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Programa en Ciencias de la Tierra
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Magnetic properties of airborne particles, collected in Queretaro (Mexico) and Stuttgart (Germany)

Tesis que para optar por el grado de
Maestro en Ciencias

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Declaration

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been fully acknowledged according to the ethic code of the National Autonomous University of Mexico.

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Gloria Ramírez

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To my family for all the advises between life and science.

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Abstract

This study tested the use of cylindrical neodymium magnets (NdFeB, grade N45, Ø 3.8cm, 3.8cm long) were used as collectors in two locations in Queretaro (U_1,U_2), and one location (L_1) in Stuttgart (NdFeB, grade N45, Ø 3 cm x 1 cm long) in order to collect airborne particles and determine its magnetic properties and phases. Magnets were wrapped with latex, filter paper and teflon, each for three different periods of time in Mexico; in Stuttgart, magnets were wrapped with plastic and teflon for two different periods of time. Magnetic analyses were carried in Germany; magnetic mass specific susceptibility (χ) values were 1.698×10^{-4} m^3/Kg and 2.607×10^{-4} m^3/Kg in Germany, with frequency dependence susceptibility using an Agico MFK1-FA Kappabrige (976 Hz χ_{lf} low frequency and 15,616 Hz χ_{hf} high frequency) of 5.8 and 8.3 (χ fd%); thermomagnetic low and high temperatures curves for Mexico and Germany showed the Verwey transition as the main feature indicating the presence of magnetite phase, the Curie temperature of magnetite (Fe_3O_4) and metallic iron (Fe) are the features used to distinguish the other magnetic phases; hysteresis loops were narrow with low coercivity (*H*c) values < 9 mT. Non magnetic analysis by SEM/EDX showed a particle size range between 4 to 20 µm, amorphous elongated grains as well as spherule shape particles were found in Mexico; besides Iron and Oxygen, elements more frequently found in Mexico were Si, Ti, F, Al, and Mg and Si, Ca, Al, K in Germany. Spherules were scarcely found in Stuttgart compared to amorphous particles, their particle size range was between 10 – 64 µm. Mössbauer spectra were determined for samples from Stuttgart, identifying magnetite as the main magnetic phase (~34% by mass), a poor crystalline phase the second (~27%), metallic iron the third (~24%) and goethite as the fourth (~24%). There was an increase in the fine dust alarms days of PM_{10} and $PM_{2.5}$ as well as the mass specific magnetic susceptibility in the same period of time in Stuttgart, thus indicate a possible relation between this property and the enhancement.

En este estudio se probaron el uso de imanes cilíndricos de Neodimio (NdFeB N45, grado N45, Ø 3.8cm, 3.8cm longitud) como colectores en dos sitios en Querétaro (U_1,U_2), y un sitio (L_1) en Stuttgart (NdFeB, grade N45, Ø 3 cm x 1 cm longitud) con el fin de colectar partículas de aire y asi poder determinar sus propiedades y fases. En Querétaro los imanes fueron cubiertos con látex, papel filtro y teflón, cada material con tres diferentes intervalos de tiempo; en Stuttgart se utilizó plástico y teflón. Análisis magnéticos se realizaron en Alemania; los valores de susceptibilidad especifica magnética de masa (χ) fueron de 1.698×10^{-4} m^3/Kg and 2.607×10^{-4} m^3/Kg para Alemania con una susceptibilidad dependiente de la frecuencia de 5.8 and 8.3 (χ fd%); curvas termo magnéticas a temperaturas altas y bajas mostraron la transición de Verwey usada como la característica principal para indicar la presencia de la fase de magnetita; la temperatura Curie de magnetita (Fe_3O_4) y hierro metálico (Fe) son las características principales para caracterizar esas fases magnéticas; las curvas de histéresis fueron estrechas, con valores bajos de coercividad (Hc) < 9 m. Análisis no magnéticos mediante SEM/EDX mostraron tamaños de partículas en el rango de 4 a 20 µm, partículas amorfas y de forma de esferulas se encontraron en México; además de Hierro y Oxigeno, elementos encontrados más frecuentemente fueron Si, Ti, F, Al, y Mg para México y Si, Ca, Al, K para Alemania. Esferulas en Alemania escasas comparadas con partículas amorfas, el tamaño de las partículas fue de 10 – 64 µm. Espectroscopia Mössbauer fue determinada para las muestras de Stuttgart, se identificó magnetita (~34% masa) como la fase magnética dominante, una fase cristalina (~27 %) como la segunda, hierro metálico la tercera (~24%) y goetita como la cuarta (~24%). Hubo un incremento en los días de alarma de PM_{10} y $PM_{2.5}$ lo que probablemente indicaría una relación con la susceptibilidad magnética especifica de masa la cual también tuvo un incremento en su valor en el mismo periodo de tiempo.

Chapter 1. Introduction

1.1 Environmental Magnetism

Oxygen (O) is the most abundant element on earth crust by mass, iron (Fe) is the fourth; compounds of these two elements are often found in the form of iron oxides. Most common magnetic iron oxides discussed have been: magnetite(Fe_3O_4), hematite(α-Fe_2O_3) and maghemite(γ-Fe_2O_3) (Evans & Heller, 2003), and they are usually referred as phases. These phases have been found alongside with heavy metal elements in environmental samples from leaves and soils; they have been studied as possible proxies of the environmental heavy metal pollution (Cao et al. 2015; Ohja et al. 2015; Muxworthy et al. 2001; Shu et al. 2001; Matzka & Maher, 1999). To understand better the magnetic behavior of the phases mentioned, the fundamentals of magnetism will be explained.

1.2 Fundamentals of Magnetism

The explanations as well as the terms in this thesis could be found in more detail in (Evans & Heller, 2003; Hughes, 2005; Maher & Thompson, 1999; Stacey & Banerjee, 1974).

Magnetism is a phenomenon observed when a charge (electron, e^-) is moving. Each e- has a magnetic moment (μ) due it's motion around the nucleus and its own axis (spin) and the smallest unity of a magnetic moment is 9.27×10^{-24} Am^2 which is known as a Bohr magneton (μB).

1.2.1 Terms and formulas

1.2.1.1 Magnetization (M)

Magnetic moment (μ) per volume unit (v).

$$M = \frac{\mu}{v} \qquad (1)$$

1.2.1.2 Magnetic susceptibility (K)

The ratio between the magnetization (M) acquired in an external magnetic field (H).

$$K = \frac{M}{H} \qquad (2)$$

1.2.1.3 Mass specific magnetic susceptibility (χ)

The relation between k and the density (ρ) of the sample. Mass specific magnetic susceptibility units are therefore the inverse of density units m^3/Kg.

$$X = \frac{K}{\rho} \qquad (3)$$

Interactions of e^- due orbital and spin motion give rise to different manifestations of magnetism: diamagnetism, paramagnetism and ferromagnetism considered as the principal forms of magnetism in this thesis.

1.2.1.4 Diamagnetism

Diamagnetism is present in all materials, but this effect is weak and easily masked by other forms of magnetism. Diamagnetism is visible only in materials that do not contain atoms or molecules with a net magnetic moment (Egli, 2016). The magnetic moments of the electrons are governed by their orbital motions. When a magnetic field (H) is applied all magnetic moments are already compensated and therefore the net magnetic moment do not arise. Examples of diamagnetic substances, minerals and elements are: water (H_2O), quartz (SiO_2), silver (Ag), gold (Au) and copper (Cu); they can be recognized by its negative values in magnetic susceptibility, for example: water (-0.90×10^{-8} m^3/Kg) and quartz (-0.62×10^{-8} m^3/Kg) (Dunlop, 1997).

1.2.1.5 Paramagnetism

When a magnetic field (H) is applied, a net magnetic moment arises; afterwards, when the magnetic field is gone, the magnetic moments will orient in random directions.

Paramagnetism is stronger than diamagnetism, here the spin motion is considered more important than the orbital motion. Examples of paramagnetic minerals and substances are: biotite (4×10^{-7} m^3/Kg), muscovite (0.89×10^{-7} m^3/Kg), Fe_2SO_4 (12.6×10^{-7} m^3/Kg). Their magnetic susceptibility values are positive.

1.2.1.6 Ferromagnetism

Ferromagnetism is much stronger than paramagnetism, and occurs only in crystals. The magnetic moments are oriented in a way that none of them cancel each other out and it's governed mainly by the spin motion. Ferromagnetism is observed mainly in transition elements: iron (Fe), nickel (Ni) and cobalt (Co). Their 3d subshell is only partially filled and because of "exchange coupling" interactions take place due to the overlap of orbitals (Evans & Heller, 2003). Examples of ferromagnetic minerals and phases are: metallic iron, and other elements such as cobalt and nickel; their magnetic susceptibility values are much greater than paramagnetism, for example: iron ($2.76x10^{-1}$ m^3/Kg), and cobalt (2.04 $x10^{-1}$ m^3/Kg) Dearing (1999). In ferromagnetism higher magnetic fields are necessary to align the magnetic moments.

Because of the "exchange coupling" of sub-lattices other forms of "ferro"magnetism arise: antiferromagnetism (such as FeO), ferrimagnetism (such as magnetite and maghemite), and canted antiferromagnetismus (hematite).

1.2.1.7 Antiferromagnetism

The magnetic moments of sub-lattices are oriented in a way that the net magnetic moment is zero.

1.2.1.8 Ferrimagnetism

The magnetic moments of sub-lattices are oriented in a way that there is a partial cancelation.

1.2.1.9 Canted antiferromagnetism

The magnetic moments of sub-lattices are compensated but exist a slightly deviation on them. A visual representation of how the magnetic moments are aligned can be seen in figure 1 (Soffel, 1991).

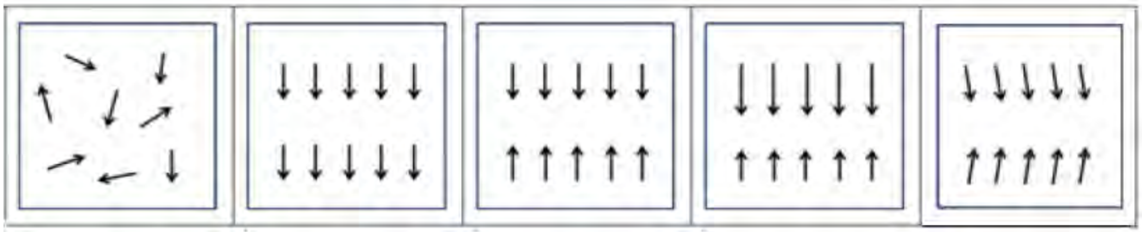


Figure 1: Visual representation of the magnetic moments represented by arrows (Soffel, 1991).

1.2.1.10 Magnetic domains

In ferromagnetism, the magnetic moments are aligned in regions; these regions are called magnetic domains (figure 2). Domains are formed to minimize the total energy in a crystal. Crystals with only one domain are called single domain (SD), larger grains contain more domains, although their behaviors can be similar to SD grains, showing relatively high coercivity; they are called pseudo single domain (PSD). Grains with a greater number of domains are called multi domain (MD) and their magnetic properties differ from PSD by smaller coercivities.

Figure 2: Visual representation of the magnetic moments in a grain. Lines represent the boundaries of the domains, arrows represent the direction of the magnetic moments in each domain. On the right grain, the magnetic moments remain aligned after an external field was applied. (Hughes, 2005).

1.2.1.11 Hysteresis

The relation between magnetization (M) in an external magnetic field (H) follows a non-reversible behavior which is called Hysteresis. From hysteresis curves, parameters identified are: saturation magnetization (M_s), saturation remanence (M_{rs}), coercive force (H_c), coercivity of remanence (H_{cr}).

1.2.1.12 Saturation Magnetization (M_s)

As the field (H) increases (to high enough values), the value of M remains constant; this indicates that all the domains in a grain have been aligned parallel to the field (figure 2).

1.2.1.13 Saturation Remanence (M_{rs})

When the field (H) is removed, saturation remanence remains.

1.2.1.14 Coercive Force (H_c)

The reverse field necessary to reach a value of M=0. This value is dependent of the grain size and will vary among different samples, the variation will be different for each phase. An example of the variation of H_c with grain size of different phases is shown on figure 3.

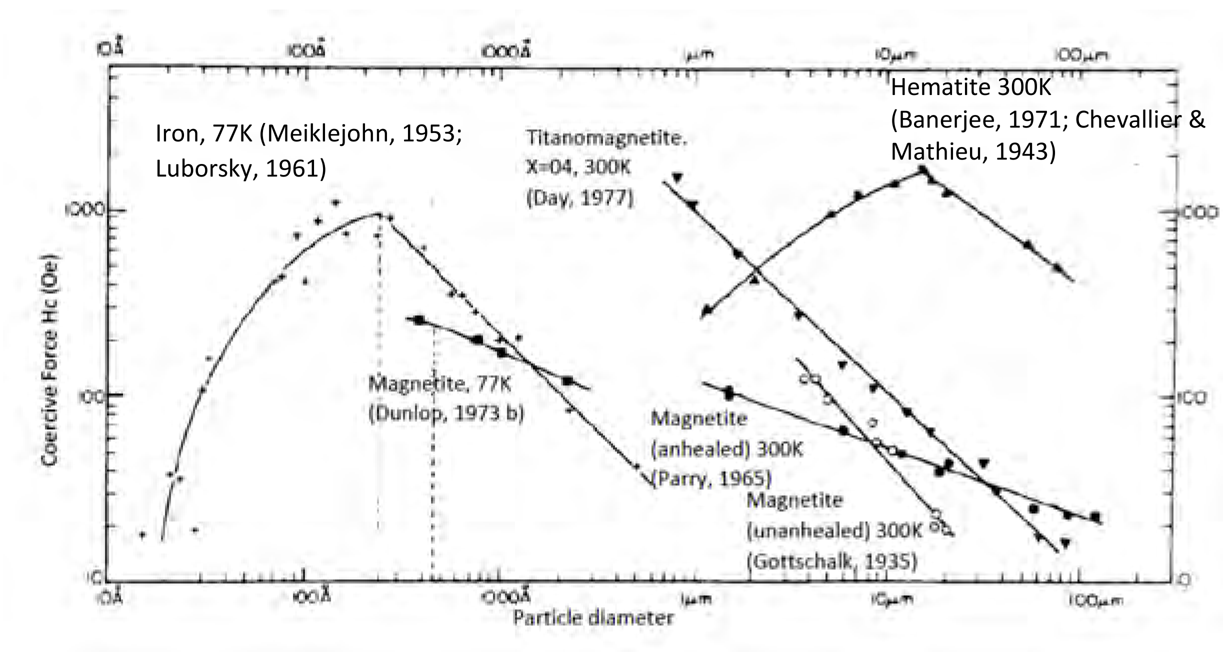


Figure 3: Coercive force and its variation with grain size for different phases, original from Dunlop (1981) as cited in Moskowitz (1991).

1.2.1.15 Coercivity of Remanence (H_{cr})

The field (H) necessary to reach the origin of the M-H graph. The value is larger than H_c.

An example of a Hysteresis curve from Maher & Thompson (1999) is shown in figure 4.

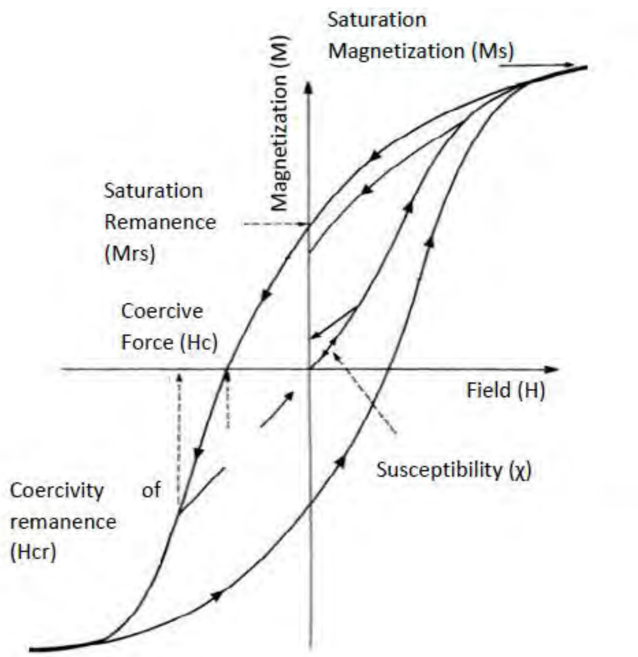


Figure 4: Hysteresis curve as presented in Maher & Thompson (1999) starts with the measurement of the magnetization at low fields known as magnetic susceptibility (reversible). The magnetic field (H) increases until the magnetization (M) reaches its maximum, known as the saturation magnetization value (M_S), after this value (M) stops increasing. When the field (H) decreases to zero, remanence magnetization (M_{rs}), is reached; afterwards the field (H) continues to lower towards more negative values until M becomes zero, at this value, coercive force (H_C) is reached. The field continue to increase towards more negative values until the origin of M-H point is reached at the point of coercivity of romance (H_{cr})

1.2.1.16 Day Plot

The Plot M_{rs}/M_s vs H_{cr}/H_c known as Day Plot after the original of Day et al. (1977) allows to characterize a sample by its domain structure: SD,PSD,MD; each point on the curve represents a hysteresis curve. In figure 5 it can be seen how hysteresis curves varies for different domain states.

1.2.1.17 Superparamagnetism (SP)

The induced magnetization in SP particles is strong but the remanence is getting lost within milliseconds to seconds after the field is removed, and their magnetic susceptibility is frequency dependent. The transition size between SD,PSD,MD,SP varies for different phases but also depends on the particle shape.

Typical transition sizes for particles of magnetite are SP-SD: < 0.2 µm, PSD: 0.2-110 µm, MD: > 110 µm; in crystal, less than 0.03 µm the domain state is essentially SP (Dearing, 1999).

1.2.1.18 Frequency-dependent magnetic susceptibility ($\chi_{fd\%}$):

Is usually interpreted as resulting from ultrafine superparamagnetic (SP) particles. Industrial fly ash particles are larger and typically in the multi-domain (MD) and pseudo-single domain (PSD) grain size range (Flanders, 1994; Jordanova et al., 2014) as cited in Liwan et al. (2015).

$\chi_{fd\%}$ is measured at two frequencies, for this work, frequencies of 976 Hz and 15,616 Hz were measured (χ_{lf} low frequency and χ_{hf} high frequency) respectively.

$\chi_{fd\%} = ((\chi_{lf} - \chi_{hf}) / \chi_{lf}) * 100$

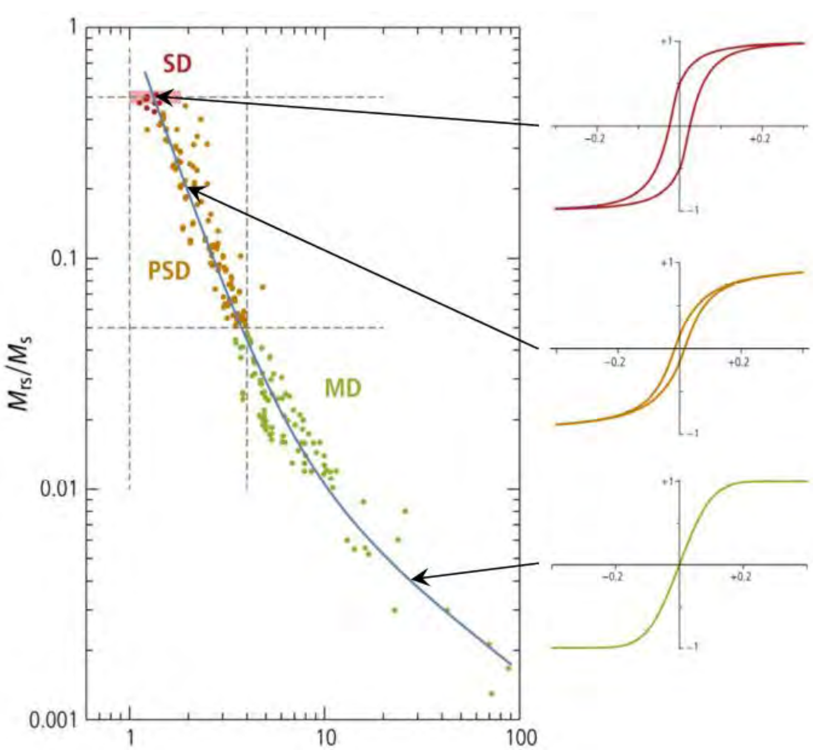


Figure 5: Day Plot (Egli, 2016) after the original publication of Day et al (1977) with Data from Dunlop (2002). Natural (titano) magnetite particles clusters along a universal trend line (blue).

Hysteresis curves typical for SD,PSD and MD are shown on the right side.

1.2.1.19 Curie Temperature

The temperature when a ferromagnetic or ferrimagnetic sample becomes paramagnetic due to the loss of the magnetic moment's alignment by the thermal energy.

Chapter 2. Problem Statement

2.1 Fe in Air

Particle matter in the air, especially small sizes in the order of µm, has been marked as a threat for health by the World Health Organization (WHO). Two frequently reported sizes are: PM_{10} - particle matter (PM), with an aerodynamic diameter of 10 µm or less and $PM_{2.5}$ – (PM), with an aerodynamic diameter of 2.5 µm or less. The risk from these PM have been associated with cardiopulmonary conditions, respiratory infections and lung cancer (WHO, 2009).
Studies on air filters and particle matter (PM); have found magnetic phases such as magnetite, hematite and maghemite in different mixtures and their magnetic responses have shown associations with heavy metals (e.g; Castañeda-Miranda et al. 2014; Petrovsky et al. 2013; Sagnotti et al. 2006, 2009; Shu et al. 2001).

Magnetic airborne particles and permanent magnets as collectors such particles directly from air, have been scarcely documented (Flanders,1994; Jung et al. 2012).

