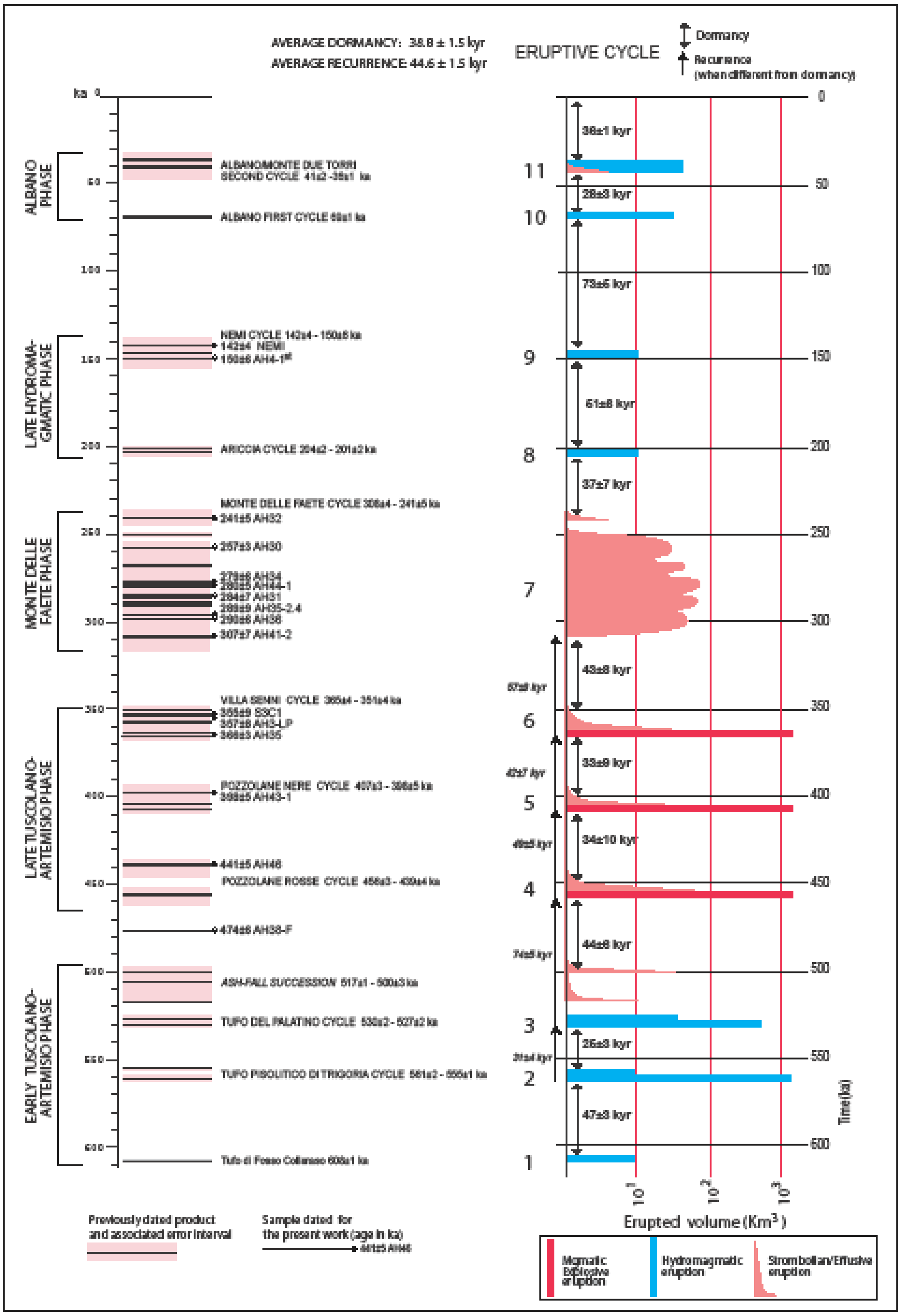


Figure 2. Fig. 2 – Chronostratigraphic scheme summarizing the eruptive history of the Colli Albani Volcanic District based on $^{40}Ar/^{39}Ar$ geochronology data newly obtained for in this work (in bold) and to data already published (Karner and Renne, 1998; Karner et al., 2001b; Marra et al., 2003; 2009; Freda et al., 2006; Giaccio et al., 2007; Gaeta et al., 2011). The pinkish portions represent the overlapping age intervals based on the associated errors at 2σ. On the right column, the eruptive history is represented as a function of the eruption style, energy, and duration. Dormancies represent the time elapsed since the end of one eruption cycle and the beginning of the following one; recurrences are assessed based on the time elapsed since the beginning of each eruptive cycle. See text for further explanation.

