

# THE SCIENTIFIC WAY TO DEAL WITH CLIMATE CHANGE IS TO FOLLOW GEOLOGICAL EVENTS DEALING WITH THE LIVING ROCK OF THE NEPHELINE SYENITE ALUMINA-SILICATE FAMILY

BY KEYSER SÖZE, FEBRUARY 2020

**O**ne simple way to deal with Global Warming is to start with the basics of living on a planet still in formation. Beginning with the transformation of deep seated molten magma that was uplifted as an intrusion — a volcanic pipe that did not explode and dissipate as pumice into the atmosphere — or flow as a glassy silicate Obsidian, which cooled so rapidly that atoms were unable to arrange themselves into a crystalline structure, which is why this amorphous material is known to some as a “mineraloid” just as mined Anthracite or Bituminous coal.

As, however, the bits of a Nepheline Syenite in a “natural glass rock” that can be measured by Atomic Weight, it is even harder to describe the liquid mantle transformation of a pyroclastic flow bubbling, burping, folding, and being reheated again, and again, into a puddle of a naturally “cemented” sill, which somehow reminded someone of *The Septuagint* (the Greek version of the Old Testament) translated “Nephilim”, with the Greek word for “giants.” Appropriate, for all the struggle of solidifying. So, it became written — Nepheline Syenite,  $\text{Na}_3\text{KAl}_4\text{Si}_4\text{O}_{16}$  — almost as a joke of a rock seldom seen in mineral educational collection specimen kits for students.

Where Barry Murray’s friend and mentor, Alaskan Ernest Wolff, a Research Associate for the Alaska College Sciences and Mineral Industry —and better known for his “*Handbook for the Alaskan Prospector*” — described Nepheline Syenite as a “*Magmatic concentration of contact metasomatism*”. What triggered his interest was when Canadian Nepheline Syenite claims were staked on Blue Mountain near Peterborough, Ontario, in 1932 — where this “common variety material” is still being produced by an often described, by informed sources as an “International Cartel.”

Today, in Costesti, Transylvania, Romania, tourists are drawn to “Trovants”, a German term for “Sandsteinkonkretionen” for cemented sand that when it is chemically active secretes a cement making it appear to grow at times, as if alive. Perhaps the explanation of a “*Fluid Evolution in the Nepheline Syenites of the Ditrau Alkaline Massif, Romania*” an intrusion in crystalline zone of Nepheline syenites. The insider joke being, a long ongoing discussion as to exactly what is the crystal pattern on an ever-changing holocrystalline —where every bit of the mineral matter is in a crystalline form, and there is no glassy fractions—other than the plutonic rock.

Just as mysterious was a Paper out of the *Department of Chemistry, University of*

Trondheim, Norway, where referring to the [USGS PROFESSIONAL PAPER 840](#) on Rock Standards where “*STM-I is a sample of peralkaline nepheline syenite from Table Mountain, Oregon, in many cases considered to be a difficult material for analysis, and should as such be a valuable sample for the testing of new methods.*”

The fact that variations on a new theme of Felspathoid/ Alumina-Silicate being labeled something brand new by for evening news broadcasting of something you might want to stick in an investment folio, has not helped scientific contrast and comparison. As a Greenland discovery of Anorthosite(?) being marketed as a possible replacement of a European Nepheline Syenite for use in cement?

Back to the problem of identifying a mixed and matched Nepheline Syenite past this true, classic description accepted at Wikipedia:

***“Nepheline syenite is a holocrystalline plutonic rock that consists largely of nepheline and alkali feldspar. The rocks are mostly pale colored, gray or pink, and in general appearance they are not unlike granites, but dark green varieties are also known. Phonolite is the fine-grained extrusive equivalent.”***

However when recognizing that contact metamorphism of a Felsite, not further explained as being Hypidiomorphic or Xnomorphic, with a “6 degrees of separation shaggy dog story” of the “Feldspar” State of Oregon designated Gemstone, marketed as a [“Sunstone”](#) Crystal leads to a Old West tale.