2.2 Querétaro, México

Santiago de Querétaro city, known as Querétaro (figure 6) has 878,931 habitants (INEGI, 2015). The allowed limit of PM_{10} is 75 µm/m^3 and for $PM_{2.5}$ is 45 µm/m^3 (NOM-025-SSA1-2014), in comparison with Germany, where the limit of PM_{10} is 50 µm/m^3 and for $PM_{2.5}$ 25 µm/m^3 (Directive 2008/50/EC of the European commission for air quality) as shown in table 1 both limits for a 24 hrs period.

Figure 6: Querétaro de Arteaga state marked in red, the capital is called Santiago de Queretaro City, known as Queretaro.

The inventory of emissions in 2008, took into account 7 counties (figure 7). The majority of PM sources (figure 8) were classified as Area sources, they include: industrial, commercial, agricultural and domestic combustion, natural forest fires, carbon roast and farming. Permanent sources: production of electricity; oil, chemist and steel work, food and beverage, glass industry, wood and waste management. (SEMARNAT, 2014).

Table 1: Limits for PM for Stuttgart and Queretaro, according to the official Mexican norm (NOM-025-SSA1-2014) and the European commission's standards for air quality. Limits are specified for a 24 hrs period.

	PM_{10} (µm/m^3)	$PM_{2.5}$ (µm/m^3)
Mexico	75	45
Germany	50	25

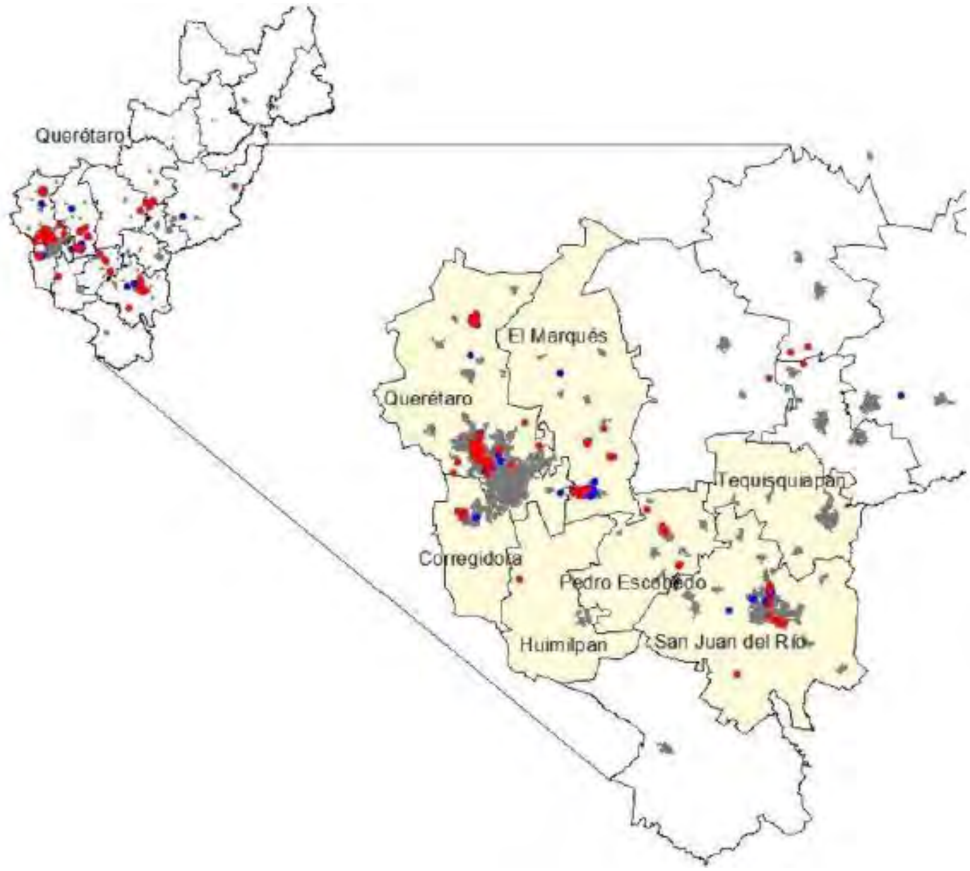


Figure 7: Counties of Queretaro state (marked with light, yellow color), were taken into account for the emission inventory. Red dots represent companies from federal jurisdiction, blue points represent companies from Queretaro state jurisdiction, gray areas represent urban spaces.(SEMARNAT, 2014).

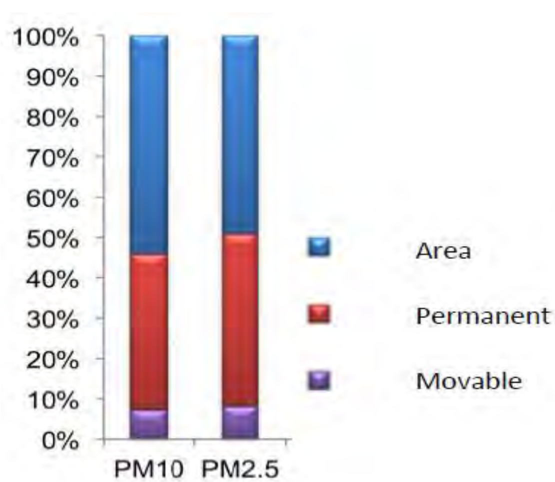


Figure 8: Sources of PM. Area: Industrial, commercial, agricultural and domestic combustion, forest fires, carbon roast and farming. Permanent: Production of electricity, oil, chemist and steel work, food and beverage, glass industry, wood and waste management. Movable: Private and urban traffic. (SEMARNAT, 2014).

2.3 Stuttgart, Germany

Stuttgart is located in the southern part of Germany, in the Neckar Basin. Location L_1- am Neckartor (48°47'16.44"N, 9°11'26.73"E) is shown in figure 9 at the same level as the central main station (Hauptbahnof) (Fenn, 2005). This location is well known in Germany for often surpassing the limits of PM_{10} : 63 days in 2016 (Stadtklima Stuttgart, 2017).

Sources of PM_{10} in Stuttgart according to the State agency for the environment, measurement and nature conservation, LUBW 2017, include street traffic as the principal with a 51%. Figure 10 show traffic as the main source of PM_{10} in L1 – am Neckartor

Figure 9: City of Stuttgart in the southwest part of Germany.

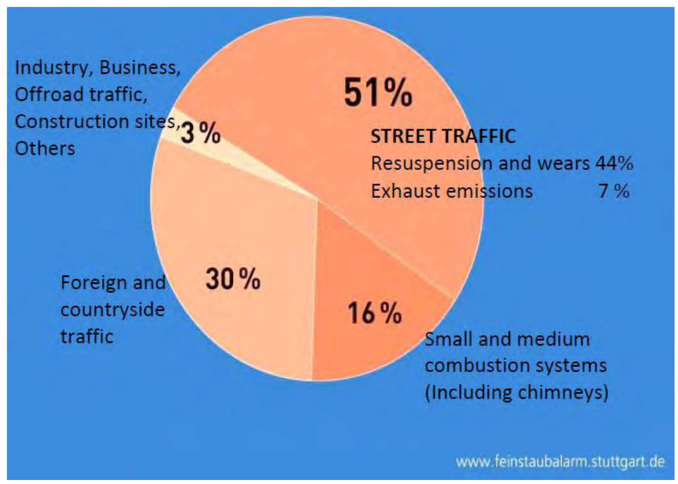


Figure 10: Sources of PM10 in Stuttgart am Neckartor (Stadtklima Stuttgart, 2017).

Chapter 3. Objectives

The main objectives in this work are:

1. Find an efficient way to use the permanent magnets in order to collect a considerable amount of airborne particles.
2. Determine the magnetic properties of airborne particles using permanent magnets as collectors in order to find a possible relation with PM_{10} and $PM_{2.5}$

Querétaro, México

In figure 11 locations U_1 and U_2 are shown, the map also shows the land use of the city. Location U_2 lies at the rooftop in a building from the National Autonomous University of México campus Juriquilla (20°42'11.49"N, 100°26'50.05"W) (figure 12). Location U_1 (20°35'14.79"N, 100°23'42.09"W) lies in a firemen station, diesel fire trucks are in use the whole year (figure 13). Both locations have meteorological stations nearby.

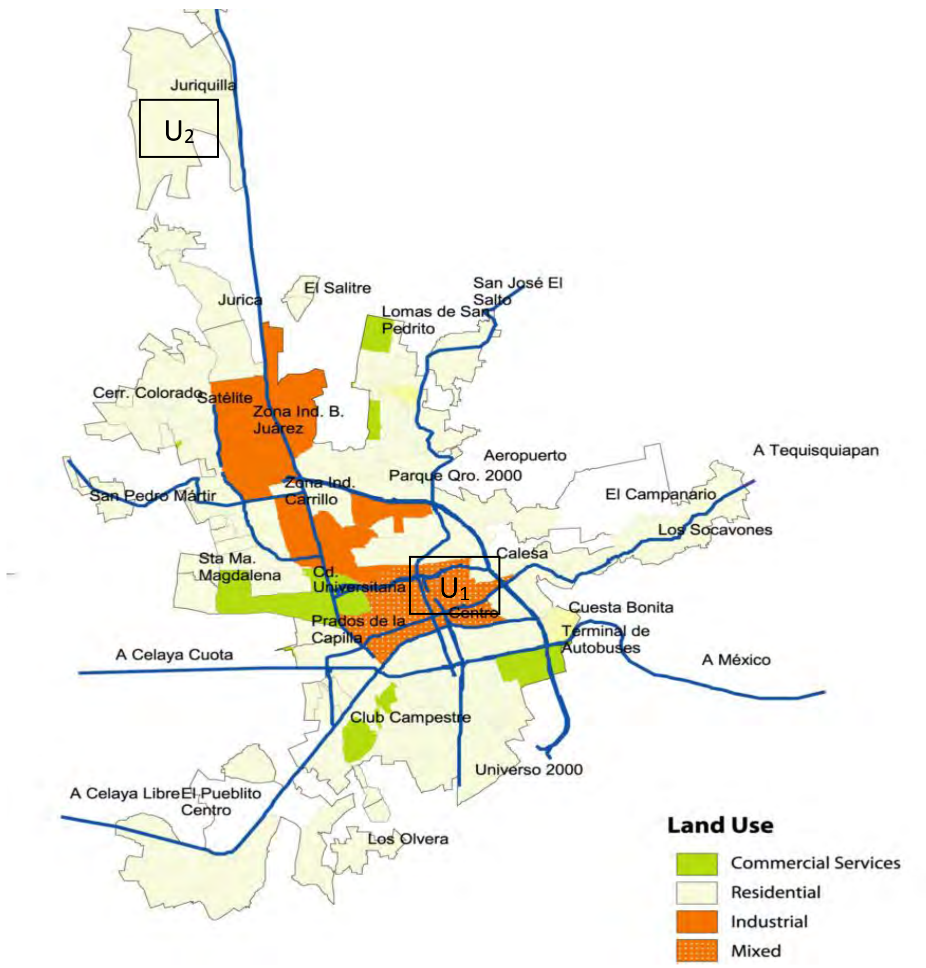


Figure 11: Land use of Queretaro by (Cordeiro et al. 2008). Site U_1 is on the city center and location U_2 on the northern part, blue lines represent the main avenues.

Figure 12: Location U_2, aerial view (left) and view of the meteorological station on the rooftop (right).

Figure 13: Location U_1, aerial view (left) and front view (right) from the firemen station. Yellow rows represent the direction of the traffic in Zaragoza Av. (one of the main avenues in Queretaro).

Magnets

Spatial arrangements of the magnetic field gradient (H) and its variation with different numbers of magnets at different angles was modeled in 2D (figure 14) using the open finite element method Software FEMM v.4.2 (Meeker, 2015).

The difference between the grades of the magnets and its variation with the field density and gradient was not significant. Moreover, the length of the magnet was a stronger factor to contribute to the variation of the field density (figure 15); and therefore, a length of 3.8 cm was accorded with a reasonable price.

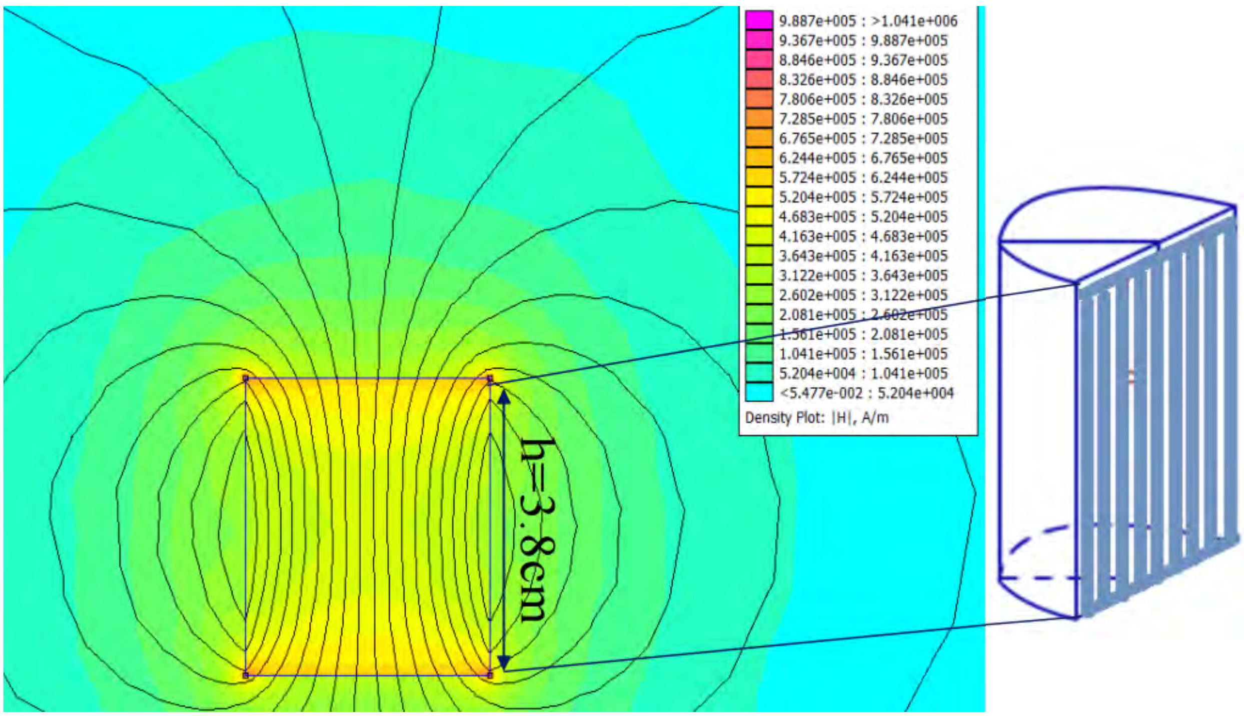


Figure 14: Example of a 2-D representation of the magnetic field intensity (H) from the transversal face (right) of one neodymium magnet grade N45. Warm colours such as yellow and red represent a higher (H) density.

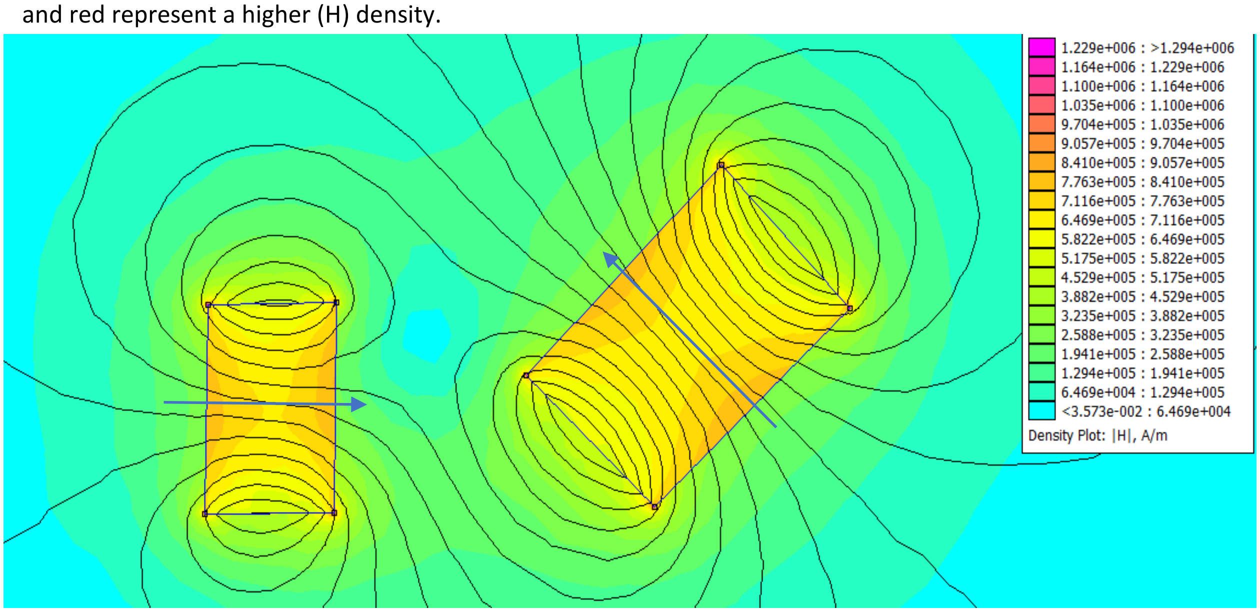


Figure 15: Example of a 2-D representation of the magnetic field intensity (H) from two transversal permanent magnets faces of two neodymium magnets. The magnets are N52 grade. Blue arrows indicate the direction of magnetization.

Sampling

The sampling was conducted from June to August 2016 for three periods of time (T_1, T_2, T_3). Figure 16 shows the covers used on magnets for each period.

Magnets were attached to magnetic surfaces with prior permission from University UNAM building's administration and firemen association. Samples from the magnets collected, varied according to the number of magnets recovered.

1.- Period T_1 (June 2016 - 10 days) samples from 5 magnets (Ø 3.8cm, 3.8cm long, cylinder shape, NdFeB grade N45) were collected daily. U_1 samples were collected first, afterwards, samples from location U_2 (~2 hours difference). Magnets were covered with latex and left exposed to environmental conditions (exposed to sunlight, rain, and wind) for ~24 hrs, afterwards the latex began to tear apart.

2.- Period T_2 (July 2016 - 31 Days) magnets were wrapped with filter paper. Samples from 3 magnets were collected. The rest couldn't be recovered due to problems with environmental conditions; the filter paper started to tear apart 1 week after they were exposed to environmental conditions. The magnets then were recovered from a separate area, no sun and no rain where in contact with the magnets, only air circulation has to be considered.

3.- Period T_3 (August-September -57 Days) magnets were wrapped with teflon tape. This material was used in order to find a material to endure harsh environmental conditions (exposed to sunlight, rain, and wind) , however, due to human intervention in location U_1, magnets recovered (3 magnets) were from the separate area, where only air circulation has to be consider.

None of the samples could be accurately weighed, and therefore mass specific magnetic susceptibility measurements are not presented. During the three periods; experiments with different magnet's covers were tested: epoxy materials with glass fiber, aluminum paper and plastic foil were examined as possible magnet's covers, none of them were successful for the retention of particles. For the recovery from location U_2, the number of magnets were matched to location U_1.

Gathering of particles

Period T_1. In figure 17a & 17 b airborne particles from location U_1 were scratched from 50 magnet's foils (Latex foil was scratched)and gathered into a new plastic foil, they are shown as the black powder in the plastic foil. Airborne particles from location U_2 couldn't get gathered due to the small amount collected.

Period T_2. In figure 17c airborne particles, collected in location $U_{2,}$ are shown attached to the cover material (filter paper), the airborne particles couldn't be unattached from the paper.

Period T_3. In figure 17d & 17e, airborne particles are attached to the cover material (Teflon tape), the particles couldn't be unattached.

a) b) c)

Figure 16: a) Latex cover from location $U_{2,}$ airborne particles are not appreciated. In b) filter paper cover from location U_1 from the separated area; airborne particles are appreciated around the magnet's diameter edges as a fine black line of dust. In c) teflon tape cover, magnetic particles are not appreciated.