Alban Hills Mineralogy

- **4 type localities for Gismondine, Haüyne, Latiumite and Phillipsite-K**
- **More than 70 valid minerals**

Gismondine, Alban Hills (courtesy of R. Pucci)

Haüyne, Alban Hills (courtesy of Mineralogy Museum, Sapienza University of Rome)

Latiumite, Alban Hills (courtesy of R. Pucci)

Phillipsite-K, Alban Hills (courtesy of R. Pucci)

Gismondine

Gismondine-Ca: Arensberg, Zilsdorf, Hillesheim, Eifel, Rhineland-Palatinate, Germany

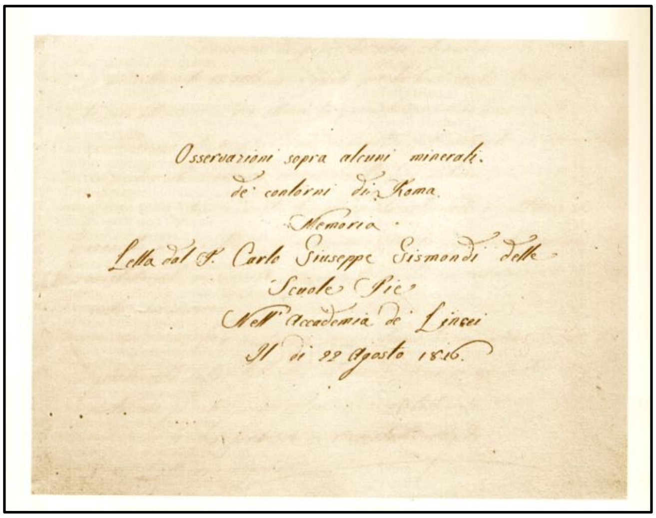
Gismondine: Vedretta della Miniera, Zebrù Valley, Valfurva, Valtellina, Sondrio Province, Lombardy, Italy

Formula: $Ca_2(Si_4Al_4)O_{16}\cdot 8H_2O$

IMA status: Valid; Approved species

Type Locality: Capo di Bove, Rome Province, Latium, Italy

Name: Named for Carlo Giuseppe Gismondi (1762-1824), Italian mineralogist, who also discovered "zeagonite" - a mixture of gismondine and phillipsite.



Osservazioni sopra alcuni minerali
de' contorni di Roma.
Memoria
Letta dal P. Carlo Giuseppe Gismondi delle
Scuole Pie
Nell' Accademia de' Lincei
Il dì 22 Agosto 1816.

Presentation of the new mineral later named Gismondine: original note written by Carlo Giuseppe Gismondi, 1816 (courtesy of "Il Cercapietre", March 1997)

Gismondine $Ca_2Al_4Si_4O_{16} \cdot 9H_2O$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals dipyramidal, composite, to 2 cm. In stellate or radiating spherulitic aggregates; powdery. *Twinning:* On the normal to {100}, giving pseudotetragonal or pseudo-orthorhombic individuals.

Physical Properties: *Cleavage:* $\{\overline{2}32\}$, distinct. *Fracture:* Subconchoidal. Hardness = 4.5 D(meas.) = 2.20–2.26 D(calc.) = 2.28 Piezoelectric.

Optical Properties: Transparent to translucent. *Color:* White, grayish, bluish white, reddish; colorless in thin section. *Luster:* Vitreous.
Optical Class: Biaxial (–); sectored. *Orientation:* $Y = b$; $Z \wedge c = 42.5°$. $\alpha = 1.525$–1.540 $\beta = 1.531$–1.544 $\gamma = 1.541$–1.550 2V(meas.) = 82°–86°

Cell Data: *Space Group:* $P2_1/c$. a = 10.02 b = 10.62 c = 9.84 $\beta = 92°25'$ Z = 2

X-ray Powder Pattern: Round Top volcano, Hawaii, USA.
2.706 (100), 4.25 (70), 3.19 (70), 4.93 (60), 3.13 (60), 7.26 (55), 2.738 (55)

