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(54) Precipitation management method by desert soil

(57) This invention is in regard to the interaction of desert soil with clouds and its use for precipitation control. Via this invention the clouds that are not capable of producing precipitation under normal conditions are forced to precipitate without any addition of chemicals or any instruments that can alter the physical properties of the clouds. In this invention the desert dust is dispersed into the clouds having appropriate temperatures as to increase both the size and the number of cloud condensation nucleus (CCN).

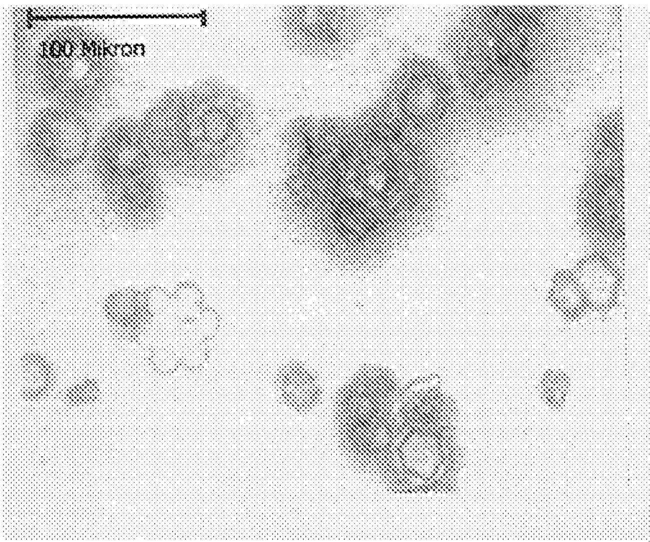

Figure 1

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Description

Technical Scope

[0001] This discovery is in regard to the interaction of desert soil with clouds and its use for precipitation control.

Previous Technical

[0002] The scarceness of water on the planet is a big problem for many parts of the world. Besides other elements for water usage sustainability management, ways for controlling the primary source of water, clouds, is of great importance as well. One of the known applications in a technical aspect is the use of various artificial chemicals to increase the number and volume of cloud seeding for precipitation enhancement, this method has been put to trial and is still being used. Various artificial chemicals, polymers, bacteria and fungi are used aiming to create precipitation. Applications force a cloud to precipitate by aiming to increase the number and size of ice nuclei, which are hexagonal formations in the cloud known to cause precipitation.
[0003] Patent document with application number US2005056705 in the United States mentions the usage of materials like sodium or calcium chloride and urea for cloud seeding for precipitation enhancement. Patent document with application number US5357865 in the United States is about cloud seeding with potassium chloride or potassium perchlorate.
[0004] Patent document with application number US6315213 in the United States mentions that precipitation can be withheld because of seeding of clouds with cross-linked polymers, resulting in the absorption of water and falling in a gelatin like form.
[0005] Patent documents with application number FR2808222 in France and with application number of US60556203 in the United States mention increasing the size of ice nuclei by including liquid carbon dioxide, liquid propane, liquid air and liquid nitrogen in the cloud and forcing of clouds to precipitation.
[0006] Patent document with application number US5174498 in the United States mentions precipitation enhancement of clouds by seeding with long bonded aliphatic alcohols.
[0007] Patent documents with application numbers US3774842 and US3774843 in the United States mention the formation atomized water droplets by the shock freezing of water droplets or the formation of ice nuclei by the adiabatic freezing of expanding air while spraying high pressured water.
[0008] Patent documents with application numbers ZA7803207 and US3788543 mention of cloud seeding with different concentrations of chemicals including silver iodide and different systems of application in to the cloud.
[0009] Patent document with application number US5169783 in the United States mentions the enhancement of precipitation by introducing lichens in to the clouds.
[0010] Patent document with application number US4200228 in the United States mentions the use of bacteria for cloud seeding. The document mentions that bacteria are important as cloud condensation nucleus.
[0011] Previously known technical applications involves the use of various chemical and physical techniques for the formation of ice nuclei within the cloud. However, applications involving bacteria as cloud condensation nucleus does not mention about any in cloud mechanisms or oxalate production by the bacteria and fungus.