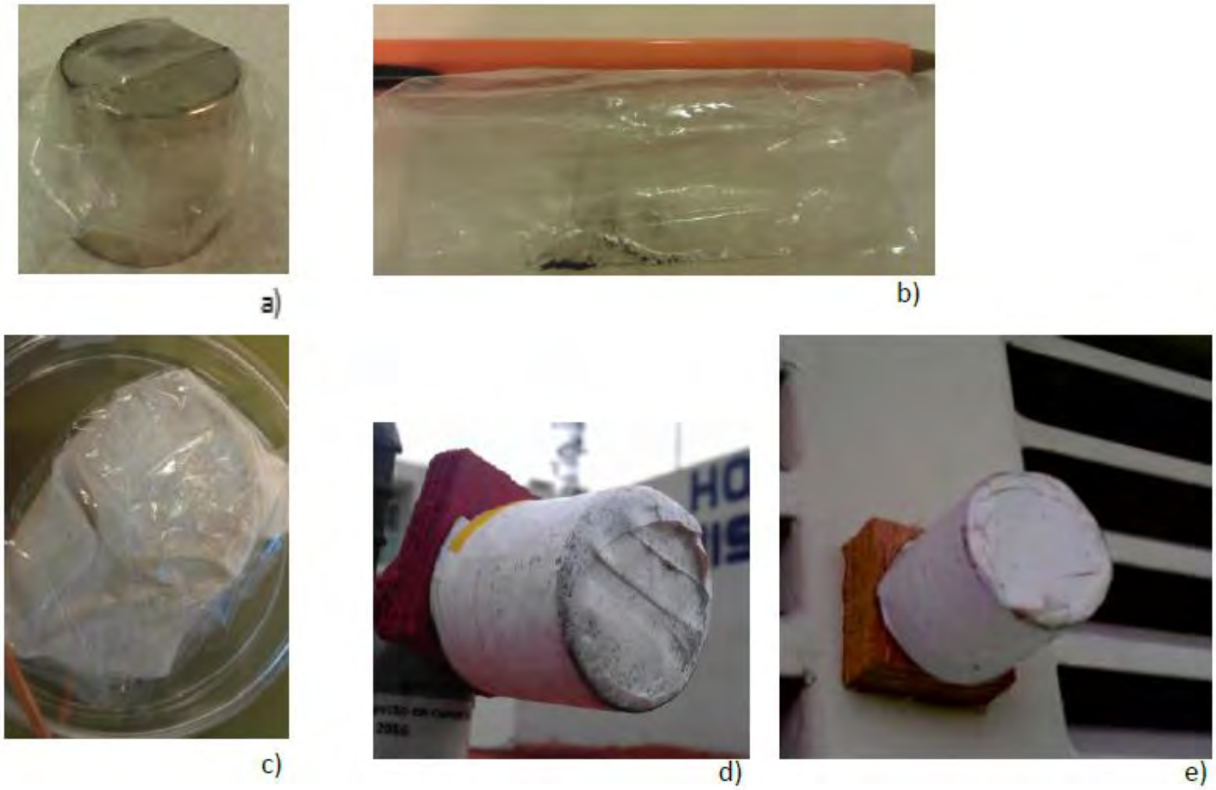


Figure 17: a),b) Airborne particles gathered with magnetic force from location U_1 during sampling period T_1, airborne particles are appreciated as a fine black dust around the magnet's diameter edges. c) Filter paper from location U_2 during sampling period T_2, airborne particles cannot be appreciated. d) Teflon tape cover from location U_1 during sampling period T_3, particles are appreciated as a fine black dust around the edges of the magnet's diameter. e) Teflon tape cover from location U_2 during T_3 sampling period, airborne particles are slightly appreciated as a fine line of dust around the edges of the magnet's diameter.

Germany

In figure 18, location L_1 (figure 18 a) with a meteorological station from LUBW is shown. The station measures: NO_2 ($\mu g/m^3$), wind velocity (m/s), air temperature (°C), humidity (%), and air pressure (hPa).

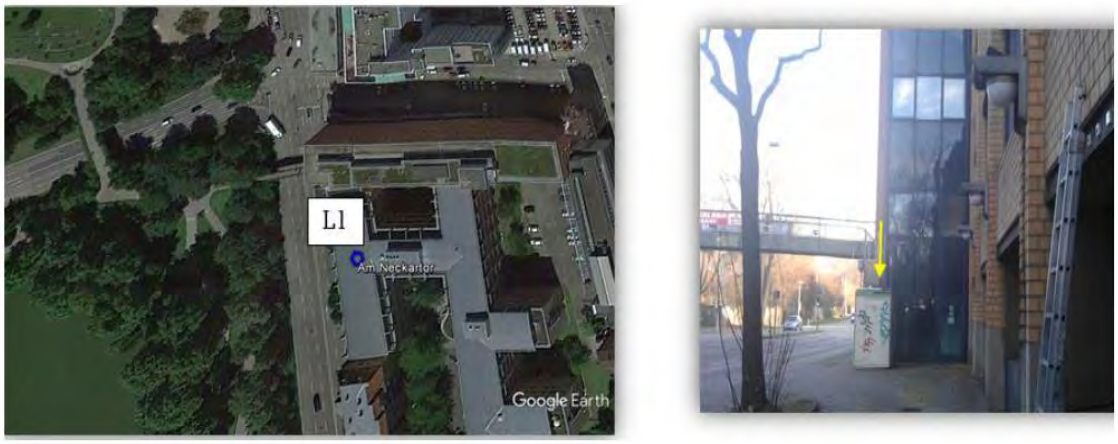
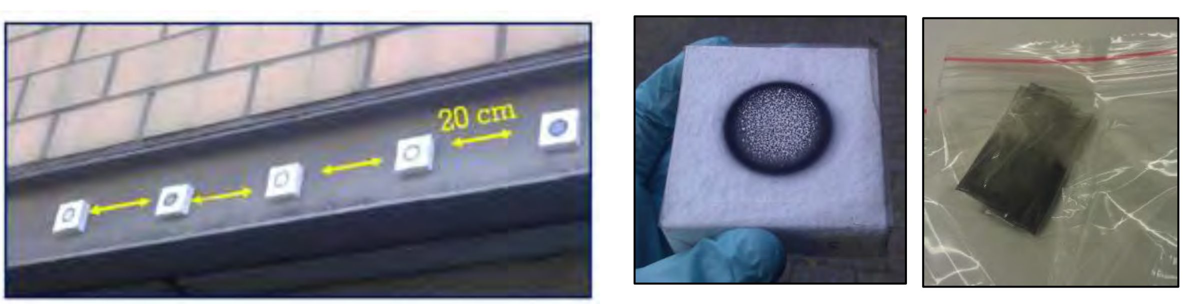


Figure 18: Aerial view of the location L_1 (left), close-up view to the location L_1 (right). The meteorological station is signalized with a yellow arrow. Magnets were attached to an iron surface 2 m above the ground, next to the ladder on the right figure.

Cylindrical neodymium magnets (5 Magnets: Ø 3 cm x 1 cm N45- figure 19) were used to gather airborne particles from 2 sampling periods: Period S_1 (40 days during September/ October 2016), and period S_2 (39 days during October/Nov 2016).

The magnets were mounted in square 6 x 6 cm styrofoam containers, afterwards, the magnet inside and the container were lined with plastic to ensure isolation from the magnet's surface with the collector material. In sampling period S_1, teflon and plastic foils were used.



a) b) c)

Figure 19: a) Magnets attached to an iron surface, b) Airborne particles from S_1 period, they can be appreciated as a black fine powder, more intensively around the edges from the magnets diameter. c) Plastic foil folded , and saved inside a plastic bag.

Chapter 5. Results

5.1 Magnets: efficiency of recovery.

The recovery from the magnets placed vs magnets recovered is shown on table 2 and table 3. In period T1 magnets recovered were the same as the magnet placed, however, the length of exposure was 24 hrs. and therefore the material is non-recommendable.

Table 2: Number of Magnets recovered by location from Querétaro, México. Magnets from location U_2 during period T_2 and T_3 were matched to location U_1. * Each Sample lasted 1 day approx., after each day the samples were collected on a plastic foil.

Period	Material	Magnets used U_1	Magnets Recovered U_1	Magnets used U_2	Magnets recovered U_2
T_1 (10 days)*	Latex	5	5	5	5
T_2 (31 days)	Filter paper	5	3	5	3
T_3 (57 days)	Teflon tape	5	3	5	3

Table 3 : Number of magnets recovered by period for location L_1 Stuttgart, Germany.

Period	Number of magnets placed	Number of magnet recovered
S1	5	5
S2	5	5

5.2 Magnetic Parameters

Hysteresis and KTL curves were measured for each sample (5 samples) for each period (S_1 and S_2), afterwards, the mass specific magnetic susceptibility from 4 foils (4 samples) were gathered, they were enough to be weighted due to balance's sensitivity, they were deposited in a new piece of plastic foil (Figure 20 a).

2.- The airborne particle mass was weighed in a KERN balance 570 (Figure 20 b) with a sensibility of 0.0001 gr. The airborne particle mass of each sample was S_1 = 0.0254 gr, S_2= 0.0195 gr.

3.-Magnetic susceptibility was measured 5 times using an MFK1-FA Kappabridge (AGICO)(Figure 20 c), and the average is reported in table 4.

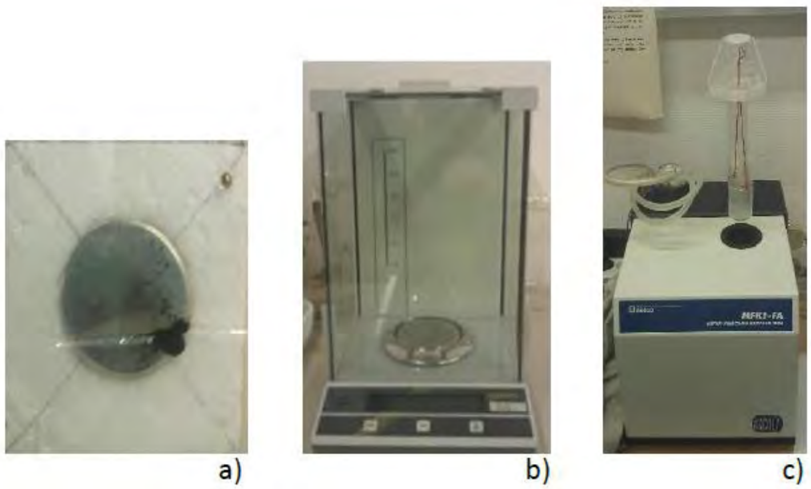


Figure 20: a) Magnetic airborne particles from 4 plastic foils gathered with the magnetic force from 1 magnet, b) KERN Balance, sensitivity= 0.0001gr, c) MFK1-FA equipment

Hysteresis and KTL curves were performed for the 5 samples (one sample per foil = 5 samples for hysteresis and 5 for KTL curves) for each period (S_1 and S_2), afterward they were gathered and measured mass specific magnetic susceptibility.

Results from Stuttgart, Germany.

Table 4 shows the average of PM_{10} and $PM_{2.5}$ measured by LUBW during S_1 and S_2 periods as well as the number of days with fine dust alarm; this alarm goes on at the time when PM_{10} levels are above the limit. Table 5 shows the variation of the mass specific magnetic susceptibility (χ) of airborne magnetic particles for each period. Mass specific magnetic susceptibility was higher during S_2 period (figure 21) than S_1, however, within one period to another they remain in the same order of magnitude. Values of magnetic susceptibility are in the order of a highly magnetic phase between magnetite ($5x10^{-4}$ m^3/Kg) and metallic iron ($5x10^{-4}$ m^3/Kg) (Collinson, 1983). During S_2 period Stuttgart got more fine dust alarm days, and the average of PM_{10} and $PM_{2.5}$ (µg/m^3) was as well higher. $\chi_{fd\%}$ shows the presence of SP particles and was interpreted according to (Dearing, 1999) as a mixture of SP and coarser non SP grains.

Table 4: Average of PM_{10} and PM $_{2.5}$, and # of fine dust alarm due to the surpassing of PM limits for S_1 and S_2 period.

Period	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	PM_{10} Alarm days	$PM_{2.5}$ Alarm days
S_1	34.4 ± 9.1	15.1 ± 4.8	0	1
S_2	43.4 ± 22.3	20.4 ± 10.9	11	13

Table 5: Mass collected by 4 magnets (gr). Mass specific magnetic susceptibility (χ) plus repeatability and frequency dependence susceptibility ($\chi_{fd\%}$) of airborne magnetic particles for S_1 and S_2.

Period	Mass (gr)	χ (m³/Kg)	$\chi_{fd\%}$
S_1	0.0254	1.698×10^{-4}	5.8
S_2	0.0195	2.607×10^{-4}	8.3

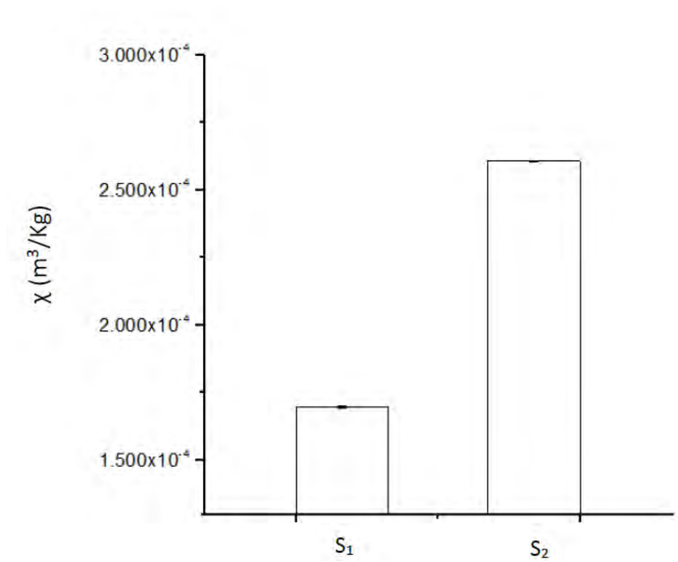
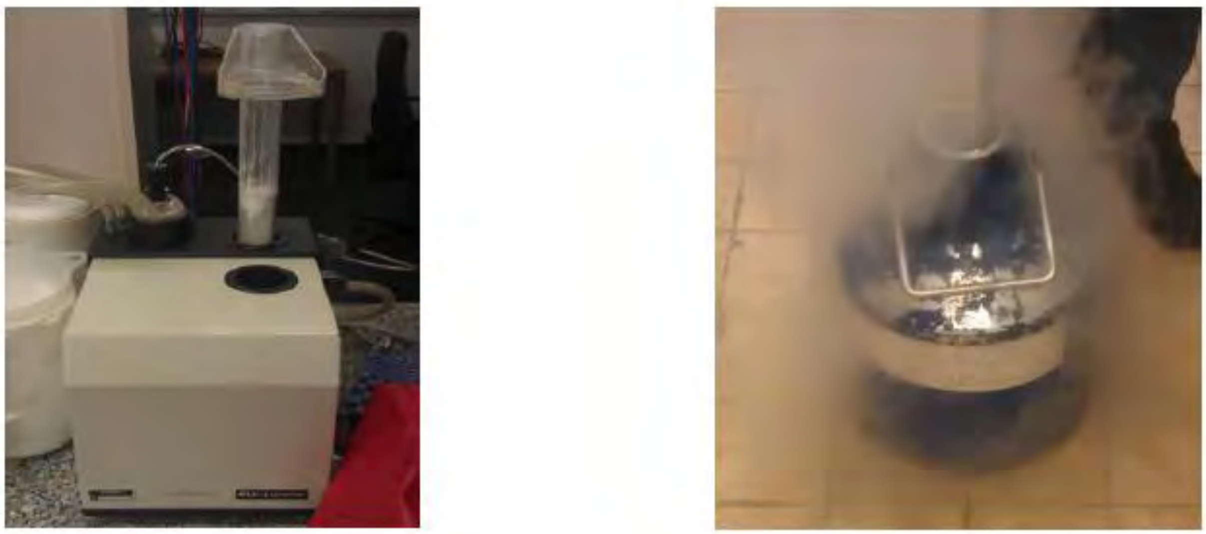


Figure 21: Mass specific magnetic susceptibility values for period S_1 and S_2, error bars on top due to repeatability, are barely visible.

5.3 Thermomagnetic curves.

5.3.1 Magnetic susceptibility curves at low temperature (KTL)

Airborne particles from each period were measured from -196 Celsius to room temperature in a KLY3 Kappabridge (AGICO) (figure 22). KTL curves were normalized by bulk susceptibility. In this



a) b)

Figure 22: a) KLY 3 Kappabridge (AGICO) equipment. b) Container of liquid nitrogen.

study, the Verwey transition is the main feature used from KTL curves indicating the presence of a magnetite phase.

From the airborne particles collected on plastic foil, a small amount was taken and used for KTL analysis (figure 23 a,b); this way, the remaining particles could be used for further analyses.

a) b)

Figure 23: a) Airborne particles gathered in a plastic foil, b) Airborne particles gathered in teflon foil. The airborne particles are seen as a black fine powder.

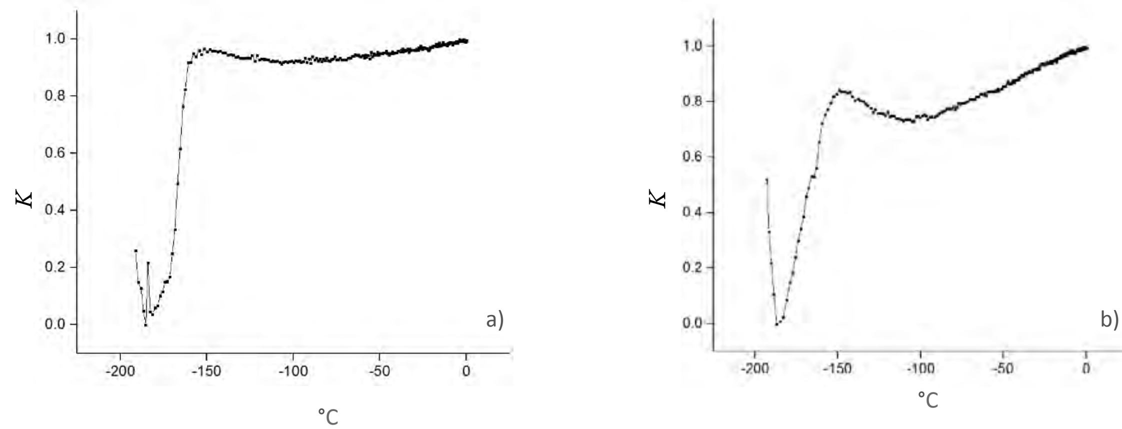
Results

Locations U_1 and U_2.

Samples from location U_1 (figure 24) and location U_2 (figure 25) all show the Verwey transition. The drop of the magnetic susceptibility around -180 Celsius is difficult to interpret. It has been also observed in the curves from Petrovský et al. (2013), however, the origin wasn't discussed. After this initial drop, there is increase of the magnetic susceptibility at temperatures ~ 160 Celsius representing the Verwey transition, followed by a peak at slightly higher temperatures which arises from the zero transition of magnetocrystalline anisotropy (isotropic point) of magnetite around 140 Celsius slightly above the Verwey transition (Moskowitz et al. 1998). The isotropic point is not visible in all these curves except a weakly appearing peak in i).

Graphs 24a and 24b: the transition is skewed to lower temperatures, which can be interpreted by a variable range of cation substitution in magnetite (Jackson et al. 2011). The continuous increase of susceptibility at temperatures > -150 Celsius indicates a PSD/SD state, which is more remarkable in graph 24b. The appearance of the isotropic point of magnetite (≈ -143 Celsius) that is visible in graphs 24a and 24b also indicates the presence of fine particle magnetite. In graph 24-c the transition is steeper, which can be interpreted as of lower cation substitution. In this graph the shape of the curve at lower temperatures is an indicator of predominantly MD particles, as a plateau-like behavior is observed and the isotropic point is not visible.

For location U_2 (graphs in figure 25) a plateau like shape at lower temperatures is visible in figure 25e) and 25f), indicating the dominance of MD magnetite. The variation at lower temperatures and the weakly visible isotropic point in graph 25d are an indicator of PSD to MD domain state.



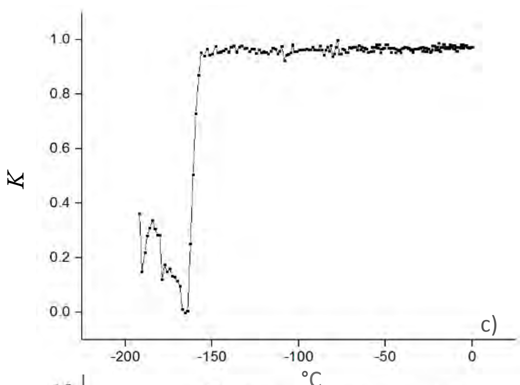
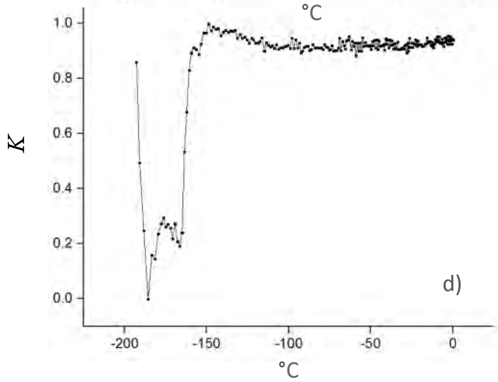
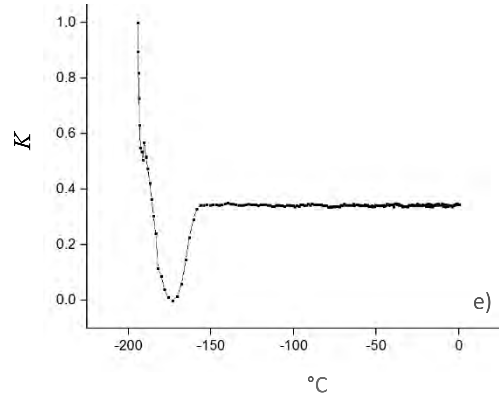


Figure 24: KTL curves for location U_1: a) KTL curve from sampling period T_1, b) KTL curve from sampling period T_2, c) KTL curve from sampling period T_3. The Verwey transition is visible in all curves around -150 Celsius (˚C).The “y” axis is normalized by K.