Chemistry:

	(1)	(2)	(3)
SiO_2	33.89	38.03	33.45
Al_2O_3	28.14	26.61	28.38
Fe_2O_3	0.00	trace	
CaO	13.96	12.81	15.61
SrO	0.025		
BaO	0.27	0.00	
Na_2O		1.32	
K_2O	2.86	0.07	
H_2O	20.76	21.58	22.56
Total	99.91	100.42	100.00

(1) Capo di Bove, Italy; corresponds to $(Ca_{1.78}K_{0.44})_{\Sigma=2.22}Al_{3.95}Si_{4.03}O_{16} \cdot 8.24H_2O$.
(2) Eyrarfjäll, Reydarfjord, Iceland; corresponds to $(Ca_{1.59}Na_{0.30}K_{0.02})_{\Sigma=1.91}Al_{3.63}Si_{4.40}O_{16} \cdot 8.34H_2O$. (3) $Ca_2Al_4Si_4O_{16} \cdot 9H_2O$.

Mineral Group: Zeolite group.

Occurrence: In cavities in nepheline and olivine basalt and leucite tephrite.

Association: Zeolites, calcite, chlorite, quartz.

Distribution: At Capo di Bove and elsewhere around Rome, Lazio, Italy. In Germany, from the Hohenberg, near Bühne, Westphalia; on the Frauenberg, near Fulda, Hesse; at the Schlauroth, Görlitz, Saxony; on the Arensberg, near Zilsdorf; and from the Schellkopf, near Brenk, and elsewhere in the Eifel district. From near Zálezly (Salesel), Czech Republic. Found near the Gorner glacier, near Zermatt, Valais, Switzerland. In Ireland, at many localities in Co. Antrim, as in the Bruslee quarry, Ballyclare. On Iceland, many localities around Reydarfjord, Fáskrúdsfjord, and Fagridalur. At Round Top volcano, Oahu, and Alexander Dam, Kauai, Hawaii, USA. From Concepción del Oro, Zacatecas, Mexico. A number of other localities are known.

Name: For Professor Carlo Giuseppe Gismondi (1762–1824), Italian mineralogist, Rome, Italy, who first examined the mineral.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 586–587. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 4, framework silicates, 401–407. (3) Walker, G.P.L. (1962) Low-potash gismondine from Ireland and Iceland. Mineral. Mag., 33, 187–201. (4) Fischer, K. (1963) The crystal structure determination of the zeolite gismondite. $CaAl_2Si_2O_8 \cdot 4H_2O$. Amer. Mineral., 48, 664–672. (5) Iijima, A. and K. Harada (1969) Authigenic zeolites in zeolitic palagonite tuffs on Oahu, Hawaii. Amer. Mineral., 54, 182–197. (6) Nawaz, R. (1980) Morphology, twinning, and optical orientation of gismondine. Mineral. Mag., 43, 841–844. (7) Vezzalini, G. and R. Oberti (1984) The crystal chemistry of gismondines: the non-existence of K-rich gismondines. Bull. Minéral., 107, 805–812.

Haüyne

Haüyne: San Vito quarry, San Vito, Ercolano, Monte Somma, Somma-Vesuvius Complex, Naples Province, Campania, Italy

Haüyne, Lazurite variety: Ladjuar Medam, Sar-e Sang, Koksha Valley, Khash & Kuran Wa Munjan Districts, Badakhshan Province, Afghanistan

Formula: $Na_3Ca(Si_3Al_3)O_{12}(SO)_4$

IMA status: Valid; first described prior to 1959 (pre-IMA) - "Grandfathered"

Type Locality: Nemi Lake, Alban Hills, Rome Province, Latium, Italy

Name: To honor Abbè Renè Just Haüy (1743-1822), French crystallographer and mineralogist.

Tentatively named lazialite in 1803 by Carlo Giuseppe Gismondi for the locality (Nemi Lake, Latium) without formal publication. Named in 1807 by Tønnes Christian Bruun de Neergaard in honor of Abbé Rene Just Haüy (February 28, 1743 Saint-Just-en-Chausse, France; June 1, 1822 Paris, France), "Father of Crystallography". Haüy was a Roman Catholic Priest and curator of the Muséum National d'Histoire Naturelle in Paris. Haüy devised and sold wooden crystal models which were highly prized internationally, both among his contemporaries as well as today. Haüyne was temporarily named hauynite by James Dwight Dana in 1868.