Short description of the discovery

[0012] The aim of this discovery is to provide enforcement of clouds to precipitate that can otherwise impossible to precipitate.
[0013] The other aim of this discovery is to enforce clouds to precipitate by using natural means without utilizing any instruments or chemicals that can alter the physical properties of the clouds.
[0014] One other aim of the discovery is to increase the number and the volume of the Cloud Condensation Nucleus (CCN) by dispersing the desert dust into the clouds at proper temperatures.
Another aim of the discovery is to enhance micronutrient elements within the clouds through solar light assisted reactions and eventually enhance the vegetative growth at receiving bodies.
[0015] Another aim of this discovery is to enforce the clouds to precipitate while traversing over the catchment regions of water reservoirs and increase snow deposition as desired hence enable sustainable management of water reservoirs.

Detailed Explanations of the Discovery

[0016] For achieving the aim of the discovery, the precipitation management by using desert soil is shown by the following figures;

Figure 1. This figure illustrates the cloud condensation nucleus within ordinary clouds.

Figure 2. This figure illustrates the size of cloud condensation nucleus with Saharan dust (100 micron).

Figure 3. This ion chromatogram illustrates the cations and oxalate following the interactions of desert soil with water.

Figure 4. This snow height versus time figure illustrates the data of the fully automatic snow monitoring station at Kop Mountain-Turkey during 1999-2000.

[0017] This discovery is about to interfere with the formation of cloud condensation nucleus by using natural substances and enforcing clouds to precipitate.

[0018] The principle of the discovery is to disperse the desert dust into the clouds at appropriate temperature as to increase the number and the size of the cloud condensation nucleus.

[0019] The discovery subject on precipitation management by using desert dust necessitates dispersing of desert dust into the clouds as to sustain the contact of bacteria and fungus present within the desert dust with water droplets. Upon contact with water, bacteria or fungus releases oxalate having hexagonal crystalline structures as a result of cellular activities. Oxalate crystal acts as a nucleus for the cloud condensation within the clouds. In precipitation management, cloud is seeded with fully natural desert soil. With this seeding both the number and the size of the cloud condensation nucleus increases.

[0020] The desert soil to be used in this discovery taken from the ephemeral lakes evolved during the past Ice Ages at Northern Sahara. For example the soil samples gathered from East and West Libya, Southern Tunisia, South central Algeria, and Afghan /Iran border regions and eliminated from boulders without any further treatment. This soil samples is grinded and sieved to collect 200 micron or less sizes as dry. The selection of desert soil is crucial for the initiation of reaction mechanism within the clouds. Soil samples contain about 10^7 bacteria per gram. But the desert origin bacterial fungal and mineralogical composition of the desert soil is also important. Not all desert soil is suitable for cloud seeding. Particularly, those ephemeral lakes evolved during Ice Ages especially at Northern Africa possessing mineralogical composition like hematite goethite and lepidocrosite. The investigations by samples obtained from those desert regions evolved from past geological marine environment cannot be used in cloud seeding activity.

[0021] One of the application procedures of the discovery subject on precipitation management by using desert dust is that the desert soil is dispersed into the clouds as dry or wet provided that the solar radiation levels is above 250 Watt per square meter. Desert dust is grinded to 200 micron or less size and then dispersed into the clouds having a temperature range of minus seven(-7) to minus fifteen(-15) degrees Celsius.

[0022] In one of the other application procedures of the discovery subject on precipitation management by using desert dust, during periods where the solar light energy is not enough or at night times, desert dust having 200 micron or less size is diluted and irradiated at least for two hours to sustain 200 Watt per square meter light requirement before dispersed into the clouds. Irradiation is preferably performed by using halogen lamps capable of having visible light spectrum. Irradiated desert dust-water solution can be dispersed or pulverized into the clouds at (-7/-15) degrees Celcius temperature range. Upon contact with water the bacterial and fungal content of desert dust matrix becomes active. In consequence of the reaction with bacteria and fungus, 1 mole oxalate that can be measured instrumentally releases. Oxalate released then attaches them to a clay mineral desert dust matrix, represented as =FeOH, as to perform the following reactions in sequence.