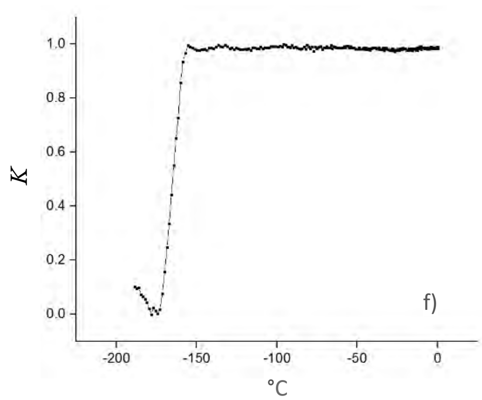
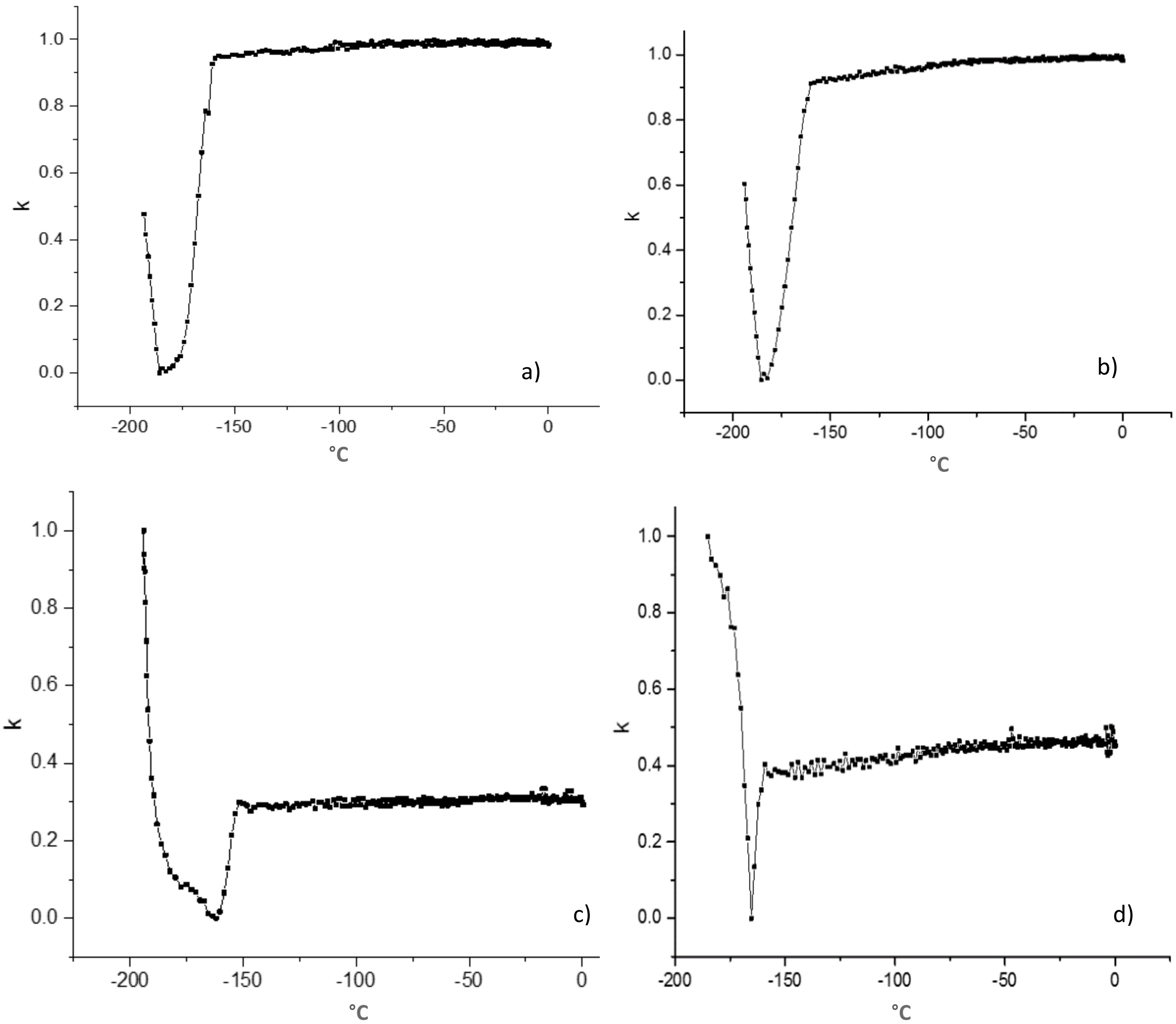


Figure 25: KTL curves for location U_2: d) KTL curve from sampling period T_1, e) KTL curve from sampling period T_2, f) KTL curve from sampling period T_3. All curves show the Verwey transition around -150 Celsius (˚C). The “y” axis is normalized by K.

Low temperature curves for location L_1 samples from period S_1 are shown in figure 26 and for period S_2 in figure 27. All samples show the Verwey transition (after an initial drop of the magnetic susceptibility observed in all graphs).

In graphs 26a, b, c, e, and 26 f,g, the Verwey transition is skewed to lower temperatures which again is interpreted as an indicator of variable substitution of cations in magnetite. In graphs 26d, 27h,j the transition is steeper, interpreted as of lower substitution of iron by other cations in magnetite. The plateau like shape at lower temperatures in all graphs of figure 26 except 26e, together with the absence of the isotropic point, is interpreted as predominant MD particle behavior. In graphs 26e and 27 f,g,h,i,j there is a clear (and partly strong) increase of the susceptibility with temperature at temperatures above the Verwey transition, which can be again interpreted as SD or PSD behavior.



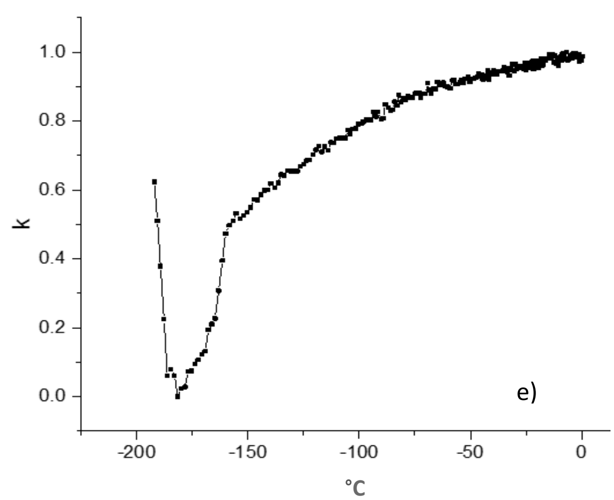


Figure 26: KTL curves for location L_1 and period of sampling S_1 sampling. All curves show the Verwey transition around -150 Celsius (˚C).

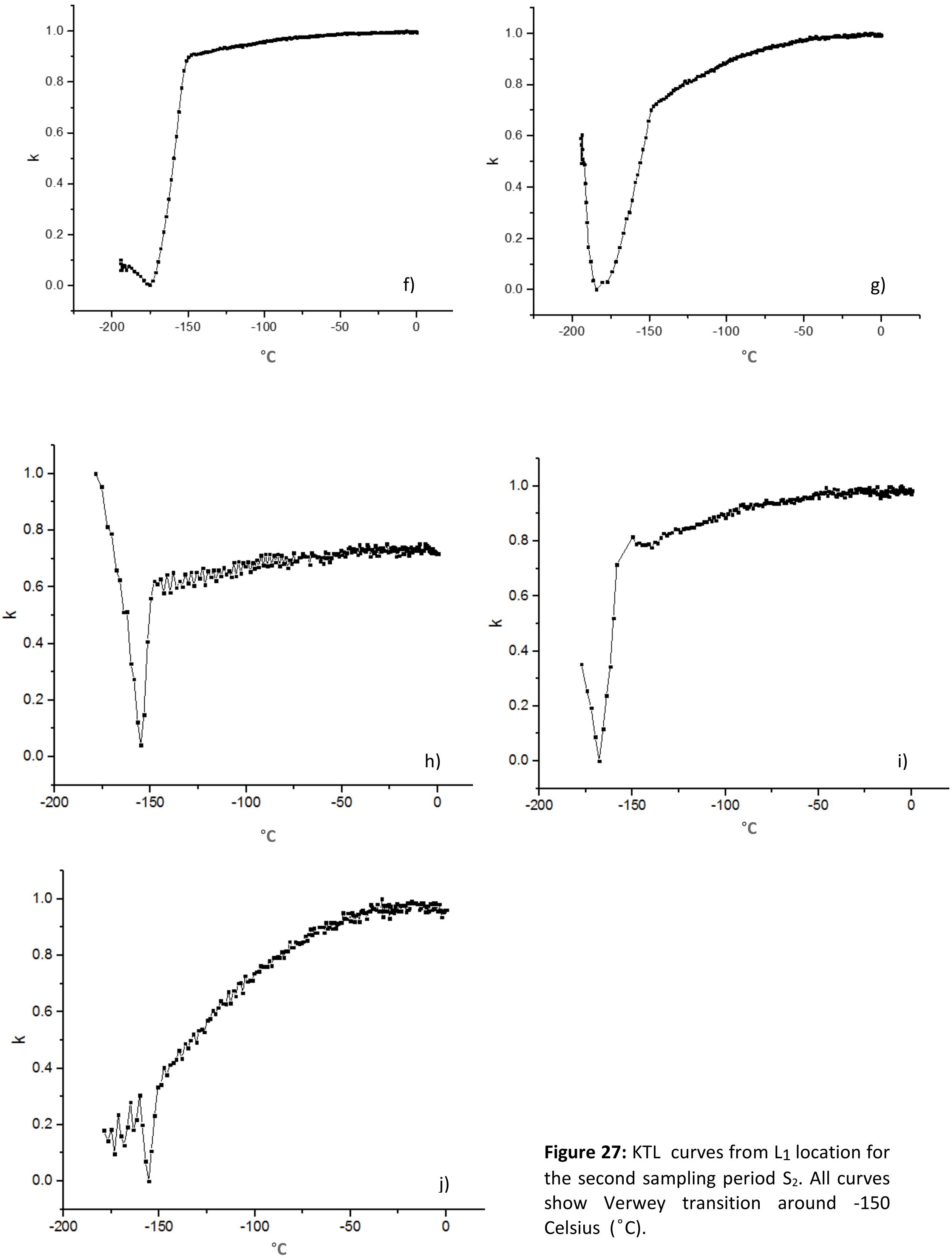


Figure 27: KTL curves from L_1 location for the second sampling period S_2. All curves show Verwey transition around -150 Celsius (˚C).

5.3.2 Magnetic susceptibility curves at high temperature (KT)

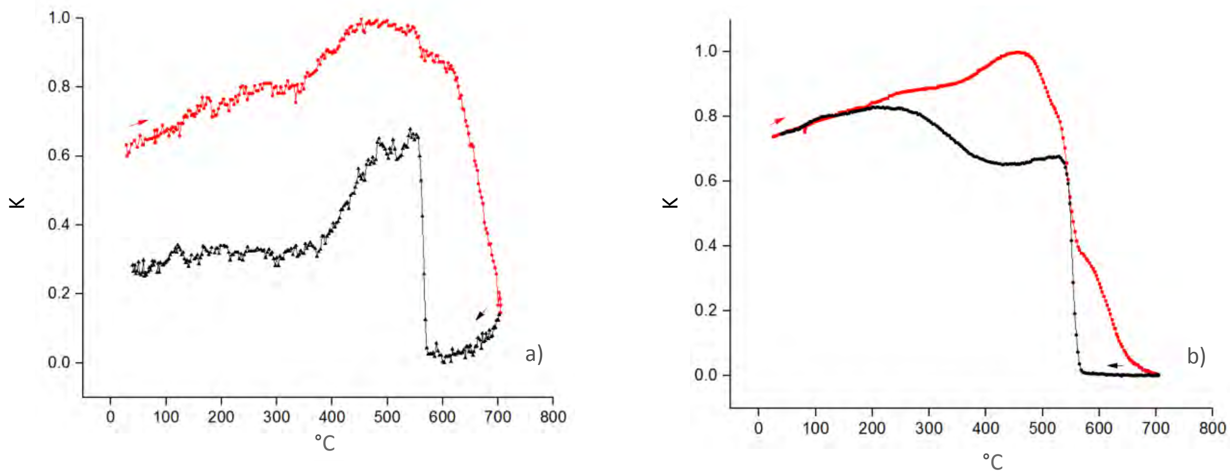
Airborne particles gathered from 4 samples in plastic and teflon foils (figure 28), the particles are seen as black fine powder, in figure 23 it is clear that not all airborne particles could be detached from the Teflon foil. To measure KT curves the airborne particles were taken from the foil instead of taken the whole sample in order to have sample left for further analyses.

Samples from location U_1 were analyzed in a KLY 3 Kappabridge with a CS-3 heating system (AGICO), the signal of the samples from location $U_{2,}$ was too low and therefore, no curves are shown. In figure 29, results from location U_1 are shown, graph a) for sampling period T_1, b) for sampling period T_2 period, c) for sampling period T_3 .

Results

U_1 and U_2

In figure 28, graphs a), b) and c) show a drop of the susceptibility on the heating curves near the Curie temperature of magnetite (580 °C), however, there is still a signal in the magnetic susceptibility at temperatures beyond 650 °C, indicating the presence of metallic iron. In figure 29-b) the increase of the magnetic susceptibility around 400 °C is followed by a drop, interpreted as metallic iron oxidizing to magnetite. The iron phase however, is not completely oxidized and therefore beyond 600 °C there is still a signal in the magnetic susceptibility. Cooling curves (black) show somewhat lower susceptibility values and no significant K values are observed at temperatures >580 °C, thus (full or part) oxidation of the metallic iron phase to magnetite is indicated. Due to the ferromagnetism from hematite and the fact that magnets are attracting highly magnetic phases, hematite is not interpreted.



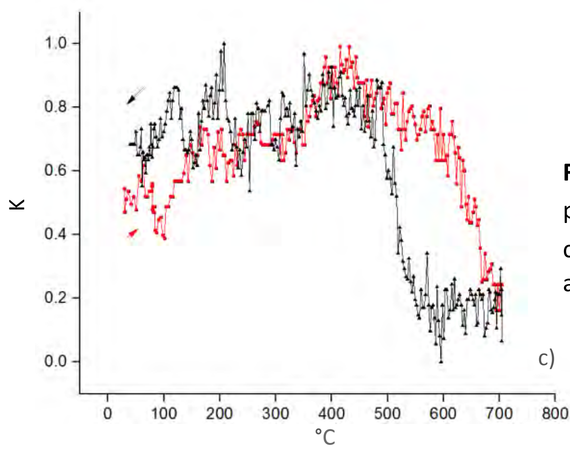


Figure 28: Graphs from location U_1: graph a) sampling period T_1, graph b) sampling period T_2 period and graph c) sampling period period T_3. Heating curves are marked as red while cooling curves are marked as black.

5.3.3 Magnetic susceptibility curves at high temperature (KT) in argon atmosphere.

Figure 29 shows KT curves measured in argon atmosphere for location U_1 and sampling period T_2.

Results

Argon Atmosphere KT.

In figure 29, heating curves (red) show a drop of the magnetic susceptibility around 550 Celsius interpreted as a magnetite-near phase. Beyond 580 °C, the magnetic susceptibility signal persists interpreted as metallic iron phase. The left graph in figure 29 corresponds to the first run in argon atmosphere, afterwards, the same sample was analyzed a second time (right side in figure 30).

In the cooling curves oxidation of metallic iron is only weakly indicated, likely due to the lack of oxygen in contrast to the KT runed in air (graphs in figure 28). The slightly lower level of susceptibility values in the cooling curves are possibly an indication of magnetite alteration at high temperatures. Samples from U_2 showed a high level of noise and therefore couldn't be interpreted. All curves were normalized by the maximum susceptibility.

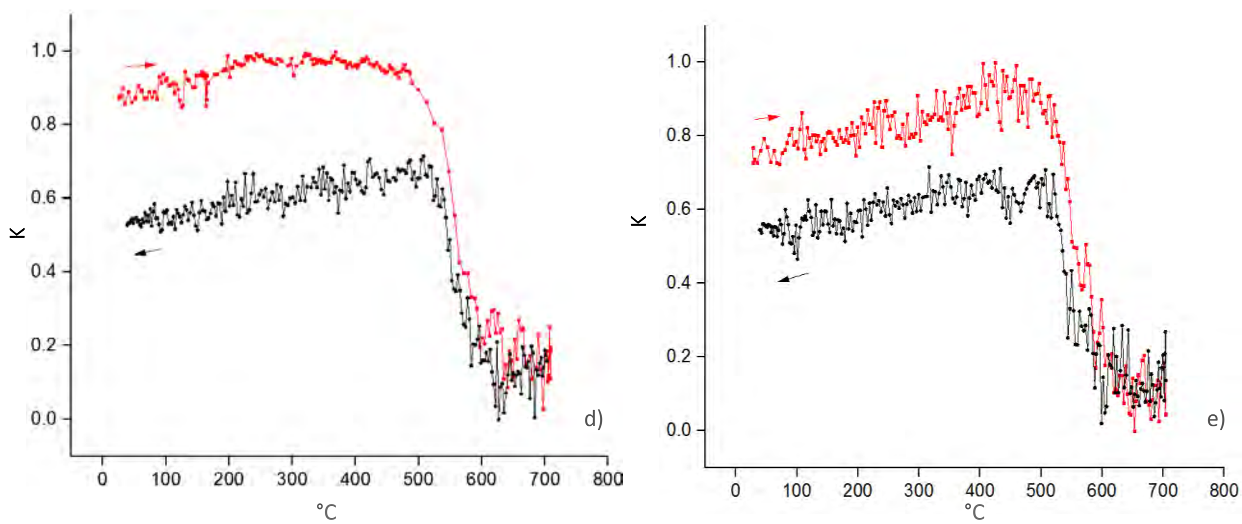


Figure 29: Graphs from location U_1 and period of sampling T_2. The left graph was first analyzed, and the same sample was then analyzed for a second time (right figure). There is a decrease in the magnetic susceptibility around 580 °C on the heating curves (red). On the cooling curves (black) there is an enhancement of the magnetic susceptibility around 580 °C, and both curves (heating and cooling) are close to each other at temperatures > 580 °C.

Magnetic susceptibility curves at high temperature (KT) Location L_1

KT curves from S_1 sampling period (figure 30 a,b) and the S_2 sampling period (figure 31 c,d), are irreversible and show a decay in the susceptibility near the Curie temperature of magnetite (580 °C). The magnetic susceptibility signal, however, doesn't drop completely to zero even at temperatures > 650 °C, again interpreted as metallic iron phase. On the cooling curves (black) an enhancement of the magnetic susceptibility is seen around the Curie temperature of magnetite, interpreted as the fully iron oxidation.

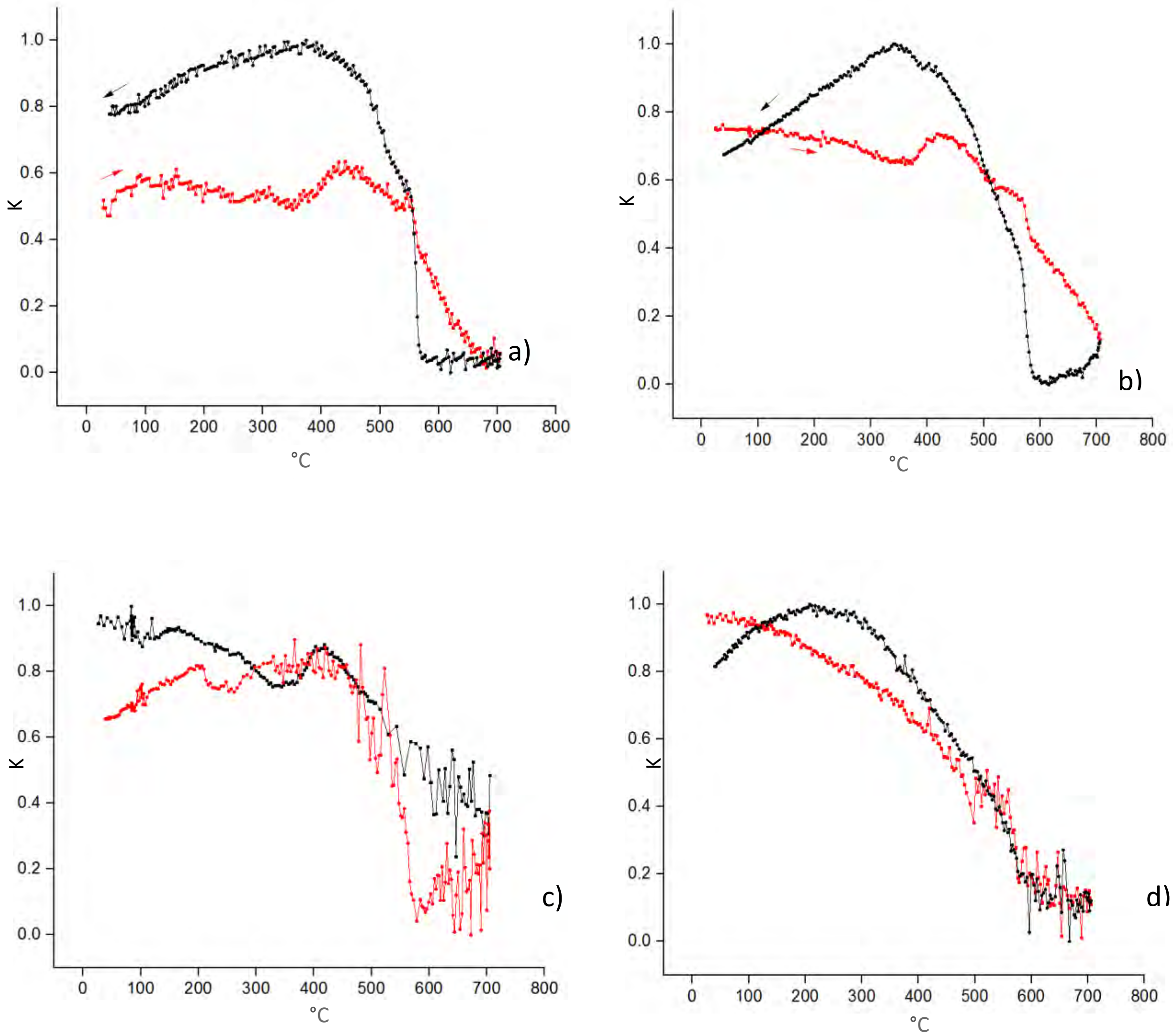
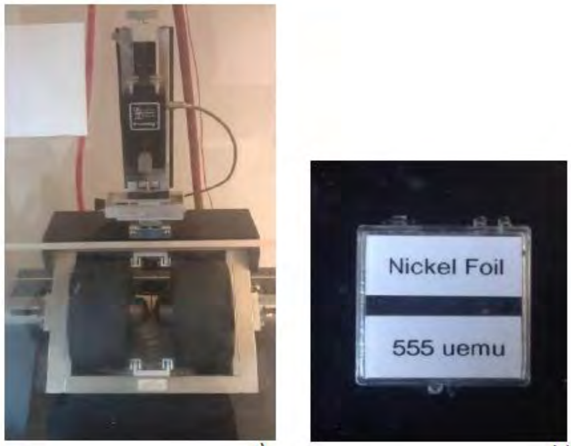


Figure 30: Graphs a) and b) are from sampling period S_1. Graphs c) and d) are from sampling period S_2. Heating curves (red) show a drop on the magnetic susceptibility around 580 °C. Cooling curves (black) show an enhancement on the magnetic susceptibility around 580 °C.

