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Aerosolized Coal Fly Ash Particles, the Main Cause of Stratospheric Ozone Depletion, not Chlorofluorocarbon Gases

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ABSTRACT

We present compelling evidence that supports our contention that aerosolized coal fly ash particles are the main agents responsible for stratospheric ozone depletion, not chlorofluorocarbon gases. Aerosolized coal fly ash particles, uplifted to the stratosphere, not only serve as ice-nucleating agents, but are trapped and concentrated in stratospheric clouds, including Polar Stratospheric Clouds. In springtime, as stratospheric clouds begin to melt/evaporate, said ozone-consuming coal fly ash particles are released making them available to react with and consume stratospheric ozone. Ceasing to contaminate the environment with aerosolized coal fly ash will decrease stratospheric ozone destruction, reduce global warming, and will significantly improve human and environmental health.

Keywords: Ozone hole, Geoengineering, Chemtrails, Troposphere, Global warming, Ultraviolet radiation.

INTRODUCTION

Earth's biosphere is collapsing at an unprecedented rate, including and especially the stratospheric ozone layer that shields surface life from the deadly ultraviolet solar radiation. That collapse, which has been progressing for decades, is due to both deliberate and unintentional human activity. Discovering the causes of biosphere collapse, we submit, should be the highest priority for scientists. But all too often, scientists continue to plod along unquestioningly working in problematic paradigms, while ignoring paradigm shifting discoveries [1, 2]. Here we question the idea that chlorofluorocarbon compounds (CFC's) are the main agents responsible for stratospheric ozone depletion, and present evidence that aerosolized coal fly ash is likely to be the most significant major cause of stratospheric ozone depletion, a cause that has been overlooked by the scientific community.

In 1982, McCormick et al. [3] reported sightings of Polar Stratospheric Clouds (PSC) by the Stratospheric Aerosol Measurement II (SAM II) satellite system during 1979 northern and southern winters. From SAM II data, Hamill et al. [4] concluded that light extinction could not be due to ice crystals alone, which implies significant particulate matter is associated with stratospheric clouds.

In 1985, Farman et al. [5] reported that total ozone levels over Antarctica during the month of October had steadily decreased since 1970. In 1986, from satellite measurements Stolarski et

al. [6] showed that the "ozone hole" covers all of Antarctica and corresponds to the region enclosed by the southern polar vortex [4]. The cause of the Antarctic "ozone hole" was a great mystery [7].

Considerable efforts were expended to determine the cause of stratospheric ozone depletion. The proposed chemical species typically involved gas-phase reactions, usually involving halogens and photodissociation [8, 9]. In 1989, the United Nations (UN) formally adopted the "Montreal Protocol on Substances that Deplete the Ozone Layer" that included regulating numerous halogen-containing chemicals that readily form gases [10]. In doing so, the United Nations *decreed* that said halogen-containing chemicals were in fact the main cause of ozone depletion.

Chlorofluorocarbons (CFC's) were used for a variety of industrial purposes including refrigerants, spray cans, solvents, and foaming agents to create insulation. In 1974, Rowland and Molina [8], advanced the theory that CFC's were destroying the stratospheric ozone layer. They reported that these molecules would not break down in the atmosphere and eventually find their way to the stratosphere where they would be photolyzed to release reactive chlorine, which depletes ozone. Ozone depletion by CFC's would occur under sunlit conditions in the upper stratosphere (30-50 km), not in the lower stratosphere, where most of the ozone resides. The overall depletion was expected to be 5-10%, not enough to explain the newly discovered Antarctic ozone hole. Homogeneous (gas phase) chemistry could not account for the ozone loss [11]. Solomon and coworkers argued that newly discovered Polar Stratospheric Clouds (PSC's) in the extremely cold polar lower stratosphere provide reaction sites for heterogeneous chemical reactions between the relative inert chlorine gases HCL and ClONO2. She hypothesized that Antarctic PSC's were electrostatically attracting CFC's and providing them sites in the form of ice crystals, on which the Rowland/Molina proposed ozone-depleting reactions could rapidly take place [12].

Recent discoveries about the causes of Earth's Great Extinctions suggest another more likely cause of stratospheric ozone depletion, coal fly ash. Earth's great extinctions correlate with epic volcanic phenomena called Large Igneous Provinces (LIP's) [13]. The Permian Extinction (The Great Dying) 250 million years ago coincided with the Siberian Traps LIP, a massive outpouring of lava and intrusion of underground magma which mixed with thick coal seams. This hot coal-basalt mixture extruded at numerous surface locations, producing multiple plumes of pyroclastic fly ash, soot, sulfate and basaltic dust which ascended to the upper atmosphere [14]. This material was dispersed globally and the resulting char deposits in Permian-aged rocks were found to be remarkably similar to modern coal fly ash [15]. The Permian Extinction was characterized by high levels of carbon dioxide, methane, and rapid global warming to levels lethal to most living organisms [16]. A period of deadly ultraviolet radiation stress may have resulted from stratospheric ozone depletion due to this outpouring of hydrothermal organo-halogens [17]. The Cretaceous-Tertiary (K-T) extinction 65 million years ago is known for the disappearance of dinosaurs and the Chicxulub (asteroid) impact. However, recent scientific evidence has linked this mass extinction to resurgent Deccan Trap LIP volcanism [18].