This trail to acceptance following an unusual appeal to the government of to settle what an unrecognized “feldspathic material” actually was. Wm. B. Murray of Portland —perhaps the most famous mining law practitioner of the West, asked his client to bring in raw samples— which were passed along to gemologist Dr. Walcott —listed in *American Men of Science*— who was friends with Linus Pauling of the same “cow college” funded by the sale of “school section” on Table Mountain. Chemist Pauling’s *“The Nature of the Chemical Bond: A Documentary History”* was awarded the Nobel prize in chemistry in 1954. Which is how it happened that the unknown material was donated to the Smithsonian, with a proviso that they assigned a name and name for tax write-off purposes. Which is why this writers favorite double, single, Nobel Prize winner, quote is, *“The best way to have a good idea is to have a lot of ideas.”*

This convoluted bubbling and burping tale also is correctly identifying commercial Nepheline Syenite competitors in Canada, Russia, China, Norway, India, Pakistan, Iran, Romania, Brazil, Greenland (?) lately have been complicated by coal and Portland cement conglomerates pushing their incorrectly identified manufactured versions of a coal based product dubiously advertised as a Roman Concrete pozzolanic “fly ash.”

One text book answer to that is *“There are four basic eruption processes that produce volcanic*

*ash: (1) decompression of rising magma, gas bubble growth, and fragmentation of the foamy magma in the volcanic vent (magmatic), (2) explosive mixing of magma with ground or surface water (hydrovolcanic), (3) fragmentation of country rock during rapid expansion of steam and/or hot water (phreatic), and (4) breakup of lava fragments during rapid transport from the vent."*

*Variations in eruption style and the characteristics of volcanic ashes produced during explosive eruptions depend on many factors, including magmatic temperature, gas content, viscosity and crystal content of the magma before eruption, the ratio of magma to ground or surface water, and physical properties of the rock enclosing the vent. Volcanic ash is composed of rock and mineral fragments, and glass shards, which is less than 2 mm in diameter."*

## **THE FOLLOW THE "BUBBLE TO THE PEAK" SCENARIO IS...**

Transformed, amorously, by reheating and folding in a pyroclastic flow. Similar silicate, naturally cemented dikes, peralkaline trachyte intruding Tertiary volcanic rocks, will most likely require today's exceptional X-ray laser to reveal structures of not-so-neat-and-tidy materials. Francis Crick, co-discoverer of the shape of DNA, said: "*If you want to understand function, study structure.*" Many decades later, this remains a tenet of biology, chemistry, and materials science to perhaps time travel on the Internet back to the Oligocene Epoch.

The best guesstimate of when all this happened was perhaps only 33,600,000 years ago. Just about the time geographical changes of a ripple effect influenced climate change and vegetation, and the ways in which animals develop. The most important geographical event echoing the present time climate change reversal was the splitting off of the *Australasian* landmass from Antarctica. As the oceans encircled the growing polar ice cap, the waters cooled. This cooling effect was spread around the globe by circulating currents that produced a dramatic drop in temperatures. And, equally important, a new climate marked by seasonal fluctuations and movements.

One yet to be proved thought, is that there is a relationship between plate tectonics theory and subduction fault zones with intrusive activity. As the Cascadian fault zone just 60 miles off the coast of Waldport. Many of the deep pegmatite pipes associated with diamonds, rare earths, a various other Alumina- Silicate activities, are found within a certain distance, worldwide from an ocean. Or at least, in "older" mountains.

The next *hard to explain Alumina- Silicate geopolymer crystalline interlocking event of a re-agglomerated concrete*, is that some geologists in Egypt have been suggesting the pyramids were constructed 4,500 years ago from geopolymer "Geo Rock Powder" mixed with a little water into a removable form, as in-place masonry, instead of thousands of slaves transporting chisel-cut blocks up an impossible incline.

## WHEN IT COMES TO DEALING WITH TODAY'S GLOBAL WARMING

**W**ANT TO SURVIVE AS A SPECIES ? THEN FOLLOW THE PRACTICAL WISDOM THE ROMAN EMPIRE, which did live through the “*Capto eos in pussy*” of emperor Caligula, and the dictator Nero, that “due to his weak character, fear of plots against his life, and the impatience of putting his own vision of Rome into action” is best remembered for playing a fiddle as fire consumed neo-trumpinian towers of me-ism. It also should be remembered that scape-goat for that political disaster, were Christians — some being very nice people—being rounded up for execution. Avoid dictators!

The buildings of Rome that lasted were due to the use of a “Nepheline Cement” having a longevity which appears to be based upon a volcanic ash— the pozzolan recipe for concrete set down by architect Vitruvius in the first century BC. The identify of this which material that weathered into a natural “pozzolana” with chunks of volcanic rock, known as tuff. Also described, as tuff-ash larger in size than scoria.