5.4 Magnetic Hysteresis

A small amount of material form each sample was taken and wrapped in tape making sure that all the particles were trapped in it. Silicon grease was used to attach the prepared samples in a holder. The prepared samples were measured at room temperature in a Princeton Measurements MicroMag 2900 Alternating Gradient Magnetometer (AGM), shown in figure 31, with a maximum applied field of 500 mT. The instrument was previously calibrated with a nickel standard.



a) b)

Figure 31: a) Micromag 2900 AGM b) Nickel foil Standard.

Results- U_1 U_2

In figure 33 graphs a),d),c) correspond to U_1 location for each period of sampling. Graphs from d) to f) correspond to U_2 location. Graphics a), d) f) and d) show higher noise compared with the rest of the graphs. The curves were corrected for the paramagnetic-diamagnetic contribution. All curves show narrow loops, and the parameters obtained from hysteresis analyses are listed in table 4. Samples from location U_1 plot in the region of PSD in the Day plot (figure 34); samples from location U_2 plot nearer the region of MD.

Table 6: Parameters obtained from the Hysteresis analyses (H_C, M_{rs}, M_S, H_{cr}) for each location and each period of sampling with their ratios (M_{rs}/M_S, H_{cr}/H_C).

U_1	Hc (mT)	Mrs (μemu)	Ms (μemu)	Hcr (mT)	Mrs/Ms	Hcr/Hc
T_1	8.0	6.7	93.2	24.4	0.07	3.05
T_2	7.0	169.9	1812.0	25.6	0.09	3.66
T_3	8.7	17.4	192.7	33.5	0.09	3.85

U_2	Hc (mT)	Mrs (μemu)	Ms (μemu)	Hcr (mT)	Mrs/Ms	Hcr/Hc
T_1	1.2	1.6	231.9	17.3	0.00	14.41
T_2	7.4	5.7	43.7	65.5	0.13	8.85
T_3	8.4	3.0	29.2	33.7	0.10	4.01

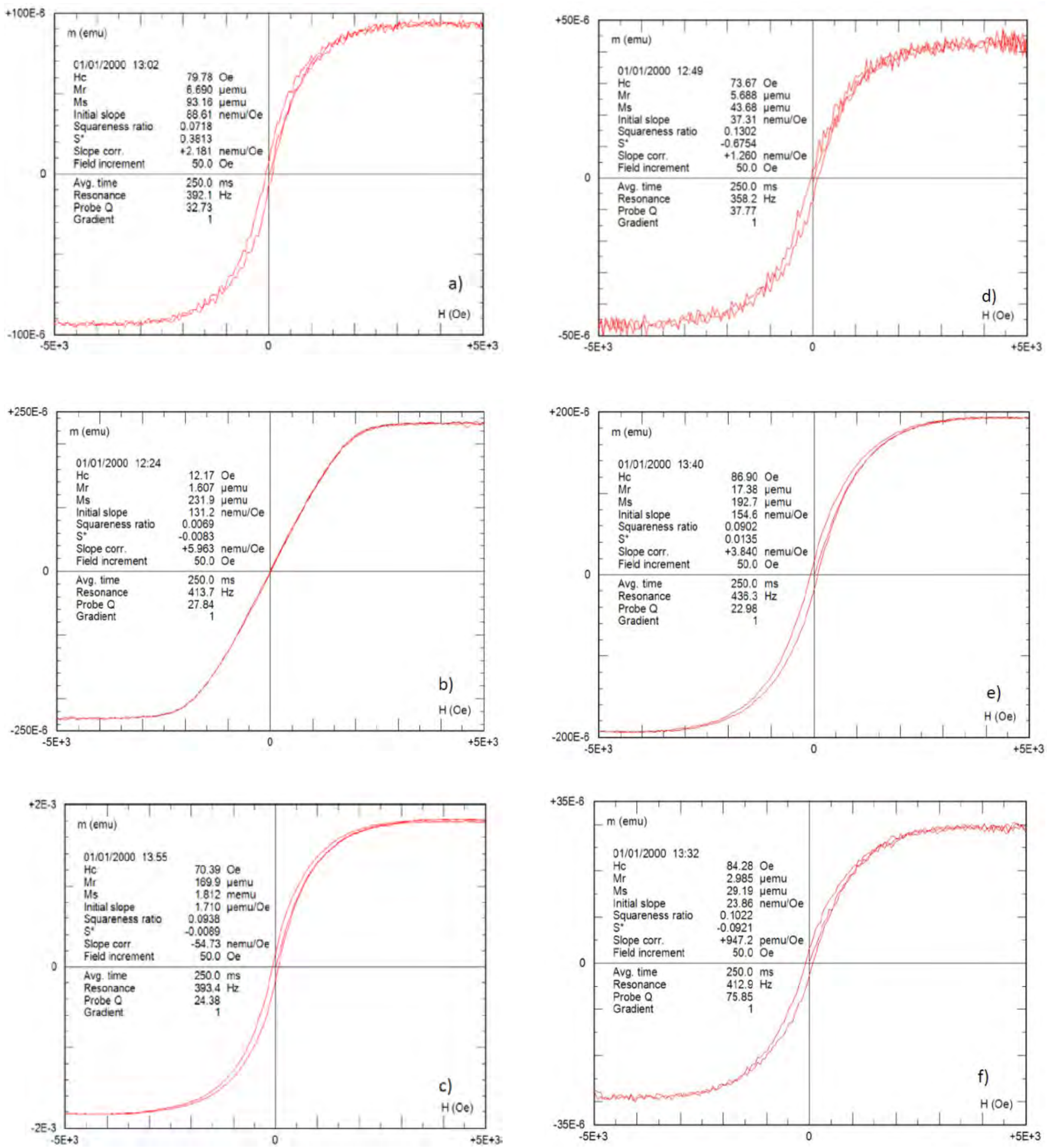


Figure 32: Hysteresis curves (red) for location U_1: a) Hysteresis loop for sampling period T_1, b) Hysteresis loop for sampling period T_2, c) Hysteresis loop for sampling period T_3. Hysteresis curves for U_2 and location U_2: d) Hysteresis loop for sampling period T_1, e) Hysteresis loop for sampling period T_2, f) Hysteresis loop for sampling period T_3.

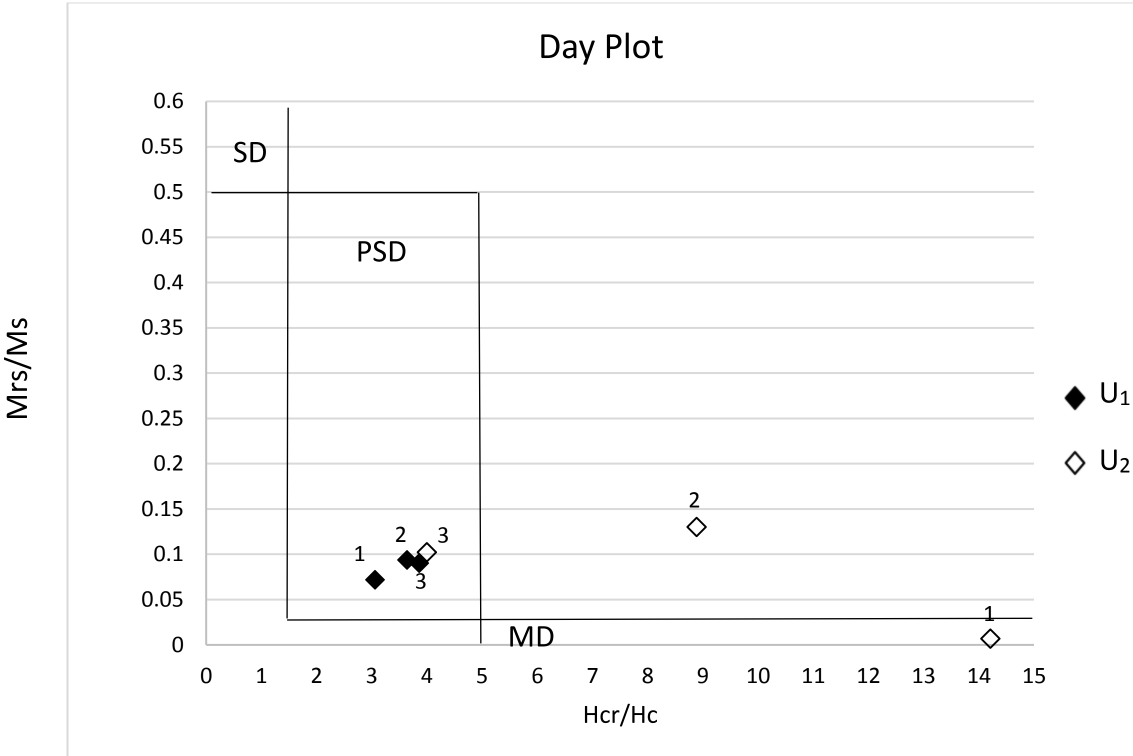
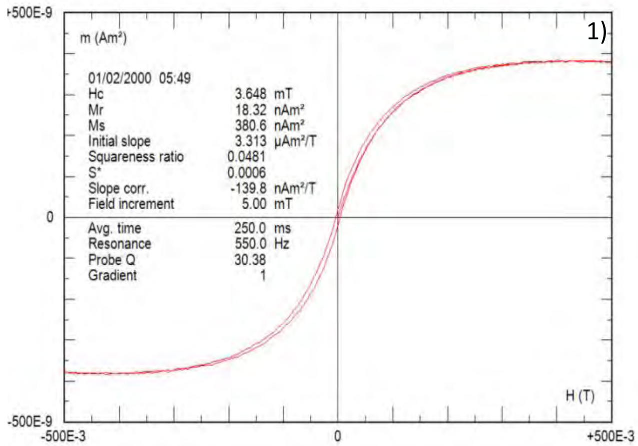


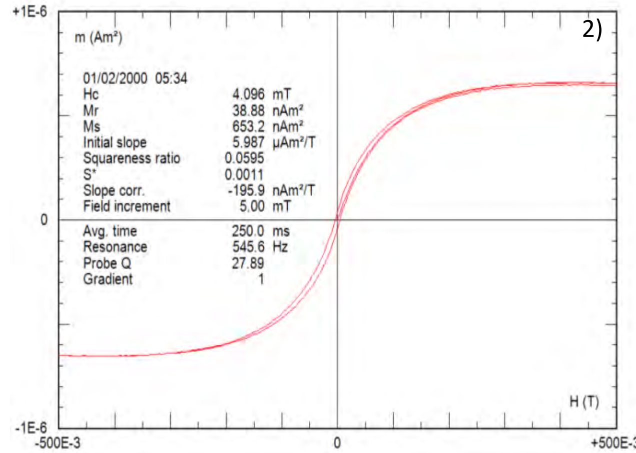
Figure 33: Day Plot (Dunlop 2002; after the original Day et al. 1997) for location U_1 (black rhombuses) and U_2 (white rhombuses). Numbers are according to the period of sampling 1= T_1, 2= T_2, 3=T_3. Domain fields are divided by Mrs/Ms and H_{cr}/H_C into single domain (SD), pseudo single domain (PSD) and multi domain (MD).

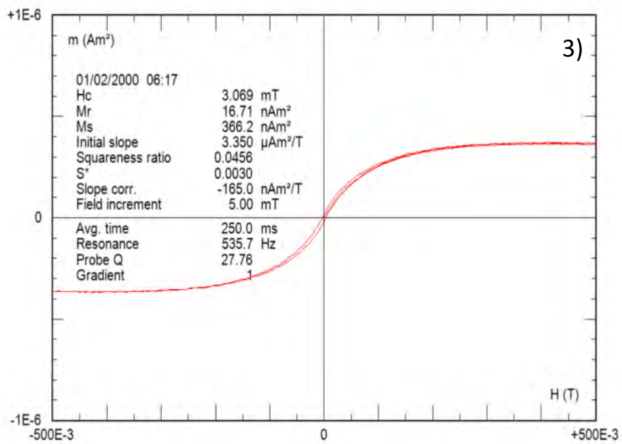
L_1

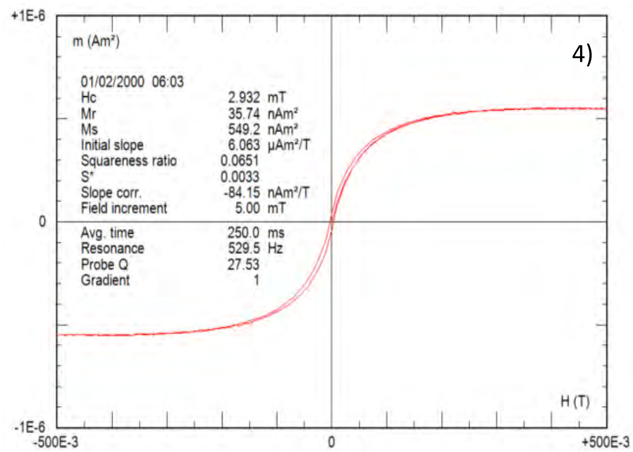
Curves for sampling period S_1 (figure 35) and S_2 (figure 36). Parameters obtained from hysteresis curves are listed on table 5 and their Day Plot is shown in figure 35.

All curves show narrow loops with low coercivity values (*Hc* <5 mT) for both periods of sampling. The Day Plot (figure 37) shows samples plot near the MD region. Coercivity for MD magnetite according to Dunlop & Özdemir (1997) as cited in Evans & Heller (2003) usually do not exceed 10 mT.









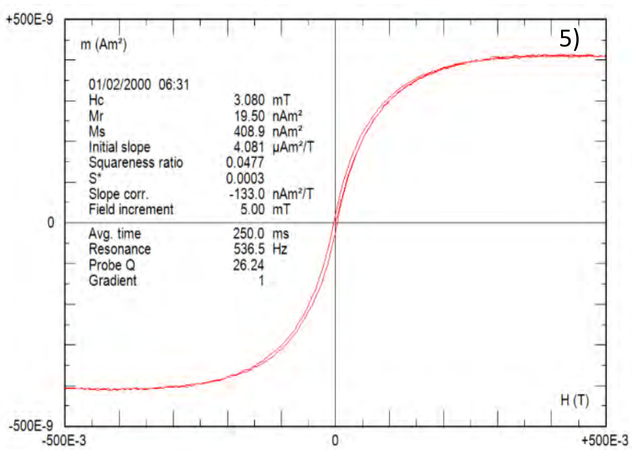


Figure 34: Magnetic Hysteresis curves from location L_1 all from S_1 sampling period. All curves present narrow loops (red).

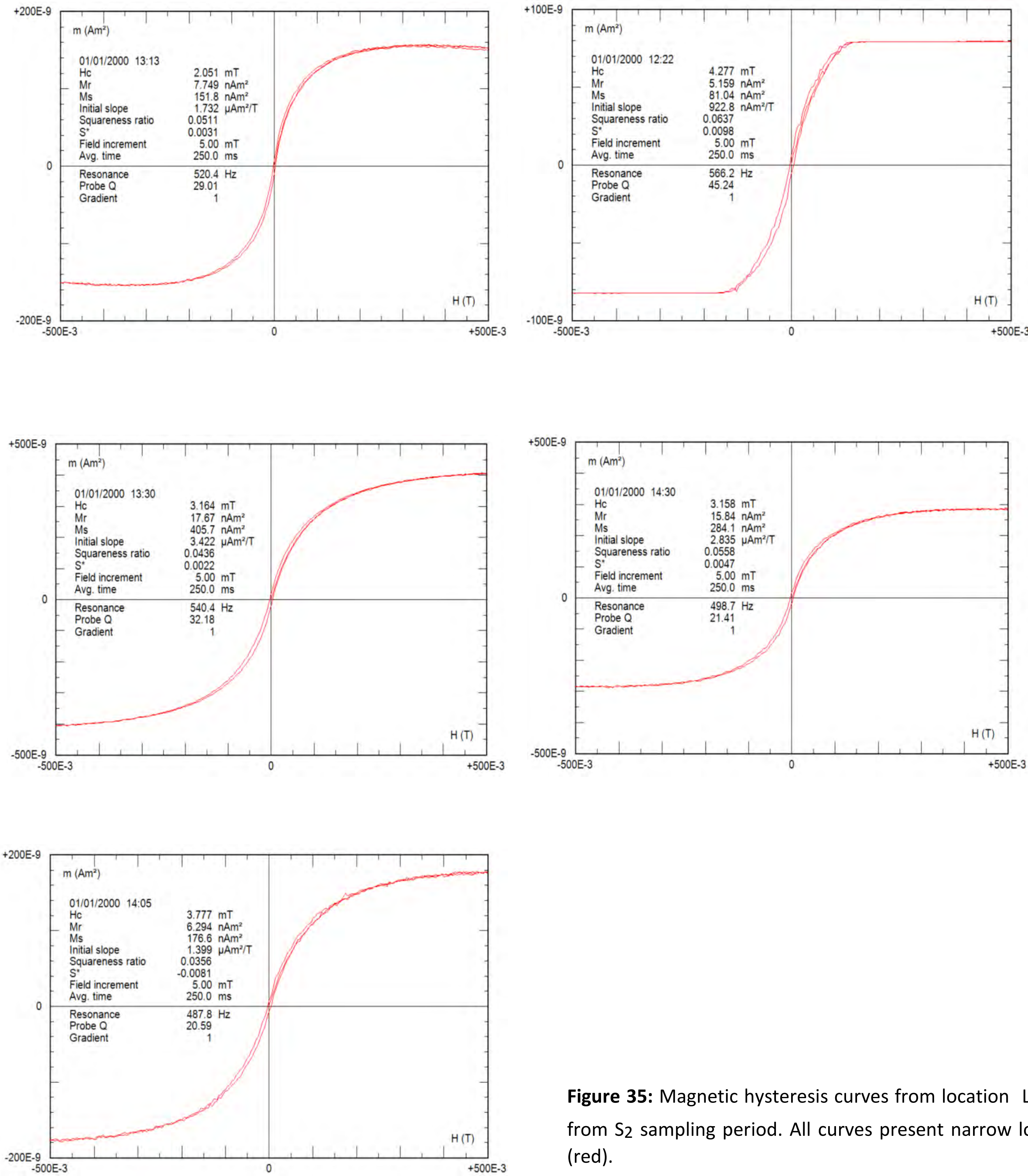


Figure 35: Magnetic hysteresis curves from location L_1 all from S_2 sampling period. All curves present narrow loops (red).

Table 7: Parameters obtained from the Hysteresis analyses (H_C, M_{rs}, M_S, H_{cr}) for location L_1 and periods S_1 and S_2 of sampling with their ratios (M_{rs}/M_S, H_{cr}/H_C).

Stuttgart S_1	Hc (mT)	Mrs (μemu)	Ms (μemu)	Hcr (mT)	Mrs/Ms	Hcr/Hc
1	3.6	18.3	380.6	30.0	0.04	8.34
2	2.9	35.7	549.2	12.5	0.06	4.31
3	4.1	38.9	653.2	27.8	0.06	6.78
4	3.1	16.7	366.2	26.3	0.04	8.48
5	3.1	19.5	408.9	15.1	0.05	4.87

Stuttgart S_2	Hc (mT)	Mrs (μemu)	Ms (μemu)	Hcr (mT)	Mrs/Ms	Hcr/Hc
1.1	4.3	5.7	81.0	23.7	0.07	5.51
2.1	3.2	17.7	405.7	30.1	0.04	9.41
3.1	3.2	15.8	284.1	19.1	0.06	5.97
4.1	3.8	6.3	176.6	23.4	0.04	6.16
5.1	2.0	7.8	163.0	14.9	0.05	7.45

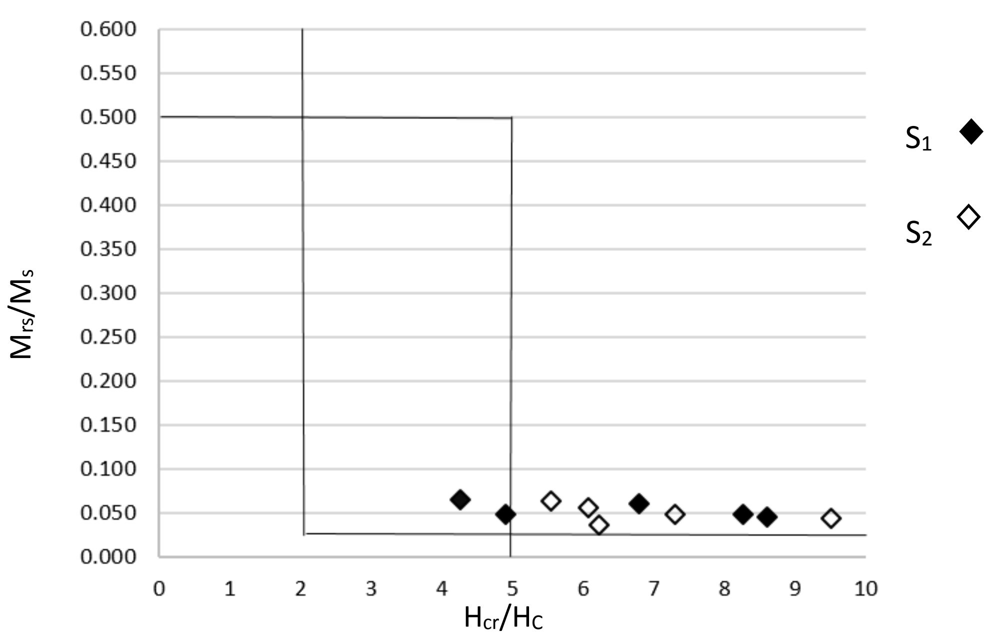


Figure 36: Day Plot (Dunlop 2002; after the original Day et al. 1997) for location L_1 for sampling period S_1(black rhombuses) and S_2 (white rhombuses). Domain fields are divided by Mrs/Ms and H_{cr}/H_C into single domain (SD), pseudo single domain (PSD) and multi domain (MD).