Renee Just Haüy

Haüyne $(Na, Ca)_{4-8}Al_6Si_6(O, S)_{24}(SO_4, Cl)_{1-2}$

Crystal Data: Cubic. *Point Group:* $\overline{4}3m$. Crystals dodecahedra or pseudo-octahedra, to 3 cm; in rounded grains. *Twinning:* On {111}, common, rarely as penetration twins; also as polysynthetic or contact twins.

Physical Properties: *Cleavage:* {110}, distinct. *Fracture:* Uneven to conchoidal. *Tenacity:* Brittle. Hardness = 5.5–6 D(meas.) = 2.44–2.50 D(calc.) = n.d. May show reddish orange to purplish pink fluorescence under LW UV.

Optical Properties: Transparent to translucent. *Color:* Bright blue to greenish blue; white or shades of black, gray, brown, green, yellow, red, may be patchy; colorless or pale blue in thin section. *Streak:* Slightly bluish to colorless. *Luster:* Vitreous to greasy.
Optical Class: Isotropic; weakly birefringent when included. $n = 1.494–1.509$

Cell Data: *Space Group:* $P\overline{4}3n$. a = 9.08–9.13 Z = 1

X-ray Powder Pattern: Niedermendig, Germany.
3.72 (100), 2.623 (25), 6.47 (16), 2.873 (14), 2.141 (14), 1.781 (10), 2.428 (8)

Chemistry:

	(1)	(2)		(1)	(2)
SiO_2	34.04	29.3	K_2O	5.44	3.71
Al_2O_3	28.27	29.0	Cl	0.76	
Fe_2O_3		0.07	H_2O	0.34	
FeO	0.69		CO_2	0.4	
MgO	0.48	0.15	SO_3	10.02	13.1
CaO	9.51	11.2	$-O = Cl_2$	0.17	
Na_2O	10.39	13.0	Total	100.17	99.53

(1) Monte Vulture, Italy; corresponds to $(Na_{3.55}Ca_{1.80}K_{1.22}Mg_{0.13})_{\Sigma=6.70}Al_{5.89}Fe_{0.11}Si_{6.00}O_{24}[(SO_4)_{1.33}Cl_{0.22}]_{\Sigma=1.55}$. (2) Anguillara, Italy; by electron microprobe, corresponds to $(Na_{4.76}Ca_{2.26}K_{0.90}Mg_{0.45})_{\Sigma=8.37}Al_{6.46}Fe_{0.01}Si_{5.53}O_{24}(SO_4)_{1.86}$.

Mineral Group: Sodalite group.

Occurrence: In phonolites and related leucite- or nepheline-rich igneous rocks; less commonly in nepheline-free extrusives.

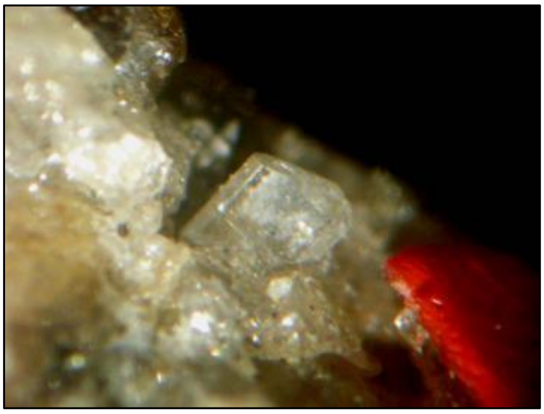
Association: Nepheline, leucite, titanian andradite, melilite, augite, sanidine, biotite, phlogopite, apatite.

Distribution: In Italy, in Lazio, at many localities in the Alban Hills, as at Ariccia, Marino, Sacrofano, and Campagnaro; on Monte Somma, and near Melfi, on Monte Vulture, Campania; in the Pitigliano quarry, near Grosseto, Tuscany. From Mendig, Mayen, and elsewhere in the Eifel district, Germany. In the USA, from Winnett, Petroleum Co., Montana, and in the Edwards mine, St. Lawrence Co., New York. In the Niangniang Shan complex, Nanjing, Jiangsu Province, China. On the smaller island of Taiarupu, Tahiti. A few other localities are known.