$$\text{Bacteria and fungus + Cloud (water)} \rightarrow HC_2O_4^- \qquad \text{(I)}$$

$$\equiv FeOH + HC_2O_4^- \rightarrow \equiv Fe\ C_2O_4^- + H_2O \qquad \text{(II)}$$

[0023] If the ground level solar light energy is or above the 200 Watt per square meter level then the reaction mechanism proceeds as shown below.

$$\equiv FeC_2O_4^-\ k(\lambda) \rightarrow \equiv Fe\ (II) + CO_2 + CO_2^{\cdot} \qquad \text{(III)}$$

$$CO_2^{\cdot} + CO_2^{\cdot} \rightarrow C_2O_4^- \qquad \text{(IV)}$$

[0024] The bacteria and fungus present within the Saharan desert can sustain themselves as thousands of years as dry. Atmospheric events may uplift the Saharan dust and may transport them far away from source regions and as they move away from their origin this increases the chance of contact with cloud, or water. Upon contact with cloud water the bacterial and fungal composition becomes active and releases oxalate as an osmosolute to their surroundings within fifteen minutes (I). This oxalate crystal not only acts as a cloud condensation nucleus but also attaches bacteria and fungus onto the surrounding clay minerals and diffuse into the crystalline structure as to form iron oxalate as shown in Reaction (II). The water molecule utilized by the bacteria and fungus as to become active supplied back to the medium as a result of Reaction(II). This process is essential for sustaining clouds. If the solar light energy at that latitude and longitude is or above 200 Watt per square meter level besides the primary oxalate formed, iron oxalate formed after minimum two hours of irradiation as a result of Reaction(2) undergoes a decraboxylation reaction and breakdowns and releases the end products as shown in Reaction(III). After two hours of irradiation (irradiation reaction symbolized as kλ at Reaction(II) the reduced iron level within the clouds reaches its maximum levels. Stochiometrically, iron at its reduced form is unstable and should be utilized immediately by the organisms. This form of iron is used by the bacteria and fungus present within the clouds bearing desert dust matrix as to sustain their biological lives. Reaction (III) also results with the formation of unstable carbonyl radical. This radical formed may catalyzes the reduction of another iron present within the clay mineral and further enhances the medium with respect to reduce iron level. The iron present within the clay mineral and the carbonyl radical formed may react with another carbonyl radical as shown in Reaction(IV) may lead to the formation of another oxalate molecule. This is the reason why it's possible to measure high levels of oxalate molecules within the clouds than outside the clouds. Bacteria and fungus present in the media satisfies their iron requirements from this reaction and the other necessary important item nitrogen from atmosphere. As a result of these activities they sustain their biological activities and able to proliferate themselves.

[0025] As a result of all these reactions cloud media with time are enhanced by the basic amino acids produced by primitive organisms. The natural proliferation of the bacteria and fungus present within the medium with time further enhances the oxalate that acts as a cloud condensation nuclei's within the clouds.

[0026] By the utilization of desert origin dust in cloud seeding the bacteria and fungus becomes active as a result of reaction scheme. The water loss as a result of reaction is replenished and as the reaction scheme progress the carbon dioxide formed acts as a micron greenhouse effect. Thus the reaction mechanisms proposed allows sustainable environment for the actions of bacteria and fungus within the cloud media.

[0027] The quantity of the desert dust appears as a limiting factor if not used sufficiently during the cloud seeding operations. The reaction scheme will breakdown flowing Reaction (I), bacterial proliferation hence oxalate formation and eventually precipitation will terminate. Thus continuous supply of desert dust into the clouds sustains both the reaction mechanisms as well as precipitation.

[0028] The clay mineral structure collapses following the reduction of iron that is present at the crystalline structure of clay mineral. This process, assisted by the solar light energy enhances the medium by reduced iron by other elements (like zinc and manganese) associated with that medium also liberated. The formation iron is entirely dependent on the light intensity and its sustainability. Following the irradiation of desert soil and water mixture for two hours the reduced iron level reaches its peak levels and the medium is also enhanced by manganese and zinc during this time. After the termination of the irradiation after two hours decrease observed in the reduced iron level. This confirms that the reaction mechanism is light dependent.