5.5 Complementary Analyses

5.5.1. SEM/EDX

U_1 U_2

Scanning electron microscopy (SEM) and Energy Dispersive X-ray (EDX) analyses were performed with a LEO1450 V instrument. Silver paint was applied on the surroundings of the samples, afterwards they were dried and coated with carbon, and mounted on a carbon base. For EDX analysis, the microscope was standardized with iron and cobalt. Figures from 37 to 39 correspond to location U_1, figures from 40 to 43 correspond to location U_2. Crosses on figures show where the EDX analysis was done.

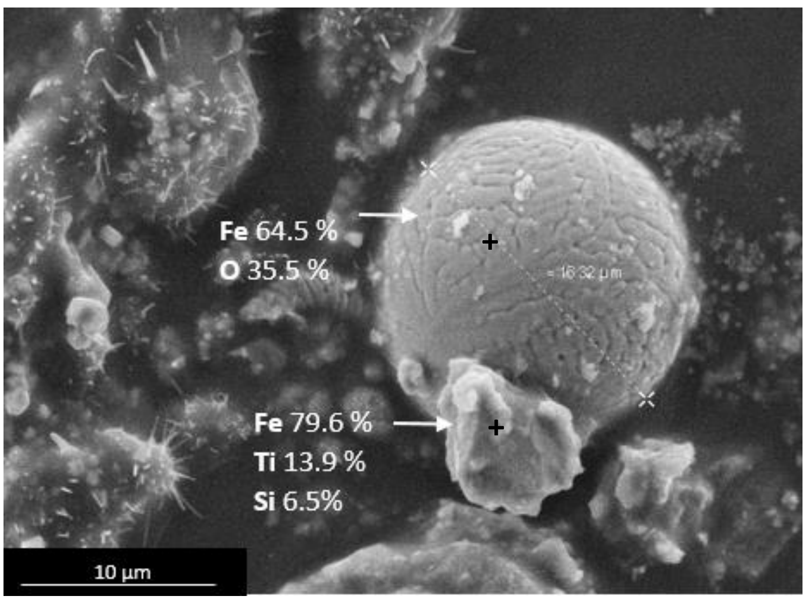


Figure 37: Iron oxide spherule (Ø 16.32 µm) showing a peel orange shape on the surface. Below to the spherule an amorphous particle is attached. Black points show the place were EDX was performed.

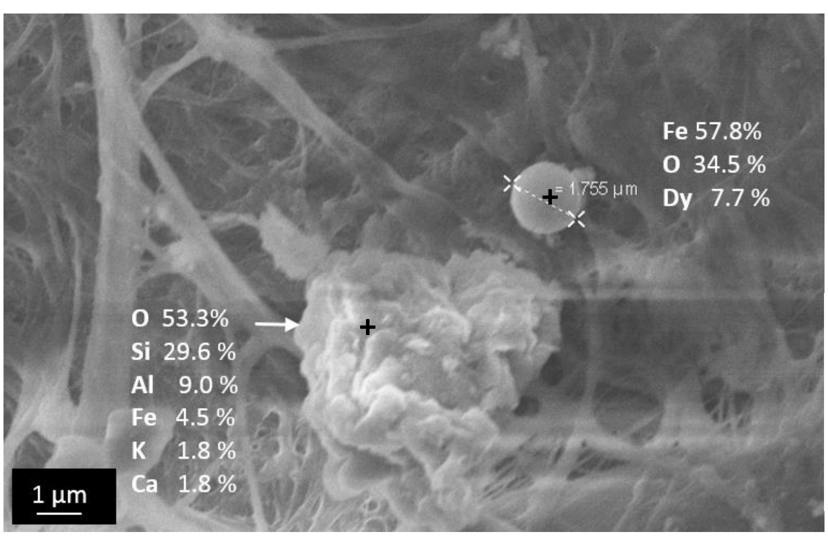


Figure 38: Iron oxide spherule (Ø 1.755 µm), showing a smooth surface texture; a larger amorphous particle is shown below the spherule.

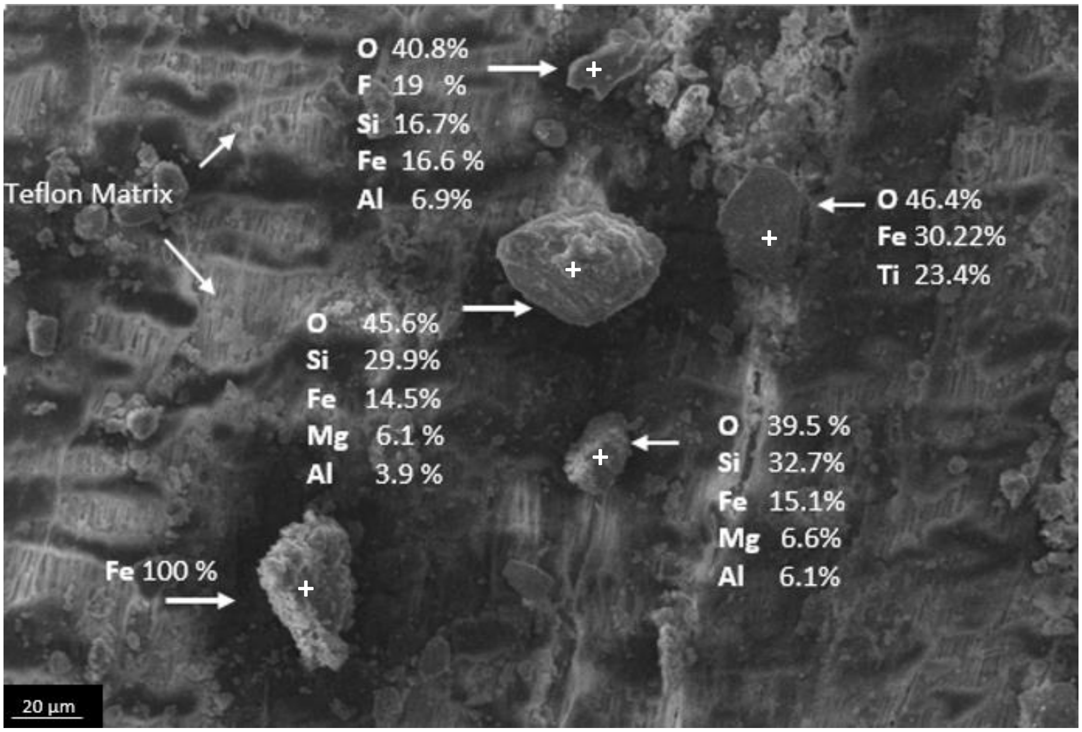


Figure 39: Iron is present as 100% at the lower left side. White marks show were EDX was measured. Oxygen, iron and silicon were the main principal components in the places from the airborne particles analyzed. Ti is present in one particle at the upper right side. Strips from the teflon tape matrix are shown on the upper left side.

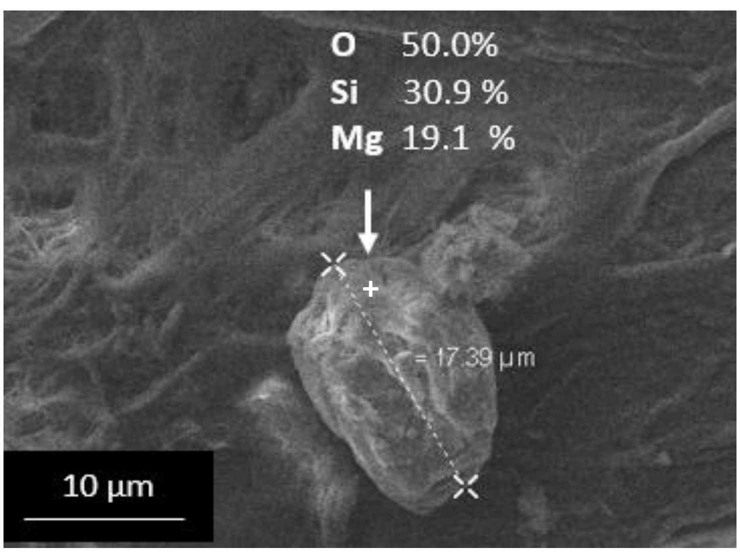


Figure 40: Airborne particle (17.39 µm in length), the spot analyzed show mainly the elements oxygen and silicon.

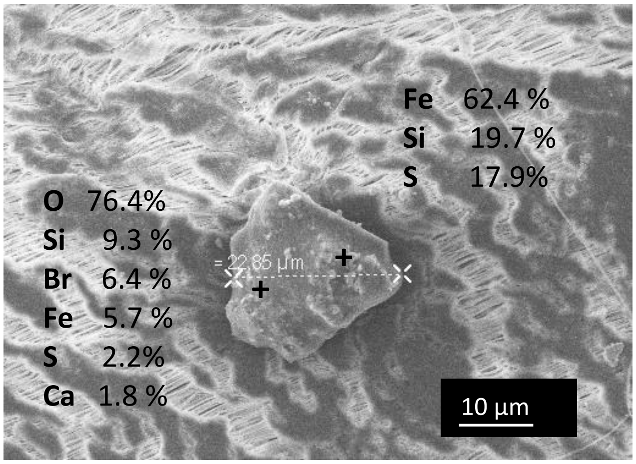


Figure 41: Airborne particle (length 22.85 µm), strips are from teflon tape matrix. The right spot on the particle showed the element iron in a high amount of mass %, the left spot on the same particle, show the element oxygen in a higher amount mass %.

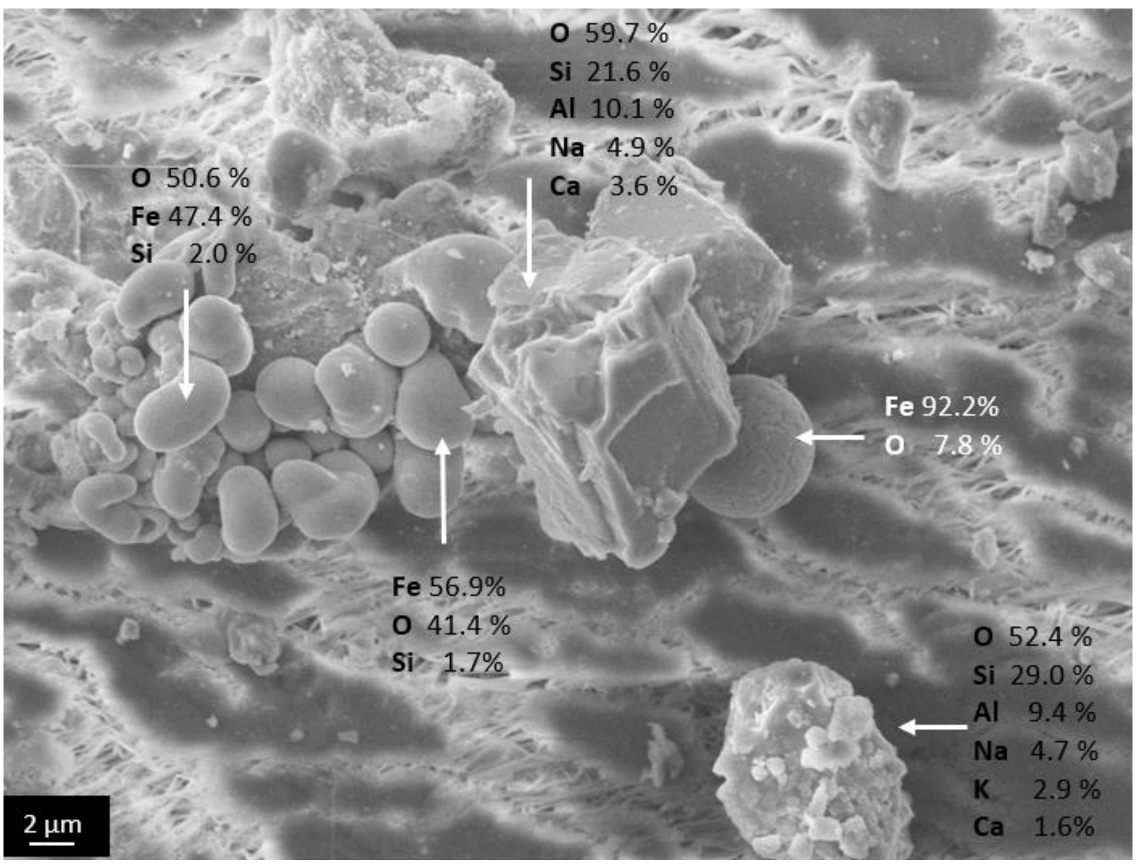


Figure 42: At the right part an iron oxide spherule with an orange peel surface is shown. Several particles at the left from the spherule show oxygen, iron and silicon mainly. A particle at the lower east side composed mainly from oxygen and silicon.

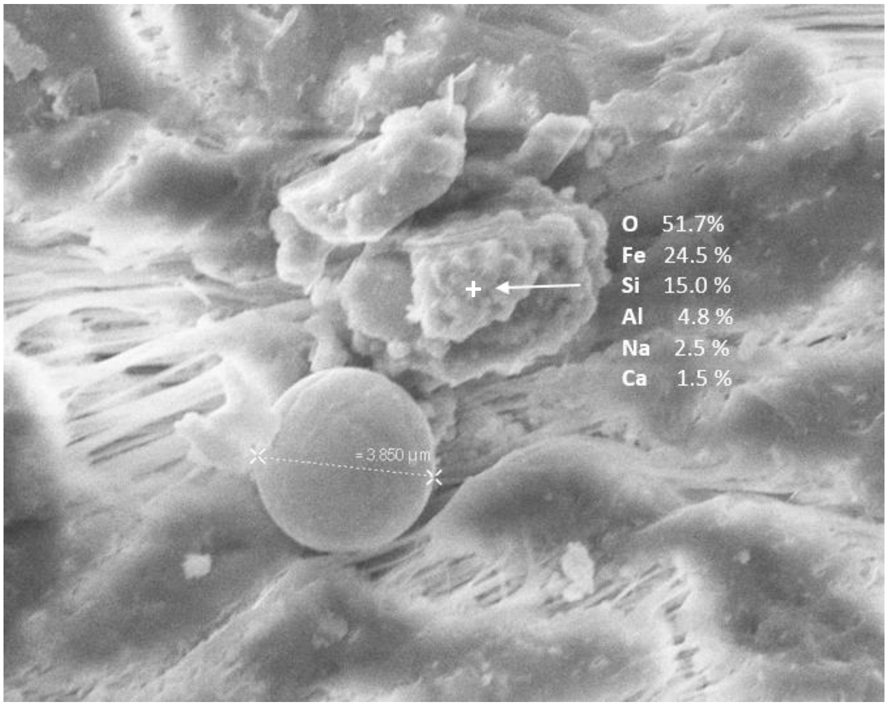


Figure 43: Spherule (Ø 3.850 µm) showing a smooth surface. Above from the spherule a spot in the airborne particle is composed mainly from oxygen, iron and silicon. White marks show where EDX was measured.

Location L_1

Figures from 44- 47 correspond to sampling period S_1 period, and figures 48 and 49 correspond to sampling period S_2.

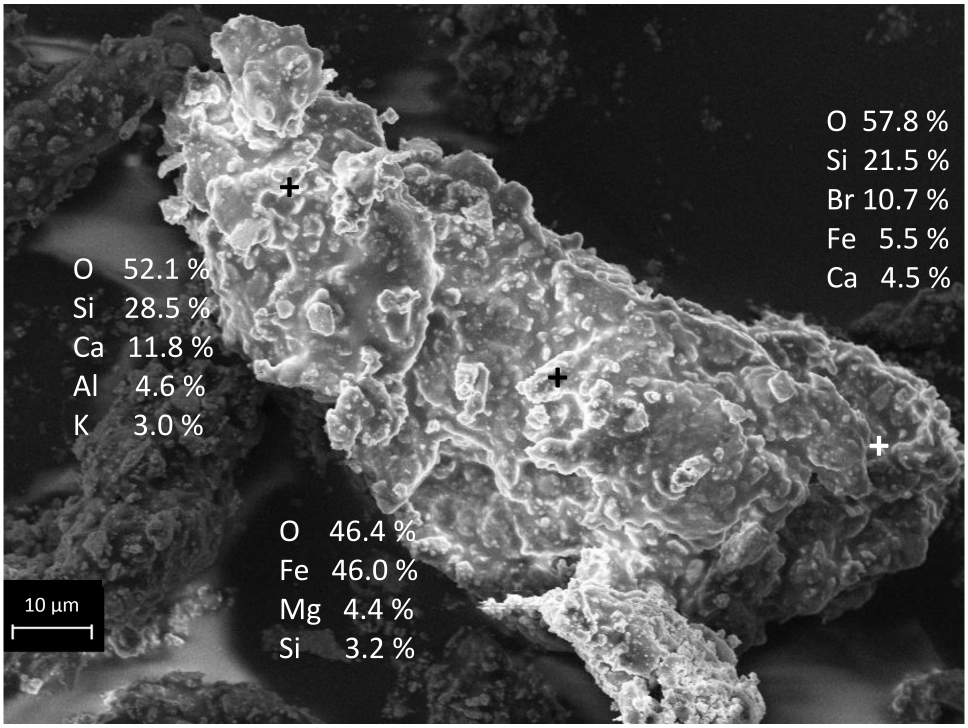


Figure 44: Long airborne particle, composed from smaller particles. The elements oxygen, silicon and iron differed in % mass from spot place to another. The element oxygen was present in all spots.

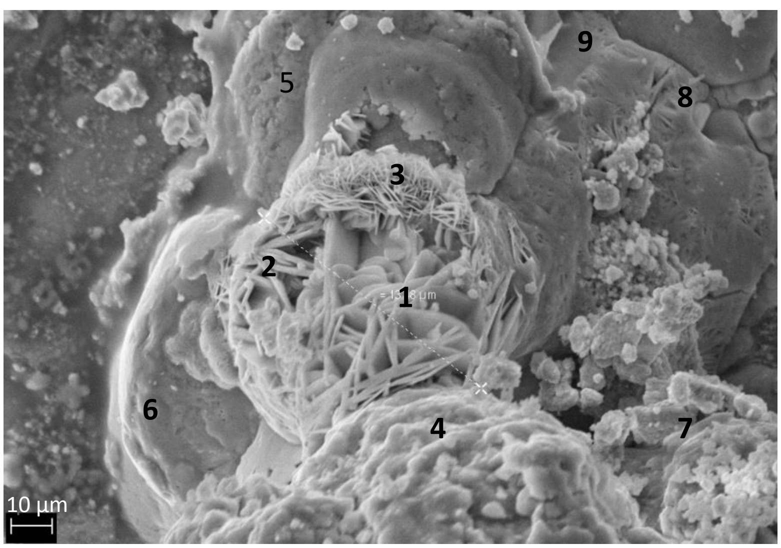


Figure 45: Conglomerate of airborne particles, all the spots marked contained the elements iron and oxygen as mainly elements.

Table 8: Elements mass % for figure 48 spots.

1	2	3	4	5	6	7	8	9
O 28.4 %	**O** 58.1 %	**O** 48.0 %	**O** 59.9 %	**O** 56.4%	**O** 57.7%	**O** 7.5%	**O** 10.7%	**O** 28.8%
Fe 61.7 %	**Fe** 36.1 %	**Fe** 44.8 %	**Fe** 14.2%	**Fe** 34.3%	**Fe** 36.7%	**Fe** 88.4%	**Fe** 84.1%	**Fe** 67.7%
Ca 4.2 %	**Ca** 3.1 %	**Ca** 4.2 %	**Si** 18.6%	**Ca** 4.3%	**Si** 3.8%	**Si** 1.9%	**Si** 5.2%	**Si** 3.5%
Cu 3.5 %	**Cl** 1.7 %	**Cl** 3.0 %	**Ca** 2.6%	**Cu** 3.3%	**Ca** 0.9%	**Ca** 2.2%		
Cl 2.2 %	**S** 1.0 %		**Br** 3.3%	**Cl** 1.7%	**Cl** 0.9%			
			S 1.4%					

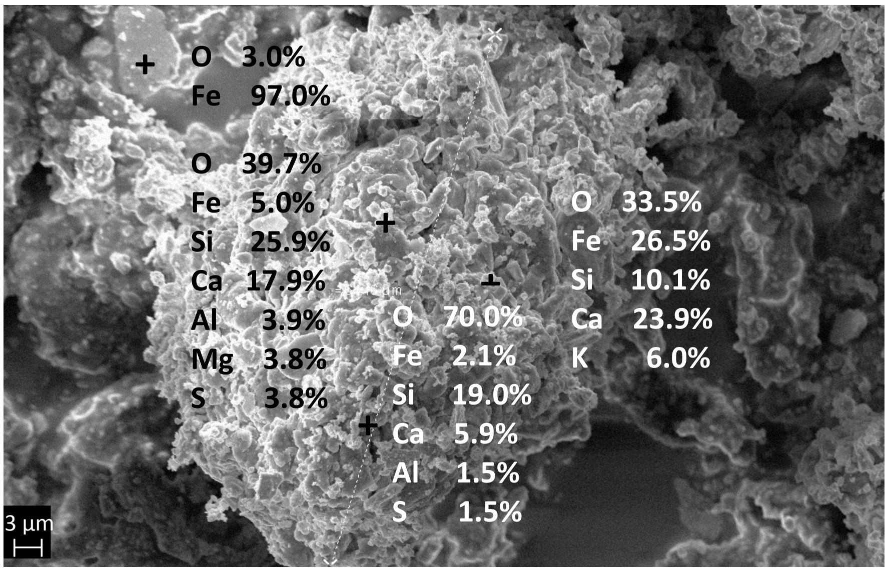


Figure 46: Airborne particles agglomerated, in all the spots analyzed oxygen, iron were the main elements found. The right upper part show a spot where iron is present in a high mass % value.