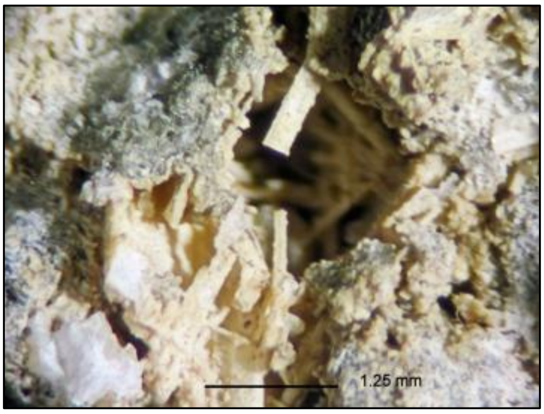
Name: To honor Abbé René Just Haüy (1743–1822), French crystallographer and mineralogist.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 431–432. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 4, framework silicates, 289–302. (3) Taylor, D. (1967) The sodalite group of minerals. Contr. Mineral. Petrol., 16, 172–188. (4) Löhn, J. and H. Schulz (1968) Strukturverfeinerung am gestörten Hauyn, $(Na_5K_1Ca_2)Al_6Si_6O_{24}(SO_4)_{1.5}$. Neues Jahrb. Mineral., Abh., 109, 201–210 (in German with English abs.). (5) Burragato, F., A. Maras, and A. Rossi (1982) The sodalite group minerals in the volcanic areas of Latium. Neues Jahrb. Mineral., Monatsh., 433–445. (6) Hassan, I. and P. Buseck (1989) Cluster ordering and antiphase domain boundaries in hauyne. Can. Mineral., 27, 173–180.

Latiumite



Latiumite: Ariccia, Alban Hills, Rome Province, Latium, Italy



Latiumite: Campagnano Quarry, Campagnano di Roma, Sacrofano Caldera, Rome Province, Latium, Italy

Formula: $(Ca,K)_4(Si,Al)_5O_{11}(SO_4,CO_3)$

IMA status: Valid; first described prior to 1959 (pre-IMA) - "Grandfathered"

Type locality: Hannibal Fields, Rocca di Papa, Alban Hills, Rome Province, Latium, Italy

Name: For the Latin name of the district of origin, Latium, Italy.

Latiumite $(Ca, K)_8(Al, Mg, Fe)(Si, Al)_{10}O_{25}(SO_4)$

Crystal Data: Monoclinic. *Point Group:* 2. Elongated tabular crystals, to 5 mm; also massive. *Twinning:* On {100} common, simple or multiple.

Physical Properties: *Cleavage:* {100}, perfect. Hardness = 5.5–6 D(meas.) = 2.93 D(calc.) = 2.92

Optical Properties: Transparent to translucent. *Color:* White, may be zoned or mottled. *Luster:* Vitreous.
Optical Class: Biaxial (+) or (–). *Orientation:* $Z = b$; $X \wedge c = 16°–28°$. *Dispersion:* $r > v$, marked. $\alpha = 1.600–1.603$ $\beta = 1.606–1.609$ $\gamma = 1.614–1.615$ 2V(meas.) = 83°–90°

Cell Data: *Space Group:* $P2_1$. $a = 12.06(1)$ $b = 5.08(2)$ $c = 10.81(1)$ $\beta = 106.0°$ Z = 2

X-ray Powder Pattern: Albano, Italy.
2.86 (s1), 3.06 (s2), 2.96 (s3), 2.54 (s), 4.6 (m), 4.5 (m), 3.83 (m)

Chemistry:

	(1)		(1)
SiO_2	28.33	K_2O	7.20
Al_2O_3	24.67	Cl	0.14
Fe_2O_3	0.50	H_2O^+	0.27
FeO	0.55	H_2O^-	0.00
MnO	0.02	CO_2	1.60
MgO	0.76	SO_3	5.42
CaO	29.41	$-O = Cl_2$	0.03
Na_2O	1.11	Total	99.95

(1) Albano, Italy; combination of two partial analyses, corresponding to $(Ca_{5.91}K_{1.73}Na_{0.40})_{\Sigma=8.04}$ $(Al_{0.76}Mg_{0.21}Fe^{2+}_{0.09}Fe^{3+}_{0.07})_{\Sigma=1.03}(Si_{5.31}Al_{4.69})_{\Sigma=10.00}O_{25}[(SO_4)_{0.76}(CO_3)_{0.40}Cl_{0.02}]_{\Sigma=1.18}$.