We are already well into the first anthropogenic extinction event in which coal is an integral, crucial part, not the least of which, we submit, is the destruction of stratospheric ozone which shields surface life from harmful solar ultraviolet radiation.

Coal is the most abundant fossil fuel on earth. Since 1970 the annual production of coal has nearly doubled [19, 20] (Figure 1).

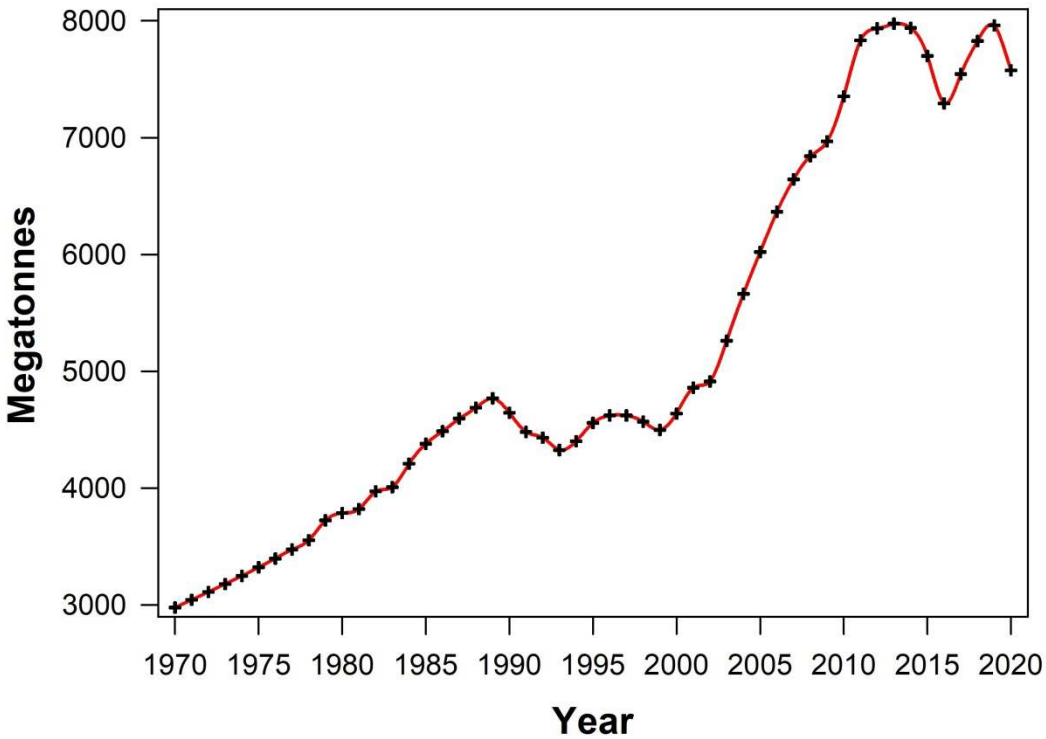

Figure 1. Global coal production by year, in millions of metric tonnes based upon [19, 20]

The use of coal is beset with serious environmental problems, including the formation of acid rain by sulfur dioxide and nitrous oxides. But far more devastating problems are caused by coal fly ash, the annual global production of which was reported in 2014 as 130 million metric tonnes [21].

During industrial coal burning, the heavy ash settles beneath the burner; the light ash, coal fly ash, forms in the gases above the burner and exits the smokestacks, unless, as in Western nations, it is trapped by electrostatic precipitators and sequestered. Even so, ultrafine aerosols from coal burning are likely to escape electrostatic precipitators [22] or be wind-blown from sequestration areas [23]. But the most devastating adverse consequence for life on this planet is the deliberate, covert, near-daily, near-global jet-emplacement of particulates, evidenced as coal fly ash, into the upper troposphere (Figure 2) [24-27].

Figure 2. From [28]. Deliberate jet-emplaced particulate trails, clockwise from top left San Diego, California (USA); Karnack (Egypt); London (England); Danby, Vermont (USA); Luxembourg (Luxembourg); Jaipur (India)

COAL FLY ASH IN THE STRATOSPHERIC POLAR VORTEX

Coal fly ash effectively nucleates ice at conditions relevant to mixed phase clouds. Enhanced ice nucleation by coal fly ash aerosol particles is initiated by their porous structure [29]. In the scientific literature, coal fly ash particles are often classified or confused with mineral dust particles. The majority of cirrus clouds freeze, or nucleate around two types of seeds, "mineral dust" and metallic aerosols, presumably with important contributions from coal fly ash to both categories [30]. But as we describe with examples, there is considerable diversity of chemical composition which is characteristic of coal fly ash mineralogy.