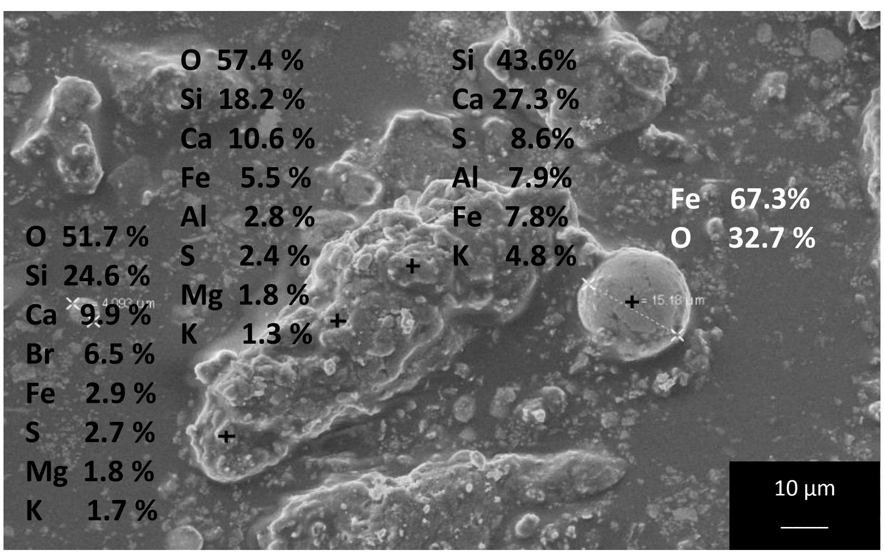


Figure 47: Iron oxide spherule shape particle (Ø 15.18 µm) on the right part of the scanning electron micrograph. On the left part from the spherule an airborne particle was analyzed in several spots which show silicon and calcium as same elements in every spot. Iron is present in small mass % and oxygen is present in two spots from the airborne particle.

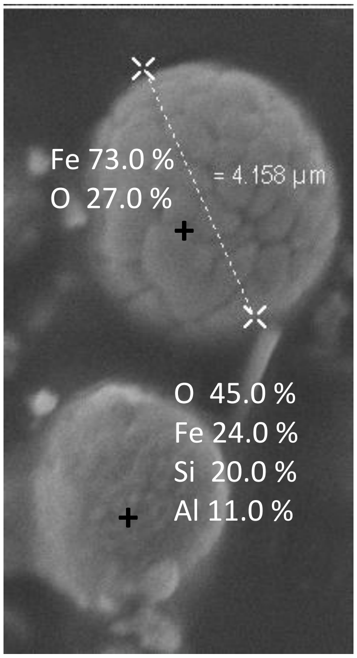


Figure 48: Spherule shape particles, the spherule on the right part show an orange peel surface and is mainly composed of iron (mass%). The spherule below shows the Si and Al elements Si, probably due to the interference with the background.

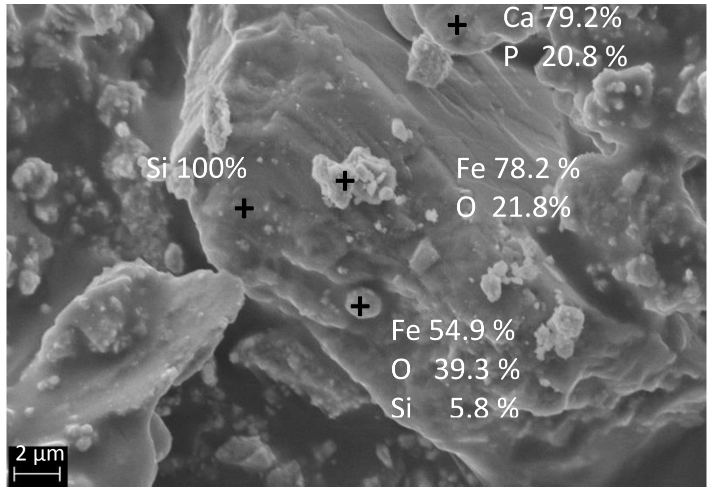


Figure 49: Spots analyzed in the particle differed in composition. In the left side Si is the dominant element, on the upper right side Ca is the main element present (79.2% by mass), on the center iron and oxygen are present as the main dominant elements.

Results

36 particles were analyzed from location U_1 and 13 particles from location U_2. 23 particles were analyzed for S_1 and 19 particles were analyzed for S_2

Spherical particles appeared at all locations (U_1 U_2), the surfaces of this spherules varied from smooth to orange peel surfaces. Iron and oxygen were always present in the spherule shape particles. These results seem to be in accordance with previous studies where spherical particles have been found in samples from high combustion processes (Blaha. et al 2008). In samples from air filters, Castaneda-Miranda et al. (2014) found semi spherical magnetite particles.

The relative abundance from each element divided by location is shown in figure 50-53. However, elements were rarely found isolated (figure 49).

The more frequently elements found were: oxygen, iron and silicon. Silicon was present in most cases, alongside with oxygen and iron. Previous studies have found silicon as SiO_2 in magnetic airborne particles (Jung et al. 2012). In Queretaro, silicon in air filters was present as SiO_2 (Castaneda-Miranda et al. 2014; Gasca 2007).

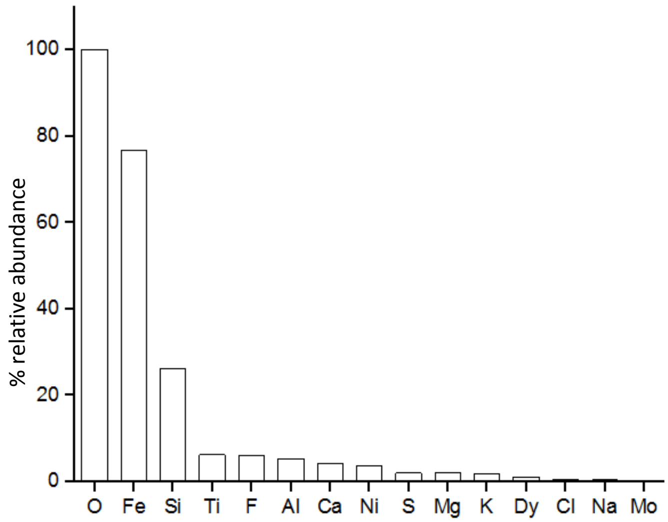


Figure 50: Elements found in U_1. Oxygen, iron and silicon were the main elements found. Values are normalized by % mass.

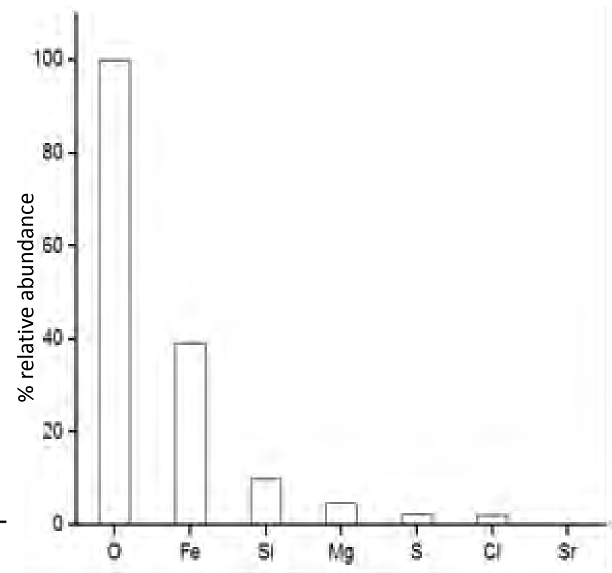


Figure 51: Elements found in U_2. Oxygen, iron and silicon were the main elements found. Values are normalized by % mass.

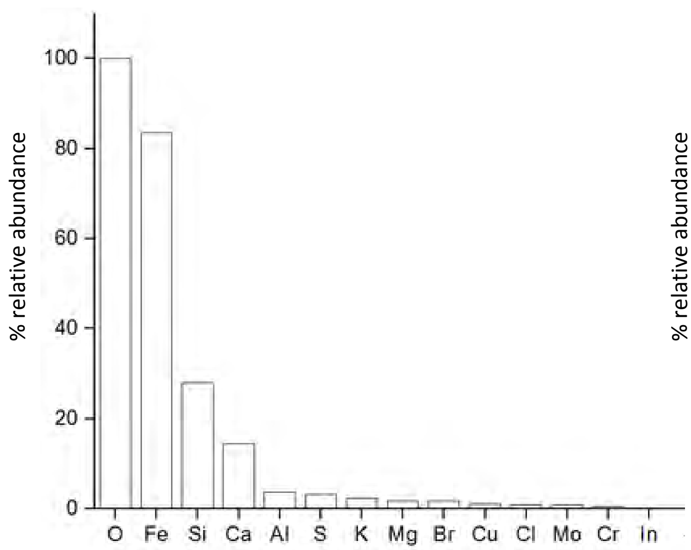


Figure 52: Elements found in S_1 period. Oxygen, iron and silicon were the main elements found. Elements were normalized by % mass.

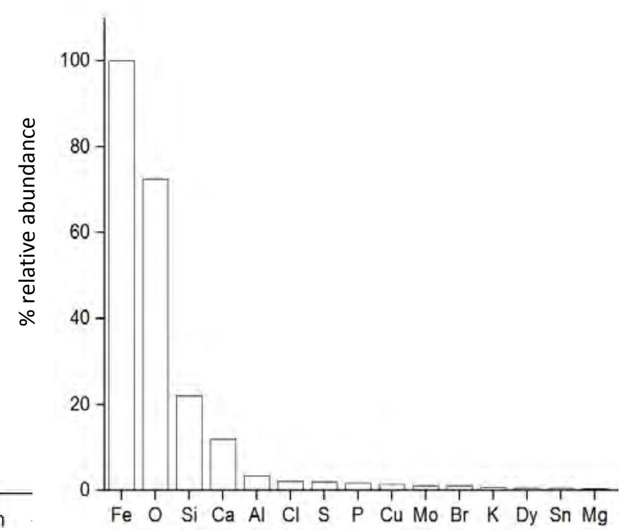


Figure 53: Elements found in S_2 period. Oxygen, iron and silicon were the main elements found. Elements were normalized by % mass.

5.5.2 Mössbauer Spectroscopy

Dried powders were loaded into Plexiglas holders (1 cm^2). Samples were then transferred to the instrument (figure 55) and loaded inside a closed-cycle exchange gas cryostat (Janis cryogenics). Measurements were collected at 5 K with a constant acceleration drive system (WissEL) in transmission mode with a $^{57}Co/Rh$ source and calibrated against a 7μm thick α-^{57}Fe foil measured at room temperature. All spectra were analyzed using Recoil (University of Ottawa) by applying a Voight Based Fitting (VBF) routine (Rancourt & Ping, 1991). The half width at half maximum (HWHM) was fixed to a value of 0.130 mm/s for all samples.

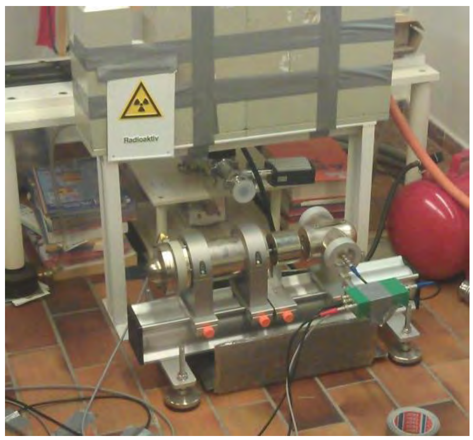


Figure 54: Equipment to measure Mössbauer spectrum.

Results

Table 7 shows the parameters for each period, and spectra are shown in figures 56 and 57. The spectra were best fitted with four sextets corresponding to different iron phases. Sextet 1, has a low center shift (close to 0 mm/s), low quadrupole splitting and a hyperfine field of 33 T corresponding to elemental iron. The other sextets are difficult to interpret, however based on the quadrupole shift of sextet 2, it could be goethite (Cornell & Schwertmann 2003). Sextet 3 shows some similarity to maghemite or magnetite, however normally these minerals are distinguishable as multiple sextets when measured at 5 K, which is not seen here. Finally, sextet

4 has a very low hyperfine field and is not fully magnetically ordered. This suggests the mineral is a nanoparticulate phase and has not become fully magnetically ordered, even at 5 K.

Table 9: Mössbauer parameters for Period S_1 and S_2. Center Split (CS), Quadrupole Shift (e), Hyperfine Field (H), relative abundance (R).

Sample	Sextet	Phase	CS mm/s	e mm/s	H T	R %	±
S_1	1	Fe(0)	0.10	-0.01	33.6	27.3	1.4
	2	Goethite	0.57	-0.19	52.0	16.9	1.4
	3	Magnetite/Maghemite	0.41	0.03	50.1	28.7	1.8
	4	Poorly crystalline phase	0.40	-0.28	34.5	27.1	2.8
S_2	1	Fe(0)	0.11	-0.01	33.7	24.4	1.6
	2	Goethite	0.54	-0.16	52.2	15.4	2.1
	3	Magnetite/Maghemite	0.43	0.00	50.2	35.6	2.5
	4	Poorly crystalline phase	0.33	-0.10	29.8	24.5	2.6

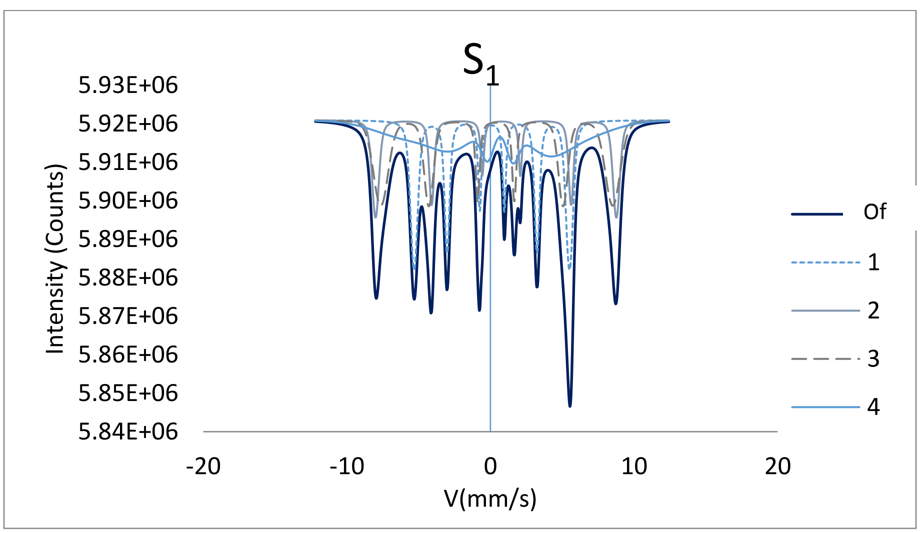


Figure 55: Mössbauer spectrum for S_1 period. sample Of = Overall fit, 1= Iron, 2= Goethite, 3= Magnetite, 4 =Crystalline phase.

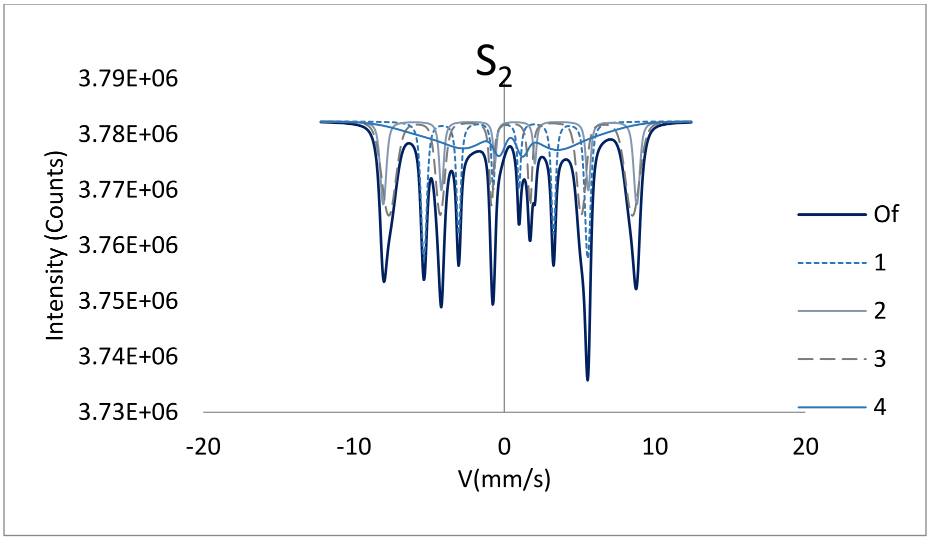


Figure 56: Mössbauer spectrum for S_2 period sample. Of = Overall fit, 1= Iron, 2= Goethite, 3= Magnetite, 4 =Crystalline phase.

Chapter 6. Discussion of Results

6.1 Magnets and mass specific magnetic susceptibility (Stuttgart)

Period S_2 shows an enhancement in the mass specific magnetic susceptibility value compared to period S_1, however, the enhancement remains in the same order of magnitude. In period S_2 more fine dust alarms were reported. The mass specific magnetic susceptibility enhancement and the increase in the number of fine dust alarms, could indicate a relation between airborne magnetic particles and PM particles

Particles in Germany could be weighted due to the way of collection around the circular magnet's area (figure 19 b) instead collecting the particles around the whole magnet's surface (figure 16). However, the particles couldn't be 100% detached from the foil (plastic and teflon).

6.2 Magnets: Use and recommendations

The use of magnets in Germany was safer due to smaller (and cheaper) magnets, compared to the magnets used in Mexico where it was very dangerous to place them together due to their highly magnetic strength. In order to find a place for the installing the magnets, it is recommendable to perform a first evaluation from the surroundings in order to look for potential iron surfaces. To avoid possible human interactions, places without an easy access (even for the people who are often around the sampling area) are an asset.

6.3. Magnetic Phases

KTL curves show differences whether the magnetite (or magnetite-near) phase is more MD or SD/PSD like. In this study, the Verwey transition is the main feature used from KTL curves indicating the presence of magnetite phase.

Hysteresis curves generally show narrow loops. Similar loops have been found in studies of PM and air filters (Castañeda-Miranda et al. 2014; Muxworthy et al. 2001; Sagnotti et al. 2009). From hysteresis curves small coercive values (table 4) of 7-8 mT (with one exception of ~ 1 mT) for samples from Mexico (U1, U2), and 2-5 mT for samples from Stuttgart (S1, S2 period), are typical for MD magnetite according to the parameters given in table M3 from the Encyclopedia of Geomagnetism and Paleomagnetism (Gubbins & Herrero-Bervera 2007). Moreover, a study from magnetic airborne particles from subway underground locations reported small coercive force values as well (Jung et al. 2012). The Day plot shows samples from location L_1 having less variation on the ratio M_{rs}/M_s compared with the samples from U_1 and U_2. None of the samples however, surpassed H_c>10 mT and according to Dunlop & Özdemir (1997) as cited in Evans & Heller (2003) values <10 mT are typical for MD magnetite.

The Curie temperature of magnetite in KT curves is clearly seen in KT curves as a drop in magnetic susceptibility values around 580 °C. There is a still a signal of magnetic susceptibility in most cases at temperatures above 700 °C interpreted as metallic iron phase. Graphs which didn't show a signal in magnetic susceptibility above 700 °C in heating curves (figure 30 c,d) were interpreted as complete oxidation of the metallic iron phase during heating, a similar behavior as for a metallic iron phase in dust samples observed by Górka-Kostrubiec & Szczepaniak-Wnuk (2016).

6.4. Non magnetic analysis

SEM/EDX showed oxygen, iron and silicon as the highest mass percentage elements present in all locations, except for one case where silicon was found making up 100% mass (figure 49).

Silicon was found together with iron and oxygen, and therefore SiO_2 is most likely present. SEM/EDX showed a change in the morphology in particles from U_1,U_2 where spherule shaped particles were more often observed than at location L_1. This difference in the morphology might be influencing the coercivity values in the magnetic hysteresis analysis as is it known that needle shaped particles of strong magnetic material can have higher coercivity values according to the magnetic parameters in table M3 from the Encyclopedia of Geomagnetism and Paleomagnetism (Gubbins & Herrero-Bervera 2007).

The finding of silicon is in accordance with Storrick (1991) who stated that calcium and silicon are often present in magnetic extracts.