[0029] The mineralogical composition of the desert soil is also important factor in this discovery. The presence of lepidocrosite is essential since it has much more amorphous crystalline structure much easier to be decomposed by oxalate released by the bacteria and fungus as compared to hematite and goethite. If, Arabian Desert soil or soil from Anatolia used as a seeding material, under similar conditions, the formation of reduced iron can only be observed at Saharan desert soil. Other samples does not show any increase in reduced iron levels.

[0030] Saharan desert samples irradiated with Co^{60} gamma rays hence sterilized from its bacterial and fungal contents by dry sterilization method. Following such sterilization it has been shown that, under similar conditions in cloud chamber Saharan desert soil has not yield any growth of cloud condensation nucleus. This proves that the cloud seeding mechanism is dependent on the oxalate crystals produced by the bacteria and fungus upon contact with water. Following sterilization it has also been shown that neither the expected oxalate nor the reduced iron production as a result of Reactions (I-II) have been realized. This further shows that desert dust soil matrix should be used as a whole for cloud seeding. In this discovery following the pulverization of dust, the clouds with time enhances by chemicals that can be named as natural fertilizers and by some other trace elements present within the crystalline structure of the clay minerals following its collapse.

[0031] In this discovery which is about precipitation management by desert dust, the hexagonal crystals of oxalate are produced by the bacterial and fungal composition of the desert soil matrix upon contact with water. The reaction scheme further results with the formation of carbonyl radicals through the decarboxylation reaction shown in Reaction (III) provided that the solar irradiation level is adequate. The carbonyl radicals formed may react with yet another carbonyl radical as to form the secondary oxalate crystals. Thus as a result these secondary oxalates that also act as a cloud condensation nuclei's, ice particles condenses as around these semi hydrophilic and semi hydrophobic nature oxalate crystals naturally. Further collision of ice particles with another ice particle within the cloud further increases the size of ice particles and enforces clouds to precipitate which then precipitate as snow or rain depending on the weather conditions.

[0032] Following the injection of the Saharan desert soil the size of the cloud condensation nucleus, which are about 10-30 micron in size naturally Figure(I), increases to 200 and even up to 400 micron size (Figure 2). The increase in the size of the cloud condensation nucleus means that the clouds enforced to precipitate.

In this discovery which is about precipitation management by desert dust stems from the fact that the snowflakes has an hexagonal centre thus similarly, cloud condensation nucleus should have an hexagonal crystalline structure . The sizes of natural ice crystals can be enlarged by dispersing chemicals having suitable crystalline structures into the clouds.

[0033] The end products mentioned at Reaction (III) can take place if the solar light energy is adequate and further proceeds if the reduced iron is utilized and atmospheric nitrogen is fixed. Such environment also favors the logarithmic proliferation of the bacteria and fungus within the clouds hence increase in the release of oxalates.

The results obtained from the fully automatic snow monitoring stations located at eastern Anatolia supports our argument since extraordinary snow accumulation measurements coincides with the time period where the solar light intensity is reaches a critical level at that latitude and longitude. As shown in Figure 4, while the observed snow accumulation from November-February can only reaches to 40-50 cm height following the time period where the solar light intensity is or above adequate level net increases in snow height are observed as shown in Figure (4).

[0034] Condensation of water molecules around the oxalate crystals is sufficient as to enforce clouds to precipitate under normal conditions, one other application of the discovery where the solar light level is not sufficient, precipitation management still can be performed simply by irradiating the desert dust prior to pulverization into the clouds clouds to precipitate at a maximum possible rate.

[0035] Experiments performed in a cloud chamber has shown that in cloud pulverization of desert dust should be performed at temperature range of minus 7 to 15 degrees Celsius as to create the best conditions for cloud condensation nucleus. However, dispersion of dust into the clouds can also be performed at any temperature range, if desired.

[0036] During the course of cloud seeding pulverization process is entirely governed by the rate of precipitation demand of the receiving body. Thus for the process of pulverization planes of various capacities ranging from capable of carrying tones of dust down to aerial fire-fighting planes can easily be used for small scale applications. If desired remote control planes can also be used to disperse dust into the clouds for very small scale applications.