Figure 3 shows an example of a captured tropospheric ice nucleus consisting of nanometer carbon balls [31] compared with similar carbon balls extracted from coal fly ash [32, 33].

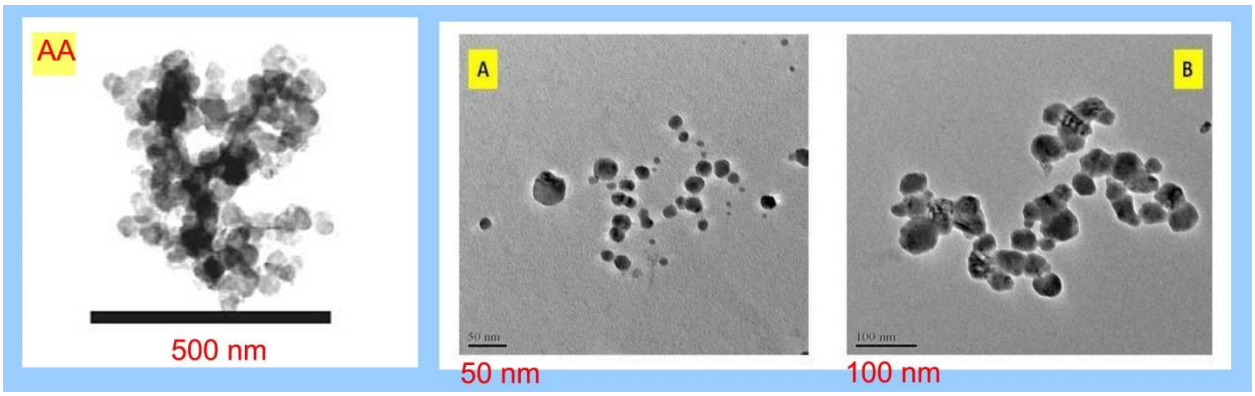

Figure 3. AA: Tropospheric ice nucleus composed of nanometer size carbon balls, adapted from [31]; A and B: similar carbon balls extracted from coal fly ash, adapted from [32, 33]

Carbon nanoparticles from coal fly ash occur in a variety of forms, as shown in Table 1, some of which have been observed in the polar stratosphere [34], for example, Figure 4.

Table 1. Different carbon nanomaterials extracted from coal fly ash. Adapted from [33]

Types of Nano-Carbons	Additional Descriptions	References
Fullerene (C_{60})	Hollow, spherical	[35] [36] [37] [38]
Nanocarbon and nanocoating	Nanoscale sooty or graphitic fullerene-like carbons; porous nanocoating	[39] [40] [41]
Carbon nanotubes	Single-walled or multi-walled; diameter of 8-20 nm; amorphous and crystalline nature	[42] [36] [43] [44]
Carbon nanoballs	5-10 nm	[45]
Carbon onions	Nanopolyhedra, onion-like particles	[46]
Chars	Porous, carbon-rich particles	[47] [48]
Soots	Ultrafine primary particles; aggregates of 10-50 nm diameter	[39] [49]