Occurrence: In blocks of metamorphosed limestone ejected by volcanism.

Association: Hedenbergite, grossular-andradite, melilite, leucite, haüyne, kaliophilite.

Distribution: From Albano, in the Alban Hills, Lazio, and from Pitigliano, near Grosseto, Tuscany, Italy.

Name: For the Latin name of the district of origin, Latium, Italy.

Type Material: Cambridge University, Cambridge, England, 45482, 29799.

References: (1) Tilley, C.E. and N.F.M. Henry (1953) Latiumite (sulphatic potassium-calcium-aluminum silicate), a new mineral from Albano, Latium, Italy. Mineral. Mag., 30, 39–45. (2) (1954) Amer. Mineral., 39, 402–403 (abs. ref. 1). (3) Cannillo, E., A. Dal Negro, and G. Rossi (1973) The crystal structure of latiumite, a new type of sheet silicate. Amer. Mineral., 58, 466–470.

Phillipsite-K

Phillipsite-K: Vallerano Quarries, Valleranello, Rome, Rome Province, Latium, Italy

Phillipsite-K: Vallerano Quarries, Valleranello, Rome, Rome Province, Latium, Italy

Formula: $K_6(Si_{10}Al_6)O_{32}\cdot 12H_2O$

IMA status: Valid; Approved species

Type Locality: Capo di Bove, Rome Province, Latium, Italy

Name: Named after William Phillips (1775-1828), English mineralogist and founder of the Geological Society of London. The K-dominant member of the phillipsite series.

William Phillips

Phillipsite $(K, Na, Ca)_{1-2}(Si, Al)_8O_{16} \cdot 6H_2O$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals always twinned, pseudosymmetrical; striated ∥ [001] on {010}, to 2 cm. Equant to prismatic, or in spherical radiating aggregates. *Twinning:* Cruciform single and double penetration twins on {001}, {021}, {110}, ubiquitous.

Physical Properties: *Cleavage:* {010}, {100}, distinct. *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 4–4.5 D(meas.) = 2.20 D(calc.) = 2.242

Optical Properties: Translucent to opaque. *Color:* Colorless, white, reddish, yellowish; colorless in thin section. *Streak:* White. *Luster:* Vitreous.
Optical Class: Biaxial (+). *Orientation:* $X = b$; $Y \wedge a = 46°–65°$. *Dispersion:* $r < v$.
$\alpha = 1.483–1.504$ $\beta = 1.484–1.509$ $\gamma = 1.486–1.514$ 2V(meas.) = 60°–80°

Cell Data: *Space Group:* $P2_1/m$. $a = 9.865(2)$ $b = 14.300(4)$ $c = 8.668(2)$
$\beta = 124.20(3)°$ Z = 2

X-ray Powder Pattern: Casal Brunori quarry, near Rome, Lazio, Italy.
3.206 (100), 7.16 (66), 7.18 (63), 4.12 (41), 3.277 (37), 4.13 (36), 2.753 (36)

Chemistry:

	(1)
SiO_2	46.03
Al_2O_3	21.43
$FeO + Fe_2O_3$	0.99
CaO	5.73
Na_2O	3.13
K_2O	5.59
H_2O	17.22
Total	100.12

(1) Mazé, Japan; corresponds to $(K_{0.79}Na_{0.68}Ca_{0.68}Fe_{0.08})_{\Sigma=2.23}(Si_{5.12}Al_{2.81})_{\Sigma=7.93}O_{16} \cdot 6.39H_2O$.

Mineral Group: Zeolite group.