One other application means of the discovery involves the use of helium filled balloons capable of dispersing dust into the clouds automatically at pre programmed temperatures.

Claims

1. - Dispersing desert origin dust into the clouds,
- the contact of bacteria and fungus present in the desert dust with water,
- the formation of oxalate having hexagonal crystalline structure by the bacteria and fungus as an osmosolute,
- the action of oxalate crystal as an cloud condensation nucleus
- triggering of snow formation within the clouds by oxalate crystals, are the basic steps that characterize the precipitation management by desert dust.

2. Precipitation management by desert dust of 1 wherein said material is **characterized by** desert origin soil evolved at the ephemeral lake basins, evolved during glacial time periods, separated from its boulders but not any other pre treatment.

3. Precipitation management by desert dust of 2 wherein said material is **characterized by** desert soil having maximum 200 micron size fraction by dry sieving and grinding.

4. Precipitation management by desert dust of 3 wherein said material is **characterized by** its hematite- goethite and lepidocrosite mineral compositions.

5. Precipitation management by desert dust of 4 wherein said material is **characterized by** dispersing into the clouds as wet or dry if the solar light energy is adequate.

6. Precipitation management by desert dust of 4 wherein said material is **characterized** to be liquidified before dispersed into the cloud if the solar light energy is not adequate.

7. Precipitation management by desert dust of 6 wherein said material is **characterized** to be irradiated at least for two hours by light sources as to achieve 200 watt light energy level.

8. Precipitation management by desert dust of 7 wherein said material is **characterized by** pulverization or dispersion of irradiated desert dust water mixture into the clouds.

9. Precipitation management by desert dust of 5 and 7 wherein said material is introduced into the clouds at temperatures of -7 to -15°C.

10. Precipitation management by desert dust of 9 wherein said material is **characterized by** in cloud reaction schemes (I,II,III,VI),

$$\text{Bactreia and Fungus + Cloud} \rightarrow HC_2O_4^- \qquad \text{(I)}$$

$$\equiv FeOH + HC_2O_4^- \rightarrow \equiv FeC_2O_4^- + H_2O \qquad \text{(II)}$$

$$\equiv FeC_2O_4^- \; k(\lambda) \rightarrow \equiv Fe(II) + CO_2 + CO_2^{\cdot} \qquad \text{(III)}$$

$$CO_2^{\cdot} + CO_2^{\cdot} \rightarrow C_2O_4^- \qquad \text{(IV)}$$

11. Precipitation management by desert dust of 10 wherein said material is **characterized** to replenish the water loss at Reaction (I), by the Reaction(II)

12. Precipitation management by desert dust of 10 wherein said material is **characterized by** the carbonyl radical that acts to reduce the clay mineral.

13. Precipitation management by desert dust of 12 wherein said material is **characterized** to form another oxalate molecule through the combination of carbonyl radicals as Reaction (VI).

14. Precipitation management by desert dust of 13 wherein said material is **characterized by** enhancement of clouds with basic amino acids with time through the bacteriological activities within the clouds.

15. Precipitation management by desert dust of 13 wherein said material is **characterized by** the reaction scheme where carbon dioxide acts to create micro greenhouse effect.

16. Precipitation management by desert dust of 9 wherein said material is **characterized by** the desert origin dust of 15 wherein said dispersion is continued as to sustain the reaction schemes and precipitation.

17. Precipitation management by desert dust of 16 wherein said material is **characterized by** easily decomposable lepidocrosite when react with oxalate.

18. Precipitation management by desert dust of 17 wherein said material is **characterized by** the sustainment of the reaction schemes at ground by irradiation if the solar light energy is not adequate.

19. Precipitation management by desert dust of 18 wherein said material is **characterized by** the transport and dispersed into the clouds via planes of various sizes ranging from big planes down to agricultural planes for large and small applications.

20. Precipitation management by desert dust of 18 wherein said material is **characterized by** the transport and dispersed into the clouds by remotely controlled planes capable of carrying loads if the application area is small enough.

21. Precipitation management by desert dust of 18 wherein said material is **characterized by** the transport and dispersed into the clouds by pre programmed helium filled balloons as to disperse the desert soil at appropriate temperatures.