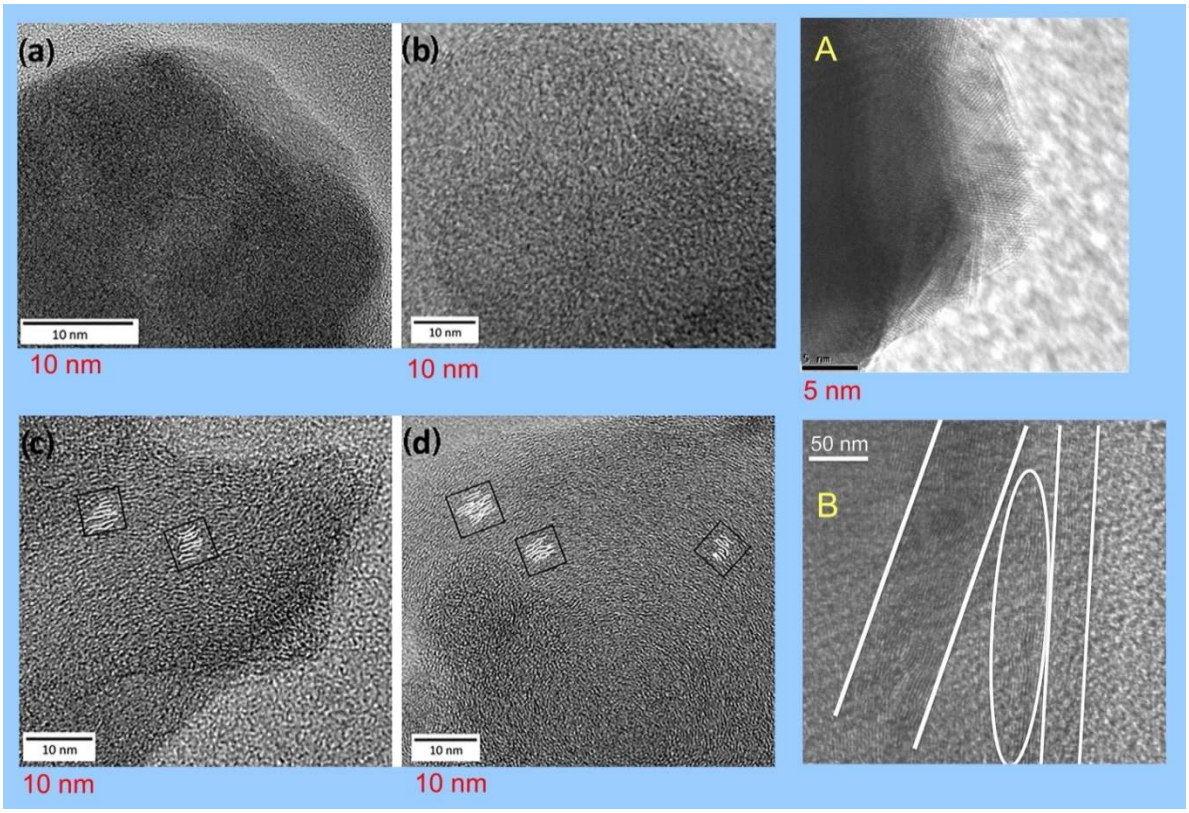

Figure 4. (a), (b), (c), (d): Carbonaceous particles from an altitude of 17.4 km in the polar stratosphere from [34]; (a) and (b) are amorphous, (c) and (d) showing regions of linear ordering. A from [50] and B from [51] are carbonaceous coal fly ash nanoparticles that also show linear structures, set off in B by white lines

Nanoparticles, lofted into the stratosphere [52-54], display a range of compositions characteristic of coal fly ash, as illustrated in Figures 5 and 6 by particles captured from Polar Stratospheric Clouds within the Arctic vortex [55].

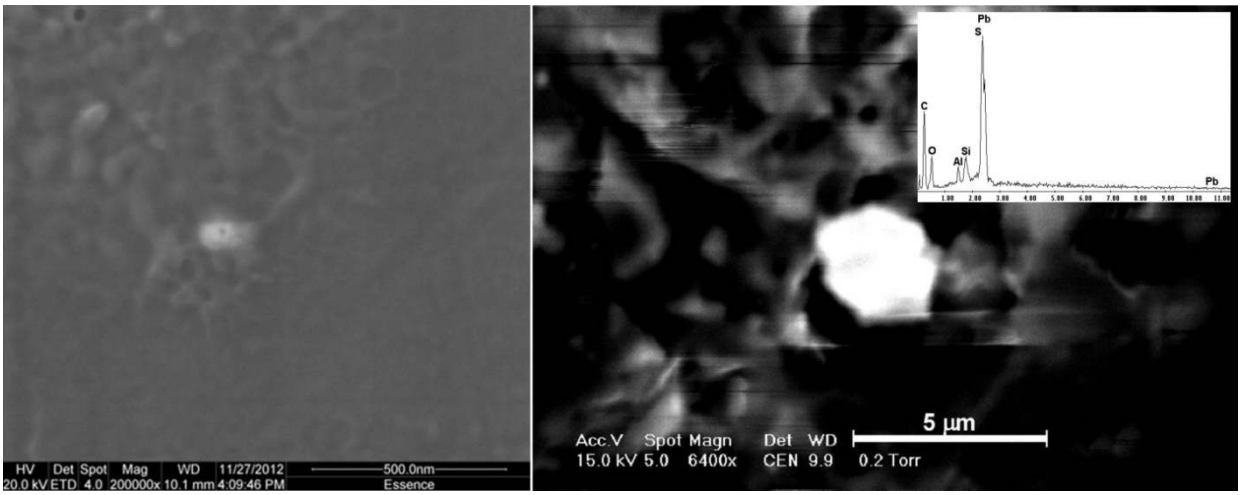

Figure 5. Left: Pb-rich nanoparticle collected from Polar Stratospheric Clouds within the Arctic vortex [55]; Right: similar PbS nanoparticle from coal fly ash [56]