The outstanding [and still standing] projects of the BPC [Before Portland Cement] era included the Pantheon. Which two thousand years after it was built, the 142 foot across dome consisting of 4,543 tons of Roman cement/concrete—but no re bar— is still the world's largest unreinforced concrete dome.

### SEVERAL VERY PROFESSIONAL PAPERS EXPLAINING THE ALUMINA-SILICATE C-A-S-H EFFECT:

#### [MECHANICAL RESILIENCE AND CEMENTITIOUS PROCESSES IN IMPERIAL ROMAN ARCHITECTURAL MORTAR, PNAS, 2014](#)

*Marie D. Jackson, Eric N. Landis, Philip F. Brune, Massimo Vitti, Heng Che*

*“The pozzolanic mortar perfected by Roman builders during first century BCE is key to the durability of concrete components in structurally sound monuments well maintained over two millennia of use.*

*Pozzolans, named after pumiceous ash from Puteoli (now, Pozzuoli) in the Campi Flegrei volcanic district, react with lime in the presence of moisture to form binding cementitious hydrates (9)]. By the Augustan era (27 BCE–14 CE), after experimenting with ash mixtures for >100 y, Romans had a standardized mortar formulation using scoriaceous ash of the mid-Pleistocene Pozzolane Rosse pyroclastic flow (Fig. S1) that substantially improved the margin of safety associated with increasingly daring structural designs (10, 11). They used this mortar formulation in the principal Imperial monuments constructed in Rome through early fourth century CE.*

*The mortar reproduction gains fracture toughness over 180 d through progressive coalescence of calcium–aluminum-silicate–hydrate (C-A-S-H) cementing binder with Ca/(Si+Al) ≈ 0.8–0.9 and crystallization of strätlingite and siliceous hydrogarnet (katoite) at ≥90 d, after pozzolanic consumption of hydrated lime was complete.”*

And —

## **THE SECRETS OF ROMAN CONCRETE —IMAGINE BUILDING STRUCTURES THAT LAST 2,000 YEARS. HOW DID THEY DO IT?**

By, Augusto CannoneFalchetto

### **“THE SECRET ROMAN RECIPE**

#### **•Pozzolan**

- A siliceous or aluminous material which in itself possesses no cementitious value, but will, in a finely divided form, and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties*
- By using volcanic ash in the place of river sand in their concrete, the Romans were able to mimic the process by which Portland cement chemically bonds lime to clay through the application of heat.*
- But finely divided pozzolan must be amorphous (glassy) to chemically react?”*

Following that local pride paper, here is a broader version of an:

### **ARCHITECTURAL SURVEY OF ART HISTORY WESTERN TRADITION, PART 1**

*“Roman concrete (opus caementicium), was developed early in the 2nd c. BCE. The use of mortar as a bonding agent in ashlar masonry wasn’t new in the ancient world; mortar was a combination of sand, lime and water in proper proportions. The major contribution the Romans made to the mortar recipe was the introduction of volcanic Italian sand (also known as “pozzolana”). The Roman builders who used pozzolana rather than ordinary sand noticed that their mortar was incredibly strong and durable. It also had the ability to set underwater. Brick and tile were commonly plastered over the concrete since it was not considered very pretty on its own, but concrete’s structural possibilities were far more important. The invention of opus caementicium initiated the Roman architectural revolution, allowing for builders to be much more creative with their designs. Since concrete takes the shape of the mold or frame it is poured into, buildings began to take on ever more fluid and creative shapes.*

*When it comes to Roman marine concrete, used to construct piers and breakwaters, “thin section” research in Israel published in 2017 found that the addition of sea water actually strengthened these structures over time, making them harder and harder over the millennia. Too bad the information about hydraulic concrete self-sealing cracks wasn’t*

available when the Surfside condo on the beach in Florida was built, or inspected.”