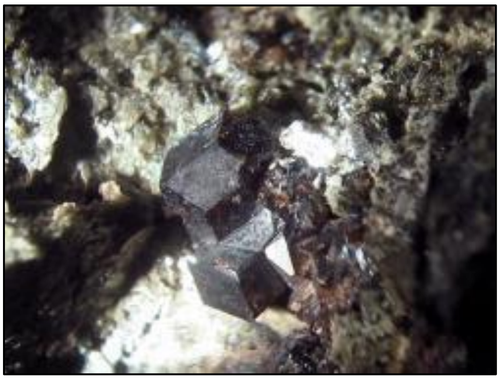
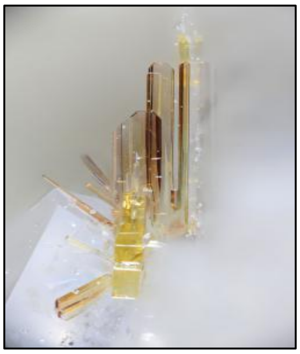
Occurrence: Typically in cavities in basalt, of hydrothermal origin; an authigenic mineral in saline lake and hot spring deposits and calcareous deep-sea sediments.

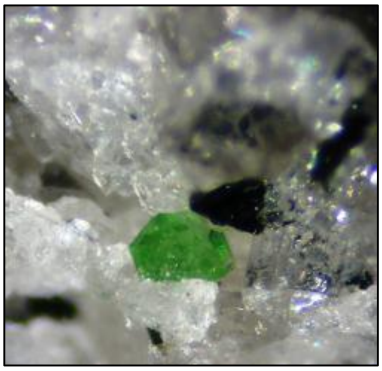
Association: Zeolites, apophyllite, calcite, nosean, nepheline, olivine, melilite, celadonite.

Distribution: Many localities, although uncommon in large crystals. Well authenticated localities include: from Aci Castello, Sicily, and at Capo di Bove and other localities around Rome, Lazio, Italy. At Annerod, near Giessen, Hesse, and Asbach, Westerwald, Germany. Along the Giant's Causeway, Co. Antrim, Ireland. In the USA, from Oregon, at Wall Creek, near Monument, and Mount Vernon, Grant Co.; at Cape Lookout, Tillamook Co.; Spray, Wheeler Co.; and many other localities. At Mazé, Niigata Prefecture, Japan. At Richmond, Victoria, and Gads Hill, near Liena, Tasmania, Australia.

Name: For William Phillips (1775–1828), noted British mineralogist.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 578–581. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 4, framework silicates, 386–399. (3) Harada, K., S. Iwamoto, and K. Kihara (1967) Erionite, phillipsite and gonnardite in the amygdales of altered basalt from Mazé, Niigata Prefecture, Japan. Amer. Mineral., 52, 1785–1794. (4) Galli, E. and A.G. Loschi Ghittoni (1972) The crystal chemistry of phillipsites. Amer. Mineral., 57, 1125–1145. (5) Rinaldi, R., J.J. Pluth, and J.V. Smith (1974) Zeolites of the phillipsite family. Refinement of the crystal structures of phillipsite and harmotome. Acta Cryst., 30, 2426–2433. (6) Gottardi, G. and E. Galli (1985) Natural zeolites. Springer, 326–328.

Andradite: $Ca_3Fe^{3+}{}_2(SiO_4)_3$	**Apatite: $Ca_5(PO_4)_3(F,OH,Cl)$**
	
Ariccia, Alban Hills, Rome Province, Latium, Italy Copyright: © Cristian B.	**Colle Cimino, Marino, Alban Hills, Rome Province, Latium, Italy** Copyright: © Luigi Mattei
Aragonite: $CaCO_3$	**Artinite: $Mg_2(CO_3)(OH)_2 \cdot 3H_2O$**
	
Colle Cimino, Marino, Alban Hills, Rome Province, Latium, Italy Copyright: © Luigi Mattei	**Albano Laziale, Alban Hills, Rome Province, Latium, Italy** Copyright: © Luigi Mattei
Augite: $(Ca,Na)(Mg,Fe^{2+},Al,Fe^{3+},Ti)[(Si,Al)_2O_6]$	**Baddeleyite: ZrO_2**
	
Parco Chigi, Ariccia, Alban Hills, Rome Province, Latium, Italy Copyright: © Alessandro Tagliaferri	**Albano Lake Crater, Albano Laziale, Alban Hills, Rome Province, Latium, Italy** Copyright: © Dario Di Domenico

Biotite: $K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH,F)_2$	**Chabazite-K:** $(K_2,Ca,Na_2,Sr,Mg)_2(Al_2Si_4O_{12})_2\cdot 12H_2O$
	