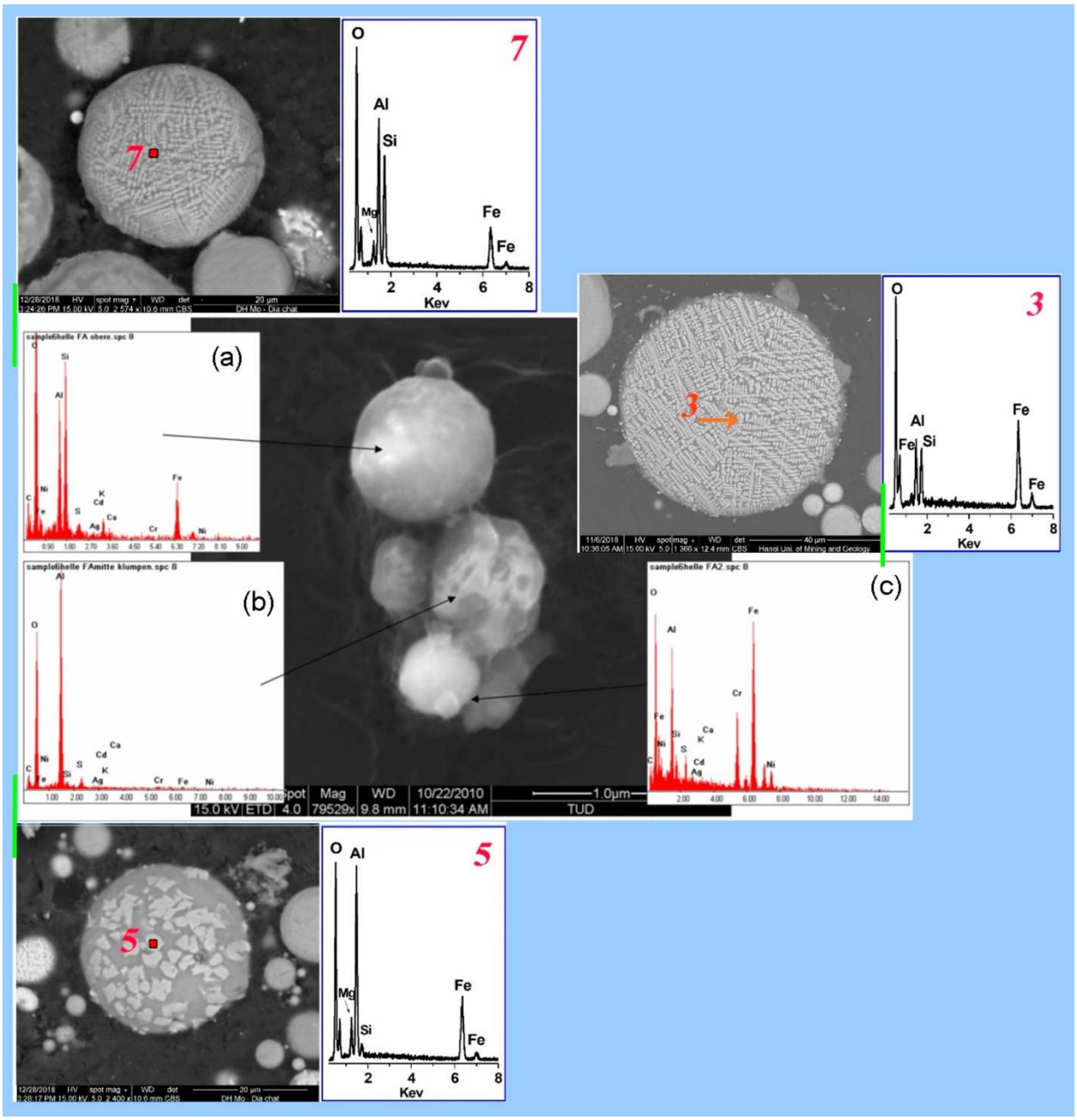

Figure 6: (a), (b) and (c): Nanoparticles collected from Polar Stratospheric Clouds within the Arctic vortex from [55]; Numbered: Larger particles displaying similar, although non-identical compositions. from coal fly ash [57]

Some idea of the compositional range of coal fly ash nanoparticles is shown in Table 2.

Table 2. Some examples of coal fly ash nanoparticle compositions.

Coal Fly Ash Nanoparticle Compositions, Figure Numbers in Parentheses	References
Hematite (1); Jarosite (2); Fe-rich in carbonaceous matrix (3); Fe-Si-Al (4)	[58]
Ti-rich (2); Ti, Al-rich in char matrix (3); Fe-rich mixed with carbonaceous (4, 5); Fe-Si-Al (6)	[59]
Rutile (1); Spheres containing Zn,Ni, Mg, Al (2); Jarosite pseudomorph (3); Fe-Pb-As particle (4); Carbonaceous (6), Quartz (7)	[60]
Al-Si-Ti-K-Mg-Fe carbonaceous sphere (3); Pb in carbon nanotubes (6)	[61]
Glassy aluminosilicate (1); Al-Si carbonaceous (2); Carbon nano-tubes encapsulating fullerenes and Hg (3); Carbon-encapsulating As-Pb-Se-Br-Si-O (4); As-bearing jarosite plus As-O-Pb amorphous, As-bearing carbonaceous + Al-Si-Pb particle (5); Amorphous Al-Cr-Fe-Mg-Si-Ti (11)	[62]
Rock fragment + spinel + zircon (1); Al-Si-O-Fe-K-Ca sphere (4); P-Nd-Ce-La-Th particle (5); Hematite + goethite + magnetite (6)	[50]
Siderite containing Cd, Mo, Mn + nano-hemitite (3); Silicate containing As, Zr, U and Fe amorphous + nano-pyrite containing Se (6)	[63]
Fe-Cr particle (3); Iron oxide spinel (4)	[64]