**EXTREME DURABILITY IN ANCIENT ROMAN CONCRETES, AMERICAN CERAMIC SOCIETY BULLETIN**

Another piece by Marie D. Jackson, Research Associate Professor, Geology & Geophysics, University of Utah

*“The concretes developed by Roman architects and engineers have unique material characteristics that have never, to date, been replicated. Roman volcanic rock hydrated lime concrete prototypes could potentially further reduce CO<sub>2</sub> emissions; enhance chemical and mechanical resilience and self-healing properties; conserve freshwater resources through the use of seawater (or brines); and greatly extend the service life of concrete structures in marine environments.*

*They also could be applied to concrete encapsulation of hazardous wastes and cementitious waste forms or low-activity nuclear wastes through crystallization and cation exchange in certain mineral cements, such as Al-tobermorite.”*

And then, following up the disciplines of Geology, Mineralogy, Geochemistry, History, Architecture, Anthropology, and now Archaeometry in:

**ROMANS’ ESTABLISHED SKILLS: MORTARS FROM D46b MAUSOLEUM, PORTA MEDIANA NECROPOLIS, CUMA (NAPLES)**

by Claudia Di Benedetto\*<sup>1</sup>, Sossio Fabio Graziano<sup>1</sup>, Vincenza Guarino<sup>1</sup>, Concetta Rispoli<sup>1</sup>, Priscilla Munzi<sup>2</sup>, Vincenzo Morra<sup>1</sup>, Piergiulio Cappelletti<sup>1</sup>, as printed as an open access paper in Greece, of some importance to Nepheline Syenite deposits in Russia, China, Norway, Brazil, etc.— and Table Mountain, Oregon, USA.

*“These deposits, linked to high-magnitude explosive eruptions, were accompanied by caldera collapse followed by emplacement of pyroclastic sequences... whereas nepheline and exotic minerals (e.g. disilicates) can be found in most evolved products (Morra et al. 2010 and references therein; Melluso et al. 2012).”*

Again, please check out the Nepheline Syenite Geopolymer C-A-S-H formula Elements and the book where Qiang Yuan, & Cong Ma state in [Civil Engineering Materials, 2021](#)

*“Natural pozzolans —The reactive chemical compositions of natural protozoans are silica (SiO<sub>2</sub>), alumina (Al<sub>2</sub>O<sub>3</sub>), and iron oxide (Fe<sub>2</sub>O<sub>3</sub>). The sum of these three oxides is required to a minimum value of 70% by mass for a suitable pozzolan.”*

**NOW IS THE TIME TO RE-THINK “COMMON VARIETY”**

**ALLEGEDLY, THE SECRET CONCRETE FORMULAS OF THE PAST WERE LOST** during the

burning of the Library of Alexander, and followed by the collapse of the Roman Empire leading to the truly Dark Ages. The mystery of Roman Cement remained lost, or at least unavailable by local supply during the coming of the Industrial Revolution— a time of burning of coal to make steel. As an age of coal used in a roasted manufactured production of Portland Cement, and the steel re-bar, needed to compete against the strength of a natural concrete.

And, according to the patented Portland Cement Association the product replacing a “common variety” soil cement, was a more cost effective to stabilize the building materials marketplace. This is how concrete became, after water, the World’s second largest used natural resource. And how the Industrial Age manufacturing of steel and cement began trading places every now and then on visual aid charts as the 2nd, and 3rd, largest producers of Greenhouse gases.

Unfortunately, the total price of quick delivering by a revolving truck a basic survival need for shelter is bringing us back full circle to the climate changes of the Oligocene. Besides our growing need for affordable housing, we also require a chemically pure water to grow food.

Another Climate Change percentage to worry about is the big “O” for oxygen— in the mix of gases we breath. The current level of 20% Oxygen in the atmosphere has been maintained by the photosynthesis of the green plants and trees of the world. As Global Warming is feeding upon itself by burning everything up, this cycle may have the biggest consequences.

So, I hope I can save my breath arguing further with the USFS, by appealing instead to the Department of the Interior —as it was until the “spotted owl” so-called protection— where the Bureau of Land Management in charge of determining what was the “country rock” of the Table Mountain Nepheline, the same the USGS used as a published rock standard in a GEOLOGICAL SURVEY PROFESSIONAL PAPER 840 in 1976.

Something that researcher Claudia Di Benedetto referred to in 2018 in her paper as an X-ray powder diffraction *reaction between silica and aluminum contained in the “pozzolanic” material, that has been elevated a common variety nepheline to an EXOTIC mineral with an economic value.*”

## A BREAKING NEWS >>> BREAKTHROUGH

**T**HE IDEA OF DOING AWAY WITH PORTLAND CEMENT MANUFACTURING , and the associated use of a Coal “fly ash” —instead of a Natural Fly Ash —which adds to a the production of “green house” gases causing violent Climate Change reactions— finally has a scientifically approved use of a Nepheline Syenite Geopolymer Cement to totally replace an Industrial Age formula.

### INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGYRELATIVE ANALYSIS OF FLY ASH BASED GEO POLYMER CONCRETE IN ATMOSPHERIC CONDITION

Mr. Ashwin Sharma \*1, Prof. Sambhav Gangwal 2 \*1 PG Scholar, Civil Engineering Department, Malwa Institute of Science & technology, Indore(M.P.) \*2 Head of Dept., Civil Engineering Department, Malwa Institute of Science & technology, Indore(M.P.)

**The importance of this was the Table Mountain Peralakaline Nepheline “Natural Fly-Ash replacing the cement in concrete with geo-polymers. In geo-polymer concrete cement is replaced by fly ash and alkaline solutions such as sodium hydroxide (Na OH) and sodium silicate (Na<sub>2</sub>O, SiO<sub>2</sub>) to make the binder necessary to manufacture the concrete. One tone of fly ash can be utilized for manufacturing about 2.5 cubic meter of high quality Geo-polymer concrete.**

*Test experiments proved as fly ash based Geo-polymer concrete has excellent compressive strength and flexural strength. the geo-polymer technology could reduce the CO<sub>2</sub> emission to the atmosphere caused by cement and aggregates industries by about 80%. One of the efforts to produce more environmentally friendly concrete is to reduce the use of OPC by replacing the cement in concrete with geopolymers (i.e. 100% fly ash in place of OPC).”*

#### LITERATURE REVIEW:

V. BHIKSHMA, M.KOTI REDDY

*“Concluded that Efforts to produce more environmentally friendly concrete is to reduced the use of OPC by replacing the cement in concrete with geopolymer. In geopolymer concrete no cement is used, instead fly ash and alkaline solution such as sodium hydroxide (NaOH) Sodium silicate (Na<sub>2</sub>O, SiO<sub>2</sub>) and potassium hydroxide (KOH) are used to make the binder necessary to manufacture the concrete.*

*Geopolymer concrete has excellent compressive strength , suffers very low drying shrinkage, low creep, excellent resistant to sulphate attack and good acid resistance . Trial mixes were done and noted the properties of the concrete both in fresh state and in hardened conditions. The workability of the concrete in terms of slump and compacting*

*factor are observed to be excellent. The geopolymer concrete in fresh state observed to be highly viscous and good in workable.*

*The mechanical properties such as compressive strength , flexural strength and modulus of elasticity of concrete in hardened state. The test experiment proved that a concrete of compressive strength of 30 MPa could be achieved in geopolymer concrete by adopting alkaline solution to fly ash ratio of 0.50 at 16 molarity of NaOH. The 28 days compressive strength of the geopolymer concrete is measured upto 26.06 Mpa.”*

#### **C.ANTONY JEYASEHAR**

*“They are proposed that a alkaline liquid could be used to react with the silicon and aluminum in a source material of geological origin or in by-product materials such as fly ash was produced cementitious binders. The mechanical properties of geopolymer concrete such as compressive strength, split tensile strength and flexural strength have been found out and compared with ordinary Portland cement. The total five beams is casted of size 125\*250\*3200 mm and tested. The one beam out of five beams is cement concrete and remaining four beams is geopolymer concrete with alkali-activator solution. The load deflection and moment curvature behaviours was obtained from the experimental results and was compared with the analytical solution. The low calcium fly ash is used for casted geopolymer concrete. The strength of geopolymer concrete is increased with increasing alkali activator solution/ fly ash ratio. The highest compressive strength of GPC is achieved in 28 days is 52.08N/mm<sup>2</sup>. The tensile strength is achieved in 28 days of GPC is 10.88.”*

#### **CONCLUSION**

*“1. After comparing compressive strength of cement concrete (M-15) and geopolymer concrete (12M) at 7, 14 and 28 days . It is concluded that Strength of geopolymer concrete is higher as compared to cement concrete. The compressive strength of geopolymer concrete in 28 days is 26.15 N/mm<sup>2</sup> and the compressive strength of cement concrete in 28 days is 17.14 N/mm<sup>2</sup>.*