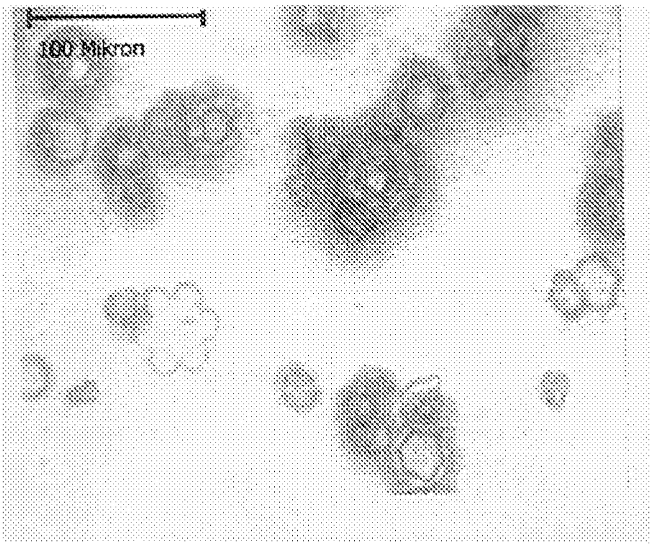

Figure 1

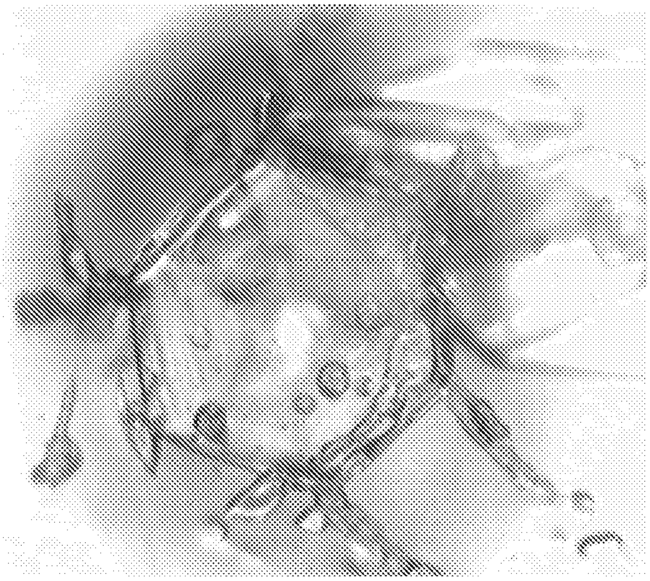

Figure 2

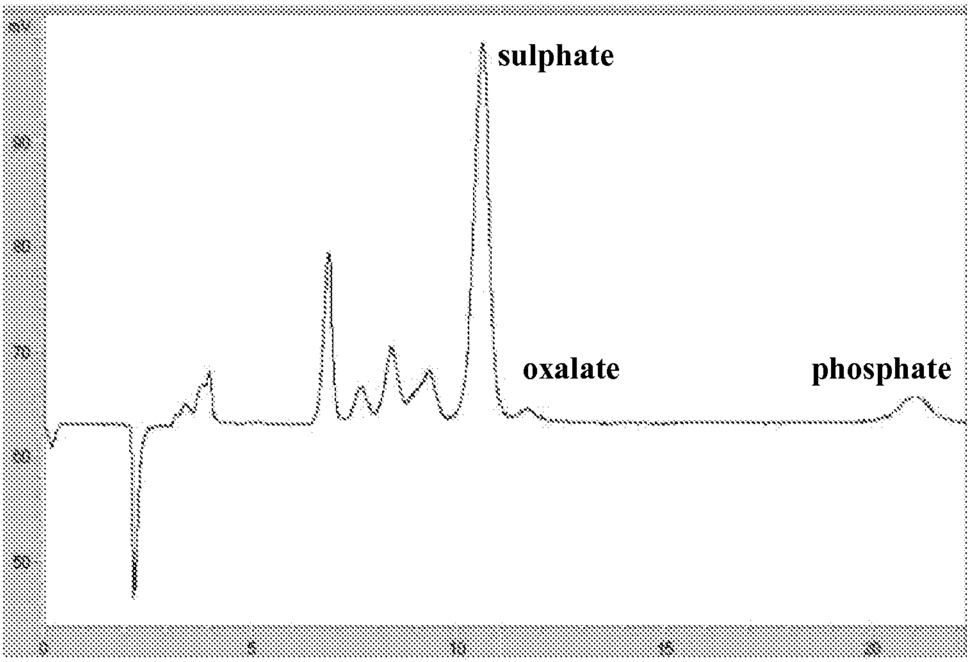

Figure 3

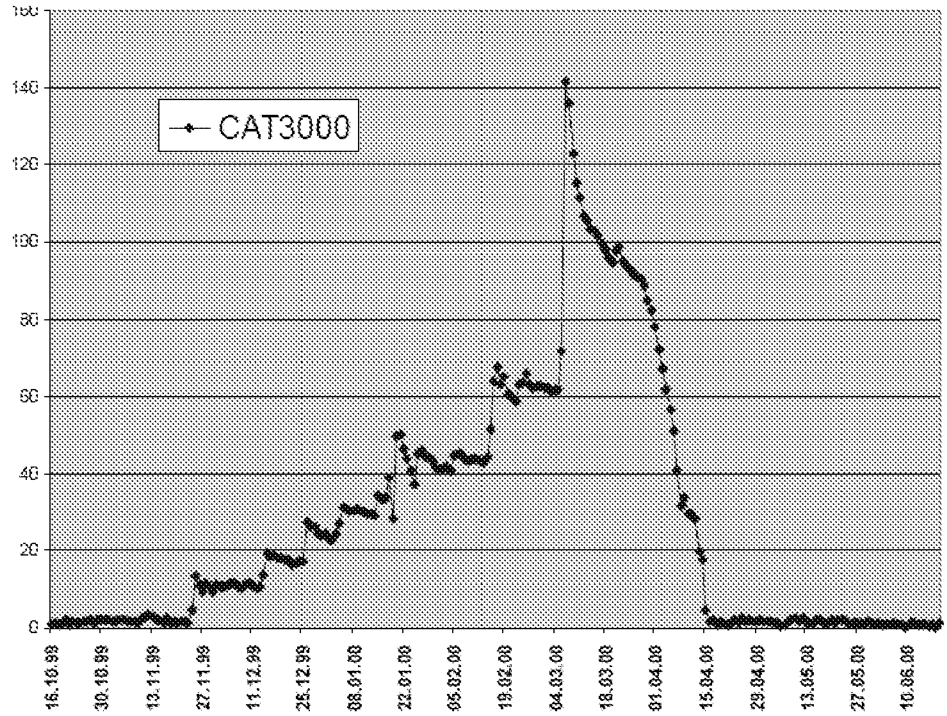
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Figure 4

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EUROPEAN SEARCH REPORT

Application Number
EP 10 17 0168

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	SAYDAM A.C., SENYUVA H.Z.: "Deserts: Can they be the potential suppliers of bioavailable iron?" GEOPHYSICAL RESEARCH LETTERS, vol. 29, no. 11, 12 June 2002 (2002-06-12), XP008128309 ISSN: 0094-8276	1	INV. A01G15/00
A	* abstract; figures 1-3 * * Conclusions and Recommendations *	4,5,7,8, 10,17,18	
X	GB 201 574 A (LUKE FRANCIS WARREN) 30 October 1924 (1924-10-30) * page 2, line 118 - line 122 * * page 2, line 104 - line 107 *	1	
A	US 5 169 783 A (KIEFT THOMAS L [US]) 8 December 1992 (1992-12-08) * claim 1 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

A01G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 October 2010	Dagnelies, Joëlle

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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EP 10 17 0168

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28-10-2010

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GB 201574	A	30-10-1924	NONE	
US 5169783	A	08-12-1992	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- FR 2808222 **[0005]**
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- US 5174498 A **[0006]**
- US 3774842 A **[0007]**
- US 3774843 A **[0007]**
- ZA 7803207 **[0008]**
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- US 4200228 A **[0010]**