COAL FLY ASH KILLS OZONE

When coal is burned industrially, coal fly ash condenses and accumulates in the hot gases above the burner. Nearly all of the chemical elements, present in trace amounts in the coal, become concentrated in coal fly ash. Many, but not all, coal fly ash particles occur as spheres which owe their shape to the surface tension of the suspended melt. Coal fly ash particles range in size from a few nm to tens of μm across and tend to be disequilibrium assemblages, having formed rapidly in an unnatural environment. Consequently, coal fly ash occurs in a multitude of elemental combinations and poses great risks to human and environmental health [26, 65].

Primary elements in coal fly ash are oxides of silicon (Si), Aluminum (Al), iron (Fe), and calcium (Ca), with lesser amounts of magnesium (Mg), sulfur (S), sodium (Na), Chlorine (Cl), and potassium (K). Carbon (C) is present in its elemental form. The many trace elements in coal fly ash include arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), phosphorus (P), selenium (Se), strontium (Sr), thallium (TI), thorium (Th), titanium (Ti), uranium (U), vanadium (V) and zinc (Zn). Generally, concentrations of these trace elements in coal fly ash are typically higher than those found in the Earth's crust, soil, or even solid coal [66]. At least 39 elements can be partially extracted from coal fly ash by exposure to water [67]. Aerosolized coal fly ash makes atmospheric water more electrically conductive because of the many dissolved, ionized elements [68].

Ozone is destroyed by reaction with halogens [69, 70]. Coal burning in China led to an unexpectedly large atmospheric component of reactive bromine and chlorine in the atmosphere [71]. Coal fly ash contains halogen elements in the ranges shown in Table 3.

Table 3. Range of halogen element contents in coal fly ash [72].

Chlorine μg/g	Bromine μg/g	Fluorine μg/g	Iodine μg/g
13 – 25,000	0.3 – 670	0.4 – 624	0.1 – 200

Experiments are sometimes made to render coal fly ash safer and more amenable for commercial use, for example, as a component of cement. Experiments that employ ozone provide important information as to the ability of coal fly ash to destroy ozone. For example, the surfaces of coal fly ash carbon particles are oxidized by ozone [73] demonstrating that coal fly ash carbon particles kill ozone. Similar investigations also indicate that coal fly ash kills ozone [74, 75].

Inferences regarding ozone destruction by the components of coal fly ash can be made on the basis of ozone destruction by similar compounds: Ozone is consumed by reaction with carbon [76, 77]. Ozone is also consumed by reactions with mineral oxides [78-82]. Furthermore, ozone is consumed by reactions with oxides of iron , manganese [83, 84]. Additionally, ozone is consumed by reactions with metals [85, 86] and noble metals [84, 87]. All of these substances occur in coal fly ash nanoparticles.

CONNECTIONS BETWEEN POLAR STRATOSPHERIC CLOUDS AND OZONE DEPLETION

On the basis of three consecutive years of observations, Hamill et al. [4] notes: "[W]*e show that the evaporation of the* [Antarctic Polar Stratospheric] *cloud is highly correlated in time with the decrease in ozone concentration.*" There is general acknowledgement that aerosol particles can serve as cloud nuclei, however, nucleation is typically the extent of discussion. Our experience with aerosolized coal fly ash particles brought to ground by snowfall sheds some light on the connections between Polar Stratospheric Clouds and stratospheric ozone depletion.

For decades, with increasing frequency and geographic range, particulate matter has been jet-sprayed into the troposphere (Figure 2). Internationally, officials decline to provide either the composition or the intent of the tropospheric particulate emplacement, and falsely assert that the jet-trails are harmless ice-crystal contrails [26, 88]. The unknown jet-sprayed aerosol substance had to contain aluminum – found repeatedly in all rainwater samples taken. The aerosolized particulate matter was clearly not a natural product, such as desert sand, because the Earth's surface aluminum is generally chemically combined, locked up tightly, with oxygen and does not dissolve in rainwater.

We published evidence that the coal fly ash is the main aerosolized particulate jet-sprayed into the troposphere [25, 89, 90] by comparing element ratios relative to barium in rainwater and melted snow with corresponding ratios measured in the lixiviate of coal fly ash leaching experiments [67, 91] (Figure 7).