Mössbauer spectra also show the presence of the metallic iron phase (already acknowledged by the Curie temperatures in KT curves). The phase goethite found by Mössbauer spectroscopy wasn't found in magnetic analysis, which is explained by its very weak saturation magnetization. The Mössbauer analyses show also a poor crystalline phase, likely a nanoparticulate phase which has not become fully magnetically ordered, even at 5 K, though unknown reasons. The results indicate that both samples from Germany (L_1) share very similar characteristics with each other.

6.5 Summary

In this work the application of strong Nd magnets for collecting airborne particles was tested. For this purpose, several non-magnetic cover materials were tried to separate the collected particles from the magnets and allow their recovery for laboratory measurements. Magnets were effective collectors in locations near high transited avenues and therefore a high PM level (location: U_1, L_1); moreover, there might be a possible connection between the mass specific magnetic susceptibility with PM_{10} and $PM_{2.5}$ concentration levels.

Magnets were used in two major cities located in geographically significant regions, in an early stage at Querétaro (México) and later in Stuttgart (Germany). The experimental setups in Stuttgart benefited from the initial experiments carried out in Querétaro. In all locations in Mexico (U_1,U_2,L_1) particles collected showed similar properties, which suggest that they might be produced by similar human activities (industrial and traffic mainly), rather than by not so similar geological materials in the surface cover (soil and sediment) and climatological conditions. Magnetic airborne particles derived from industrial activities are more likely present near location U_2, since Querétaro City has grown with more industrial parks in the surroundings (H.Ayuntamiento Querétaro 2017), and as pointed in figure 8, industry is the second main process responsible for PM. However, more studies concerning particle shape and origin are needed.

Magnets have several advantages compared to passive collectors such as bio samples (e.g tree leaves, lichens, dust). They are commercially available and of low cost, and thus can be deployed at many sites. Magnets can be fixed easily on iron structures, but also on trees, walls and purposely prepared metallic or non-metallic supports like rods, and this way at any desired height above the ground. They can collect particles from a volume around them by magnetic attraction, which mainly depends on their magnetic moment, and once the particle is attached to the cover, it is difficult to remove them by wind and rain, thus variability in weather conditions didn't affect them.

Magnetic particles collected by the magnets in this work contained all magnetite, as all samples showed the Verwey transition, possibly with some cation substitution, as the transition temperature often was partially skewed to < -150 °C. Elements which could participate in such substitutions were detected by SEM/EDX analysis. A metallic iron phase was observed in KT curves in all samples. This phase was as well by SEM/EDX observed in location U_1 (figure 39).

Mass specific magnetic susceptibility in L_1 showed values that are typical for magnetite and metallic iron (Collinson,1983), and the Mössbauer spectra revealed magnetite and metallic iron as well being the dominant phases by mass %. However, further analyses other than Mössbauer spectroscopy are recommendable in order to provide more information concerning the possible phases goethite and maghemite.

Grain size in KTL curves showed a large variation in the PSD (and possibly SD) and MD range. Hysteresis curves, showed narrow loops for all samples and (low) coercive values < 10 mT. The Day Plot showed different patterns for U_1 and $U_{2,}$ compared with location $L_{1,}$ where all samples (period S_1 and S_2) plot near the same region (MD).

Chapter 7. Conclusions

In this study no ideal material has been found which allows the reliable, complete separation of the particles from the cover material. Nevertheless, magnets are more efficient, and collect a high amount of magnetic particles in heavily transited areas. They can be attached or fixed to surfaces at different heights. It’s recommendable to find sampling sites where human interaction could be avoided as much as possible.

The enhancement in the magnetic mass specific susceptibility and fine dust alarms could indicate a relation between airborne magnetic particles and PM particles.

This study shows that magnetic airborne particles are mainly composed of low coercive magnetite and metallic iron, as dominant magnetic phases in both locations, Stuttgart and Querétaro. Both phases could be determined by the combination of magnetic and non magnetic techniques which shows this way both techniques are a powerful tool for a full characterization of airborne particles.

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Appendix

Meteorological Parameters for S_1 and S_2 shown on table, the data was provided by LUBW.

Table 10 : Meteorological parameters for S_1 and S_2 measured in the station Am Neckartor.

Period	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	NO_2 (µg/m³)	Wind Velocity (m/s)	Temp Air (°C)	Humidity (%)	Presion (hPa)
S1	34.4 ± 9.1	15.1 ± 4.8	79.4 ± 16.7	0.75 ± 0.20	12.8 ± 3.7	81.5 ± 7.9	990.1 ± 5.1
S2	43.4 ± 22.3	20.4 ± 10.9	80 ± 17.8	0.84 ± 0.29	7.3 ± 3.5	84.4 ± 7.9	990.3 ± 9.5

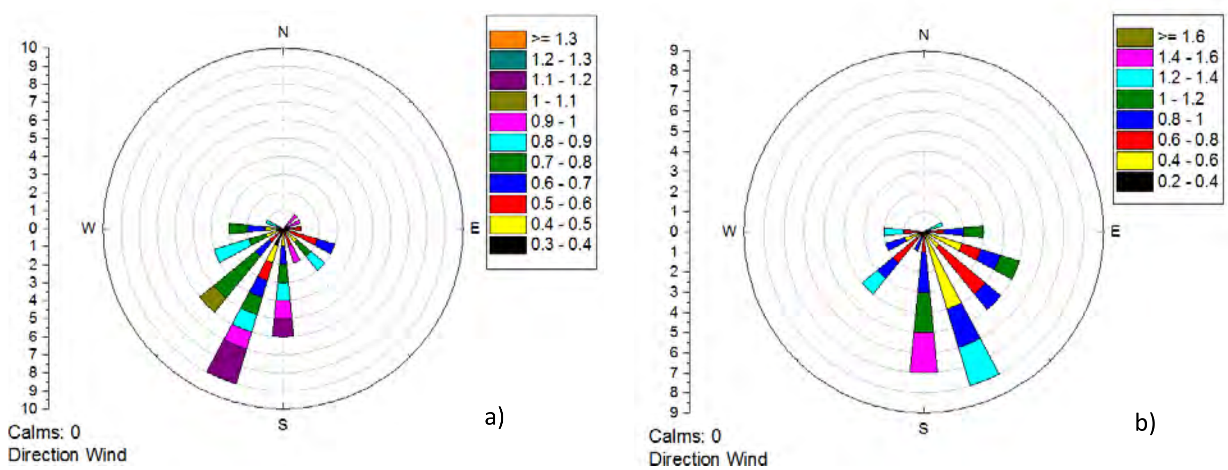

Figure 57: Wind Rose graphic describing the average direction and velocity of the Wind for a= S1 and b= S2.

Mössbauer Spectra S_1

v = velocity, Iobs = raw data, Icalc = sum of all of the fits, site1, site 2, site 3, site 4 = the individual fits.

v (mm/s)	Iobs	Icalc	site1	site2	HFD Site 3	HFD Site 4
512						
-12.1892	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-12.1411	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-12.0929	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-12.0447	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.9965	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.9484	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.9002	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.852	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.8039	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.7557	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.7075	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.6593	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.6112	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.563	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.5148	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.4667	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.4185	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.3703	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.3221	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.274	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.2258	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.1776	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.1295	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.0813	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.0331	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.9849	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.9368	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.8886	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.8404	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.7923	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.7441	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.6959	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.6477	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.5996	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.5514	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.5032	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-10.4551	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.4069	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.3587	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.3106	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.2624	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.2142	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.166	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.1179	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.0697	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.0215	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.97335	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.92518	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.87701	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.82884	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.78067	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.7325	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.68433	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.63615	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.58798	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.53981	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.49164	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.44347	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.3953	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.34713	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.29896	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.25078	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.20261	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.15444	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.10627	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.0581	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.00993	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.96176	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.91359	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.86541	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.81724	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.76907	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.7209	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.67273	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.62456	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.57639	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.52822	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.48005	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.43187	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-8.3837	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.33553	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.28736	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-8.23919	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-8.19102	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-8.14285	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-8.09468	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-8.0465	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.99833	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.95016	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.90199	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.85382	3.75E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.80565	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.75748	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.70931	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.66113	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.61296	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.56479	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.51662	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.46845	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.42028	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.37211	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.32394	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.27576	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.22759	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.17942	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.13125	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.08308	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.03491	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.98674	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.93857	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.89039	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.84222	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.79405	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.74588	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.69771	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.64954	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.60137	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.5532	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.50502	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.45685	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.40868	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.36051	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-6.31234	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.26417	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.216	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.16783	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.11965	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.07148	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.02331	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.97514	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.92697	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.8788	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.83063	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.78246	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.73428	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.68611	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.63794	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.58977	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.5416	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.49343	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.44526	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.39709	3.75E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.34891	3.75E+06	3.75E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.30074	3.76E+06	3.75E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.25257	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.2044	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.15623	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.10806	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.05989	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.01172	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.96354	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.91537	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.8672	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.81903	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.77086	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.72269	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.67452	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.62635	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.57818	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.53	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.48183	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.43366	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.38549	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.33732	3.75E+06	3.75E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.28915	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06

-4.24098	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.19281	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.14463	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.09646	3.76E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.04829	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.00012	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-3.95195	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-3.90378	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-3.85561	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.80744	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.75926	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.71109	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.66292	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.61475	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.56658	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.51841	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.47024	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.42207	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.37389	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.32572	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.27755	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.22938	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-3.18121	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-3.13304	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-3.08487	3.75E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-3.0367	3.75E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-2.98852	3.75E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-2.94035	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-2.89218	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-2.84401	3.76E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-2.79584	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.74767	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.6995	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.65133	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.60315	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.55498	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.50681	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.45864	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.41047	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.3623	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.31413	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.26596	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.21778	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-2.16961	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.12144	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.07327	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.0251	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.97693	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.92876	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.88059	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.83241	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.78424	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.73607	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.6879	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.63973	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.59156	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.54339	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.49522	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.44705	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.39887	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.3507	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.30253	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.25436	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.20619	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.15802	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.10985	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.06168	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.0135	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-0.965333	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-0.917162	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-0.86899	3.76E+06	3.75E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-0.820819	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
-0.772648	3.76E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
-0.724477	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
-0.676305	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
-0.628134	3.76E+06	3.76E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06
-0.579963	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.531792	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.483621	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.435449	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.387278	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.339107	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.290936	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.242764	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.194593	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.146422	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-0.0982507	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.0500795	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
- 0.00190825	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.046263	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.0944342	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.142605	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.190777	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.238948	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.287119	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.33529	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.383462	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.431633	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.479804	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.527975	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.576147	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.624318	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.672489	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.72066	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.768831	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.817003	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.865174	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.913345	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
0.961516	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
1.00969	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
1.05786	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
1.10603	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.1542	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.20237	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.25054	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.29871	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.34689	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.39506	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.44323	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.4914	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.53957	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.58774	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.63591	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.68408	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.73226	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.78043	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.8286	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.87677	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06

1.92494	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.97311	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.02128	3.77E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06	3.78E+06
2.06945	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.11763	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.1658	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.21397	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.26214	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.31031	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.35848	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.40665	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.45482	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.503	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.55117	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.59934	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.64751	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.69568	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.74385	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.79202	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.84019	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.88837	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.93654	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.98471	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.03288	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.08105	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.12922	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.17739	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.22556	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
3.27374	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
3.32191	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
3.37008	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.41825	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.46642	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.51459	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.56276	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.61093	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.65911	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.70728	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.75545	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.80362	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.85179	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.89996	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.94813	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

3.9963	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.04448	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.09265	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.14082	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.18899	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.23716	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.28533	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.3335	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.38167	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.42984	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.47802	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.52619	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.57436	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.62253	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.6707	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.71887	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.76704	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
4.81521	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
4.86339	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
4.91156	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
4.95973	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.0079	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.05607	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.10424	3.75E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.15241	3.75E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.20058	3.75E+06	3.75E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.24876	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
5.29693	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
5.3451	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
5.39327	3.74E+06	3.74E+06	3.76E+06	3.78E+06	3.77E+06	3.78E+06
5.44144	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.77E+06	3.78E+06
5.48961	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.77E+06	3.78E+06
5.53778	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06
5.58595	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06
5.63413	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06
5.6823	3.75E+06	3.75E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06
5.73047	3.75E+06	3.75E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06
5.77864	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
5.82681	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
5.87498	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
5.92315	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
5.97132	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.0195	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

6.06767	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.11584	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.16401	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.21218	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.26035	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.30852	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.35669	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.40487	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.45304	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.50121	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.54938	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.59755	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.64572	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.69389	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.74206	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.79024	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.83841	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.88658	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.93475	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.98292	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.03109	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.07926	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.12743	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.17561	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.22378	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.27195	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.32012	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.36829	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.41646	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.46463	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.5128	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.56098	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.60915	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.65732	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.70549	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.75366	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.80183	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.85	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.89817	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
7.94634	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
7.99452	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.04269	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.09086	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06

8.13903	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.1872	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.23537	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.28354	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.33171	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.37989	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.42806	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.47623	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.5244	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.57257	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.62074	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.66891	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.71708	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.76526	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.81343	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.8616	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.90977	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.95794	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
9.00611	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
9.05428	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
9.10245	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
9.15063	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.1988	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.24697	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.29514	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.34331	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.39148	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.43965	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.48782	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.536	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.58417	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.63234	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.68051	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.72868	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.77685	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.82502	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.87319	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.92137	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.96954	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.0177	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.0659	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.114	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.1622	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

10.2104	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.2586	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.3067	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.3549	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.4031	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.4512	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.4994	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.5476	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.5958	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.6439	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.6921	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.7403	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.7884	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.8366	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.8848	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.933	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.9811	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.0293	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.0775	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.1256	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.1738	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.222	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.2702	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.3183	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.3665	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.4147	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.4628	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.511	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.5592	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.6074	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.6555	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.7037	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.7519	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.8	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.8482	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.8964	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.9446	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.9927	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.0409	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.0891	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.1372	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.1854	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.2336	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

12.2818	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.3299	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.3781	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.4263	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

Mössbauer Spectra S_2

v (mm/s)	Iobs	Icalc	site1	site2	HFD Site 3	HFD Site 4
512						
-12.1892	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-12.1411	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-12.0929	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-12.0447	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.9965	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.9484	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.9002	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.852	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.8039	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.7557	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.7075	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.6593	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.6112	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.563	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.5148	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.4667	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.4185	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.3703	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.3221	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.274	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.2258	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.1776	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.1295	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.0813	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-11.0331	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.9849	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.9368	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.8886	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.8404	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.7923	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.7441	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.6959	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.6477	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-10.5996	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.5514	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.5032	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.4551	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.4069	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.3587	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.3106	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.2624	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.2142	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.166	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.1179	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.0697	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-10.0215	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.97335	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.92518	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.87701	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.82884	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.78067	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.7325	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.68433	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.63615	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.58798	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.53981	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.49164	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.44347	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.3953	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.34713	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.29896	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.25078	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.20261	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.15444	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.10627	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.0581	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-9.00993	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.96176	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.91359	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.86541	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.81724	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.76907	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.7209	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.67273	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.62456	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.57639	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-8.52822	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.48005	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.43187	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.3837	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.33553	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-8.28736	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-8.23919	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-8.19102	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-8.14285	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-8.09468	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-8.0465	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.99833	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.95016	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.90199	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.85382	3.75E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.80565	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-7.75748	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.70931	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.66113	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.61296	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.56479	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.51662	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.46845	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.42028	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.37211	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.32394	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.27576	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.22759	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.17942	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.13125	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.08308	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-7.03491	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.98674	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.93857	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.89039	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.84222	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.79405	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.74588	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.69771	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.64954	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.60137	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.5532	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.50502	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-6.45685	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.40868	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.36051	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.31234	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.26417	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.216	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.16783	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.11965	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.07148	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-6.02331	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.97514	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.92697	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.8788	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.83063	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.78246	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.73428	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.68611	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-5.63794	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.58977	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.5416	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.49343	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.44526	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.39709	3.75E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.34891	3.75E+06	3.75E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.30074	3.76E+06	3.75E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.25257	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.2044	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-5.15623	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.10806	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.05989	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-5.01172	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.96354	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.91537	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.8672	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.81903	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.77086	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.72269	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.67452	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-4.62635	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.57818	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.53	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.48183	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.43366	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06

-4.38549	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.33732	3.75E+06	3.75E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-4.28915	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.24098	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.19281	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.14463	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.09646	3.76E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.04829	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
-4.00012	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-3.95195	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-3.90378	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-3.85561	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.80744	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.75926	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.71109	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.66292	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.61475	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.56658	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.51841	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.47024	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.42207	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.37389	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.32572	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.27755	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-3.22938	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-3.18121	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-3.13304	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-3.08487	3.75E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-3.0367	3.75E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-2.98852	3.75E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
-2.94035	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-2.89218	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-2.84401	3.76E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
-2.79584	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.74767	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.6995	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.65133	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.60315	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.55498	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.50681	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.45864	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.41047	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.3623	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-2.31413	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.26596	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.21778	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.16961	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.12144	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.07327	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-2.0251	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.97693	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.92876	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.88059	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.83241	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.78424	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.73607	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.6879	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.63973	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.59156	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.54339	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.49522	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.44705	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.39887	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.3507	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.30253	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.25436	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.20619	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.15802	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.10985	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.06168	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-1.0135	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-0.965333	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-0.917162	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-0.86899	3.76E+06	3.75E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
-0.820819	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
-0.772648	3.76E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
-0.724477	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
-0.676305	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
-0.628134	3.76E+06	3.76E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06
-0.579963	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.531792	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.483621	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.435449	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.387278	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.339107	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.290936	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

-0.242764	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.194593	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.146422	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.0982507	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.0500795	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
-0.00190825	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.046263	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.0944342	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.142605	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.190777	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.238948	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.287119	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.33529	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.383462	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.431633	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.479804	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.527975	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.576147	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.624318	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.672489	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.72066	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.768831	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.817003	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.865174	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
0.913345	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
0.961516	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
1.00969	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
1.05786	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
1.10603	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.1542	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.20237	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.25054	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.29871	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.34689	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.39506	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.44323	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.4914	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.53957	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.58774	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.63591	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.68408	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.73226	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06

1.78043	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.8286	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.87677	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
1.92494	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
1.97311	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.02128	3.77E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06	3.78E+06
2.06945	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.11763	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.1658	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.21397	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.26214	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.31031	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.35848	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.40665	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.45482	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.503	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.55117	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.59934	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.64751	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.69568	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.74385	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.79202	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.84019	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.88837	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.93654	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
2.98471	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.03288	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.08105	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.12922	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.17739	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.22556	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
3.27374	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
3.32191	3.76E+06	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.78E+06
3.37008	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.41825	3.77E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.46642	3.77E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
3.51459	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.56276	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.61093	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.65911	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.70728	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.75545	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.80362	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

3.85179	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.89996	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.94813	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
3.9963	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.04448	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.09265	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.14082	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.18899	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.23716	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.28533	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.3335	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.38167	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.42984	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.47802	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.52619	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.57436	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.62253	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.6707	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.71887	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
4.76704	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
4.81521	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
4.86339	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
4.91156	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
4.95973	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.0079	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.05607	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.10424	3.75E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.15241	3.75E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.20058	3.75E+06	3.75E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
5.24876	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
5.29693	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
5.3451	3.75E+06	3.75E+06	3.77E+06	3.78E+06	3.77E+06	3.78E+06
5.39327	3.74E+06	3.74E+06	3.76E+06	3.78E+06	3.77E+06	3.78E+06
5.44144	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.77E+06	3.78E+06
5.48961	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.77E+06	3.78E+06
5.53778	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06
5.58595	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06
5.63413	3.74E+06	3.74E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06
5.6823	3.75E+06	3.75E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06
5.73047	3.75E+06	3.75E+06	3.77E+06	3.77E+06	3.78E+06	3.78E+06
5.77864	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
5.82681	3.76E+06	3.76E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06
5.87498	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

5.92315	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
5.97132	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.0195	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.06767	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.11584	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.16401	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.21218	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.26035	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.30852	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.35669	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.40487	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.45304	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.50121	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.54938	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.59755	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.64572	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.69389	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.74206	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.79024	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.83841	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.88658	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.93475	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
6.98292	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.03109	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.07926	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.12743	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.17561	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.22378	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.27195	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.32012	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.36829	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.41646	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.46463	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.5128	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.56098	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.60915	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.65732	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.70549	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.75366	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.80183	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.85	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
7.89817	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
7.94634	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06

7.99452	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.04269	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.09086	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.13903	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.1872	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.23537	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.28354	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.33171	3.77E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.37989	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.42806	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.47623	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.5244	3.76E+06	3.76E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
8.57257	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.62074	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.66891	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.71708	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.76526	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.81343	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.8616	3.75E+06	3.75E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.90977	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
8.95794	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
9.00611	3.76E+06	3.76E+06	3.78E+06	3.77E+06	3.77E+06	3.78E+06
9.05428	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
9.10245	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.77E+06	3.78E+06
9.15063	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.1988	3.77E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.24697	3.78E+06	3.77E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.29514	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.34331	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.39148	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.43965	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.48782	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.536	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.58417	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.63234	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.68051	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.72868	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.77685	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.82502	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.87319	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.92137	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
9.96954	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.0177	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

10.0659	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.114	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.1622	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.2104	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.2586	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.3067	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.3549	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.4031	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.4512	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.4994	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.5476	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.5958	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.6439	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.6921	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.7403	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.7884	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.8366	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.8848	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.933	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
10.9811	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.0293	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.0775	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.1256	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.1738	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.222	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.2702	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.3183	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.3665	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.4147	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.4628	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.511	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.5592	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.6074	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.6555	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.7037	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.7519	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.8	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.8482	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.8964	3.79E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.9446	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
11.9927	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.0409	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.0891	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06

12.1372	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.1854	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.2336	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.2818	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.3299	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.3781	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06
12.4263	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06	3.78E+06