*2. After comparing compressive strength of cement concrete (M-20) and geopolymer concrete (14M) at 7, 14 and 28 days . It is concluded that Strength of geopolymer concrete is higher as compared to cement concrete. The compressive strength of geopolymer concrete in 28 days is 27.23 N/mm<sup>2</sup> and the compressive strength of cement concrete in 28 days is 23.94 N/mm<sup>2</sup>.*

*3. After comparing compressive strength of cement concrete (M-25) and geopolymer concrete (16M) at 7, 14 and 28 days. It is concluded that Strength of geopolymer concrete is higher as compared to cement concrete. The compressive strength of geopolymer concrete in 28 days is 31.63 N/mm<sup>2</sup> and the compressive strength of cement concrete in 28 days is 28.09 N/mm<sup>2</sup>.”*

#### **WHAT IS NEXT???**

**THE IDEA OF DOING AWAY WITH PORTLAND CEMENT MANUFACTURING**, is leading to other breakthrough papers at: [www.ECO-Home-Research.com](http://www.ECO-Home-Research.com).

# The insider's information here is in the chemistry:

<b>Chinese Nepheline Syenite In Bulk</b>	<b>Oregon Nepheline Syenite In Bulk</b>
SiO <sub>2</sub> = from 60% to 64%	SiO <sub>2</sub> = from 58% to 59.62%
Al <sub>2</sub> O <sub>3</sub> = from 17.4% to 19.3%	Al <sub>2</sub> O <sub>3</sub> = from 18.25% to 19.35%
CaO = from 0.9% to 1.3%	CaO = from 0.85% to 1.3%
MgO = from 0.2% to 0.4%	MgO = from 0.2% to 0.3%
LOI = from 0.5 to 0.6	LOI = from 0.31 to 4.61
K <sub>2</sub> O = from 5.4% to 7%	K <sub>2</sub> O = from 4%
Na <sub>2</sub> O = from 6.1% to 7%	Na <sub>2</sub> O = from 12.52%

**\$250 per -325  
face powder ton,  
Freight on Board, China**

**\$25 per in-place  
ton of rock,  
Lincoln County, Oregon**

Chemical Component	Actual Monthly Results	Typical Range*	
		Lower	Upper
Silicon Dioxide (SiO <sub>2</sub> )	58.7	57.9	60.5
Aluminum Oxide (Al <sub>2</sub> O <sub>3</sub> )	19.1	17.6	20.5
Potassium Oxide (K <sub>2</sub> O)	5.9	5.4	6.7
Sodium Oxide (Na <sub>2</sub> O)	7.7	5.7	10.4
Iron Oxide (Fe <sub>2</sub> O <sub>3</sub> )	2.9	2.1	4.0
Calcium Oxide (CaO)	1.9	1.1	2.0
Titanium Dioxide (TiO <sub>2</sub> )	1.0	0.3	1.6
Magnesium Oxide (MgO)	1.2	0.0	1.8

**The other commercial size Nepheline Syenite in the US is 3M. As they make good use of their material in a number of innovative products, it is difficult to calculate their raw tonnage cost.**

CONTINUING FOLLOWING WHERE THIS WHITE PAPER IS GOING, AT [MININGINVESTMENT.COM](http://MININGINVESTMENT.COM), OR [WESTERNMINER.COM](http://WESTERNMINER.COM), OR [YET ANOTHER MININGMAGAZINES.COM](http://YETANOTHERMININGMAGAZINES.COM) PAPER BY KEYSER SÖZE, BELOW.

**Table 1.8** Nature of composite cement constituents

Constituents	Siliceous fly ash (bituminous)	Natural pozzolana
Reaction type	Pozzolanic	
Brief description	Partly fused ash from the combustion of pulverized coal in power stations	Material of volcanic origin such as ash
Typical composition	Range	Range
SiO <sub>2</sub>	38–64	60–75
Al <sub>2</sub> O <sub>3</sub>	20–36	10–20
Fe <sub>2</sub> O <sub>3</sub>	4–18	1–10
CaO	1–10	1–5
MgO	0.5–2	0.2–2
S	–	–
SO <sub>3</sub>	0.3–2.5	<1
LOI	2–7	2–12
K <sub>2</sub> O	0.4–4	1–6
Na <sub>2</sub> O	0.2–1.5	0.5–4
Reactive phases	Low lime silicate glass	Low lime silicate glass. Occasionally zeolite type material