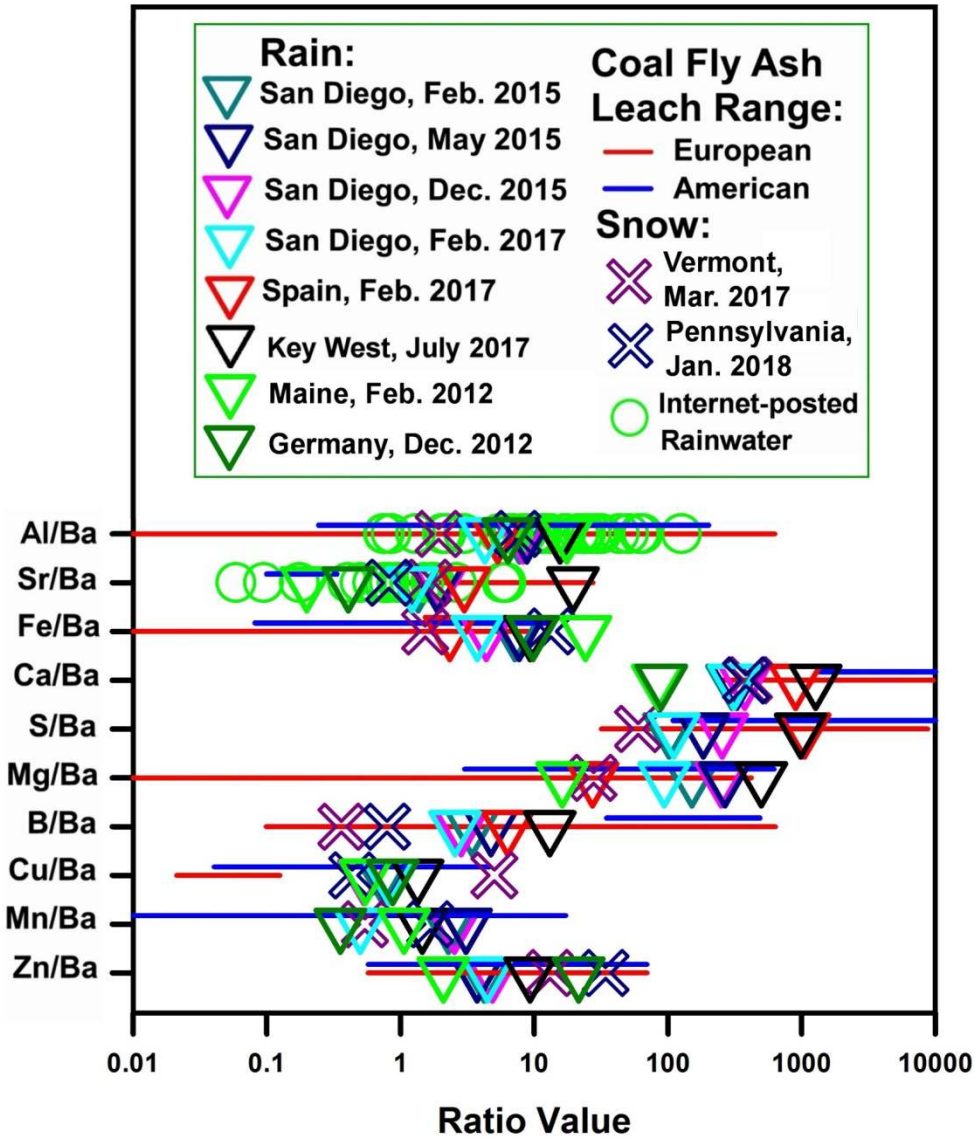

Figure 7. From [92], showing the similarity of element ratios measured in rainwater and snow with the range of comparable element ratios measured in the laboratory lixiviate of water-leach experiments [67, 91]

We have presented evidence [24] that tropospheric post-chemtrail snowfalls can collect and bring down coal fly ash aerosol particulates in a manner similar to the physical-chemical technique called co-precipitation [93] (Figure 8). One phenomenon we observed pertains to snow mold which sometimes forms beneath snow in northern latitudes, for example in Wisconsin, USA and Canada (Figure 9).