Alban Hills, Rome Province, Latium, Italy Photo ID: 274624	**Vallerano, Alban Hills, Rome Province, Latium, Italy** Copyright: © Matteo Chinellato
Cuspidine: $Ca_4(Si_2O_7)(F,OH)_2$	**Ekanite:** $(Ca,Fe^{2+},Pb)_2(Th,U)(Si_8O_{20})$
	
Ariccia, Alban Hills, Rome Province, Latium, Italy Copyright: © D. Preite - M.C.	**Albano Lake Crater, Albano Laziale, Alban Hills, Rome Province, Latium, Italy** Copyright: © Luigi Mattei
Ettringite: $Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$	**Fluoborite:** $Mg_3(BO_3)(F,OH)_3$
	
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Franzinite: $(Na,K)_6Ca_2(Al_6Si_6O_{24})(SO_4)_2 \cdot 0.5H_2O$	**Gismondine: $Ca(Al_2Si_2O_8) \cdot 4.5H_2O$**
	
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Götzenite: $NaCa_4(Ca,Na)_2(Si_2O_7)_2OF_3$	**Grossular: $Ca_3Al_2(SiO_4)_3$**
	
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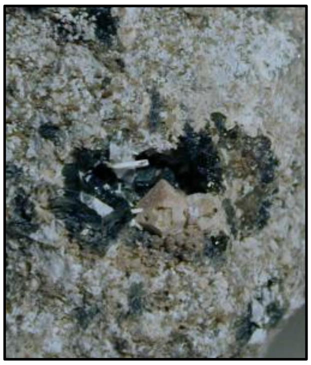
Halotrichite: $FeAl_2(SO_4)_4 \cdot 22H_2O$	**Harkerite: $Ca_{12}Mg_4Al(BO_3)_3(SiO_4)_4(CO_3)_5 \cdot H_2O$**
	
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Haüyne: $(Na,Ca)_{4\text{-}8}(Al_6Si_6O_{24})(SO_4,S,Cl)_{1\text{-}2}$	**Hellandite Group, Pyrochlore Group: $A_2Nb_2(O,OH)_6Z$**
	
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Hornblende: $Ca_2(Mg,Fe,Al)_5(Al,Si)_8O_{22}(OH)_2$	**Hydromagnesite: $Mg_5(CO_3)_4(OH)_2\cdot 4H_2O$**
	
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Kaliophilite: $KAlSiO_4$	**Kalsilite: $KAlSiO_4$;** **Melilite: $(Ca,Na)_2(Al,Mg,Fe^{2+})[(Al,Si)SiO_7]$**
	
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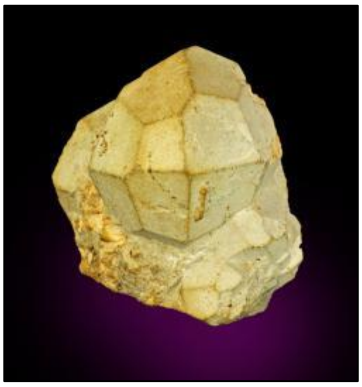
Latiumite: $(Ca,K)_4(Si,Al)_5O_{11}(SO_4,CO_3)$	Leucite: $K(AlSi_2O_6)$
	
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Magnesioferrite: $MgFe^{3+}{}_2O_4$	**Monticellite: $CaMgSiO_4$**
	
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Nepheline: $(Na,K)AlSiO_4$	**Periclase: MgO**
	
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Pyrochlore Group: $A_2Nb_2(O,OH)_6Z$	**<u>Richterite</u>: $Na(Ca,Na)_2Mg_5(Si_8O_{22})(OH)_2$**
	
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Sanidine: $KAlSi_3O_8$	**Spinel: $MgAl_2O_4$**
	
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Titanite: $CaTi(SiO_4)O$	**Tuscanite: $K(Ca,Na)_6(Si,Al)_{10}O_{22}[SO_4,CO_3,(OH)_2]\cdot H_2O$**
	
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Vesuvianite: $(Ca,Na,\square)_{19}(Al,Mg,Fe^{3+})_{13}(\square,B,Al,Fe^{3+})_5(Si_2O_7)_4(SiO_4)_{10}(OH,F,O)_{10}$	**Vishnevite: $(Na,K)_8(Al_6Si_6O_{24})(SO_4,CO_3)\cdot 2H_2O$**
	
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Wollastonite: $CaSiO_3$	
	
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