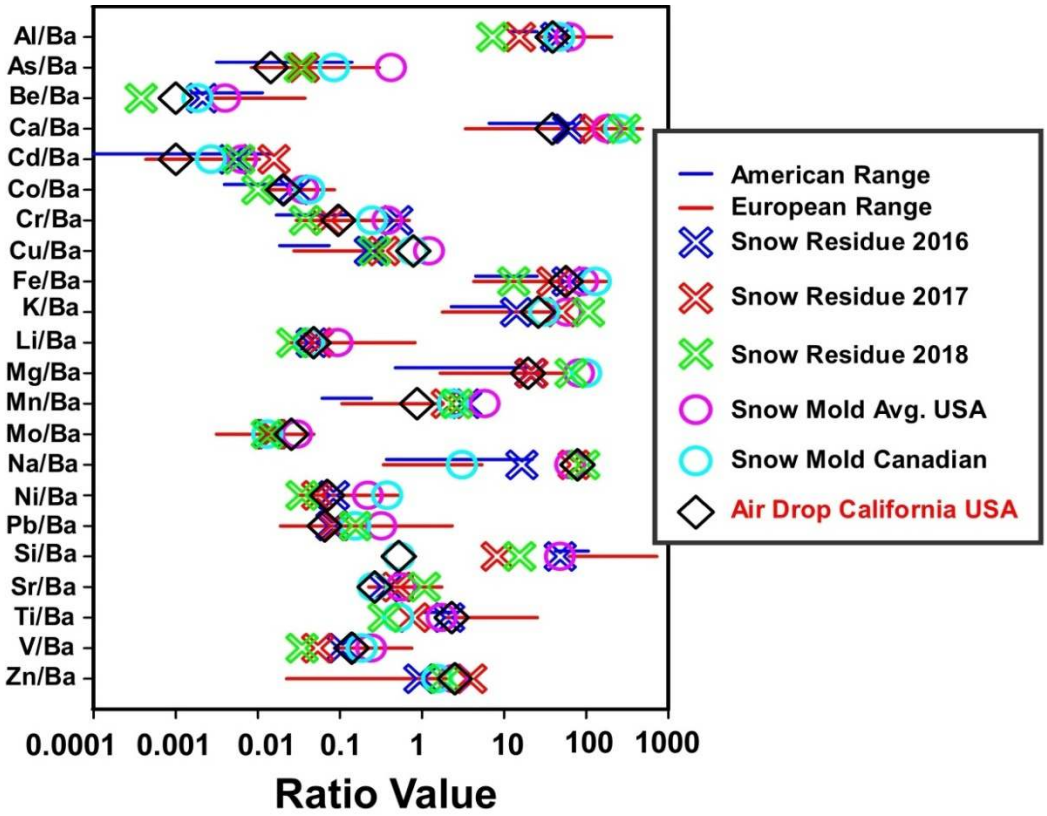

Figure 8. From [94], comparison of analytical results with the ranges of European [67] and American [91] coal fly ash samples

Figure 9. Snow mold fibers observed and sampled as snow was beginning to melt. From [24]

In springtime, as the snow begins to melt, it releases the trapped coal fly ash particles which descend and are re-trapped on the underlying snow mold. These observations suggest a commonality in behavior that is applicable to Polar Stratospheric Clouds and ozone destruction.

Coal fly ash particles, lofted into the stratosphere, not only serve as ice-nucleating agents, but are further trapped by clouds, including Polar Stratospheric Clouds. In springtime, the icy stratospheric clouds melt/evaporate releasing their trapped coal fly ash particles, and making those ozone-consuming coal fly ash particles readily available for reaction with and destruction of ambient stratospheric ozone.

CONCLUSIONS

We have presented compelling evidence that supports our contention that aerosolized coal fly ash particles are the main agents responsible for stratospheric ozone depletion, not chlorofluorocarbon gases. Aerosolized coal fly ash particles, uplifted to the stratosphere, not only serve as ice-nucleating agents, but are trapped and concentrated in stratospheric clouds, including Polar Stratospheric Clouds. In springtime, as stratospheric clouds begin to melt/evaporate, said ozone-consuming coal fly ash particles are released making them available to react with and consume stratospheric ozone.

Aerosolized coal fly ash particles are responsible, not only for the destruction of stratospheric ozone, which shields surface-life from deadly solar ultraviolet radiation, but for harm to human and environmental health. Published scientific and medical articles implicate aerosolized coal fly ash in neurodegenerative disease [95], COPD and respiratory disease [96, 97], lung cancer [98], cardiovascular disease [99], COVID-19 and immunopathology [100, 101].

Aerosolized coal fly ash contributes to global warming [102], disrupts habitats [90], contaminates the environment with mercury [24], decimates populations of insects [103], bats [104], and birds [94]. Aerosolized coal fly ash also kills trees [105, 106], exacerbates wildfires [107], enables harmful algae in our waters [108], and, as described here, destroys the stratospheric ozone layer that shields surface-life from the sun's deadly ultraviolet radiation. Despite the official narratives of "ozone recovery" due to the Montreal Protocol, stratospheric ozone levels continue to decline [109]. Ozone depletion has already led to an alarming increase in deadly ultraviolet radiation B and C penetration to Earth's surface, with increasingly apparent devastation to both plants and animals [110].

Unless global populations demand an end to the technologically-based assault on our environment, replete with its dissemination of false information [111], we will inevitably continue to charge forward in the first ever anthropogenic species extinction.

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