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A search for the origin and cause of attractive and magnetic property in meteorites

Raju D. Jadhav
rajujadhav1010@gmail.com

Harishchandra B. Mali
harishchandra.mali@rediffmail.com

ABSTRACT

Meteorites are known to be attracted towards a magnet, whether they possess magnetic property or not are unknown. Hence to study the attractive property and magnetic property in meteorites, seven meteorites, six iron meteorites namely Campo-del-Cielo 2 nos, Sikhote Aline 1 no., unknown iron meteorites 3 nos, and Chelyabinsk, a stony meteorite were investigated to study their attractive property and magnetic property. For the study purpose three experiments were conducted through mariner compass, standard magnets of different strength and iron filings. The conclusion drawn from these experimental studies showed that meteorites do not possess any magnetic property. They are found to be strongly attracted towards a magnet because of Fe compounds i.e., [Fe (iron) and Ni (nickel)] and possibly may be due to unknown elements present in them. This paper reports the work carried on seven meteorites on preliminary basis, to study the attractive and magnetic property in meteorites and to put on records the work carried out. This work is of prima facial in knowing and studying the attractive and magnetic property in meteorites by different and simple methods. This is a small attempt to solve the fundamental question about magnetic property in meteorites.

Keywords— *Meteorites, Meteoroids, Asteroids, Magnetic property, Attractive property, Mariner compass, Magnets, Iron Filings*

1. INTRODUCTION

Meteorites are extra-terrestrial bodies which when entering the earth's atmosphere escapes the burning process and lands on the earth's surface making or forming a crater. They are the source of providing knowledge about our solar system formation. The larger or bigger the meteorite and greater the speed, the bigger and larger the crater formation. Meteorites have been known and studied from ancient times. Meteorites are classified into three main categories namely, stony meteorites, stony iron meteorites and iron meteorites and in each category, there are subclasses.

1.1 Some of the earlier works on Meteorites

Several fragments of meteorite Sikhote Alin were analyzed by means of CF-LIBS[1]. The concentration values obtained for all the elements were compared with their respective crustal elemental abundance values[2]. We believe that fragmentation is a result of the combined effects of volume increase, diurnal thermal cycling, and infiltration of soil into cracks due to wind and water[3]. The density of stony meteorites is lower than that of the terrestrial rocks with which they are compared, and the porosity of carbonaceous meteorites, for example, may be as high as 20 percent[4]. Meteorites can become buried, not only from impact, but also from blowing and shifting sand agriculture, and the like[5]. Once the stone is broken, we see that only a thin external skin is black[6]. These features indicate that most meteorites formed in a highly reducing environment in which nickel and iron were largely in the metallic state[7]. Meteoritic abundances from C1 chondrites are only suitable to refine the relative abundances of the heavy elements but cannot be used to constrain the absolute element/hydrogen ratios or the total mass fractions X, Y, and Z[8]. The Akhnoor meteorite crater is a stony meteorite[9]. The meteorite interior, however, does not show much differences from other ordinary chondrites[10]

1.2 Scope of work

To study the attractive and magnetic property in meteorites and which are the elements responsible for magnetic property through experiments and analysis and to search their origin. There are three properties, 1) Deflective property, 2) Attractive property and 3) Magnetic property.

2. APPARATUS

(i) Magnetic needle or magnetic compass (mariner compass) to measure deflective property. Though Mariner compass also has directive property, in this study only deflective property has been considered
(ii) Standard magnets to find attractive property [Alnico bar magnets size 2" (50mm) (1), having strength A – 1.295 gauss, B – 1.259 gauss, bar magnet size 2"(50mm) (2), strength A – 1.538gauss, B – 1.613gauss, Bar Magnet 3" (75mm), strength A – 1.596gauss, B – 1.77gauss and horse shoe magnet 2", strength A – 0.576gauss, whereas A= mean of north pole + south pole and B = mean of north pole + south pole], was taken.
(iii) Meteorites (irons and stony classes),
(iv) Iron filings to find magnetic property in meteorites.
(v) Foot Ruler to measure the distance of attraction (i.e., force of attraction), of meteorites towards magnets of different strength.

3. EXPERIMENT

(i) For deflective property: Take a magnetic needle or magnetic compass (mariner compass) and place it on the table firmly without shaking the table. See that the table, don't shake. Let the needle come to a standstill. Now take a meteorite close or near the magnetic needle or the mariner compass. See what happens. Note down the observations.
(ii) A. Attractive property: Keep a bar magnet (size 2" i.e., 50mm) on the table. Bring the meteorite close to the magnet. See what happens. Note down the observation. See whether the meteorite attracts the magnet or the magnet attracts the meteorite.
B. Place a meteorite side of the foot ruler where markings are in cm and slowly bring the magnets of different strength towards the meteorite, note down at what distance the attraction of meteorites towards the magnets of different strength takes place. Note down the observation.
(iii) Magnetic property: Take a plain white paper. Place it on the table firmly. Take some iron filings and spread it on the paper. Take a meteorite, cover it with a butter paper and just move the meteorite gently over the iron filings. See what happens. Note down the observations. After these experiments physical parameters of meteorites were carried out and then the meteorites were sent for XRF analysis. The experiments to find the strength of bar magnets of sizes 2" and 3" and horse shoe magnet of size 2" was carried out with the help of Digital Flux/Gauss meter, holding the probe of the gauss meter very close to the magnets and readings were noted down. The magnets used are of standard nature. This work was carried under the guidance of Dr. M. K. Zate Sir, H.O.D Physics Dept., G.M.D. College, Sinnar, Nashik.

3.1 Observations

(i) If the needle deflects it shows that it has deflective property. If it does not show deflection then it has no deflective property.
(ii) A. If the meteorite attracts the magnet then the meteorite has attractive property and if the magnet attracts the meteorite the magnet has the attractive property.
B. Note down at what distance each meteorite is found to be attracted towards magnets of different strength.
(iii) If the meteorite attracts iron filings then it has magnetic property. If it does not attract Iron Filings it has no magnetic property.

4. EXPERIMENTAL RESULTS

1.

i. The needle of mariner compass did not show deflection when Sikhote Alline meteorite was kept near the compass (figure 2), but slight deflection observed when the meteorite was moved from left to right and back over the compass, which is not shown in the figure.
ii. A. Sikhote-Alin meteorite was strongly attracted towards the magnet, (figure 13).
B. Attraction of a meteorite towards magnets of different strength at a certain distance has been noted down in table 5, figure 24.
iii. The iron filings were not found to be attracted towards Sikhote-Alin meteorite nor was any movement of iron filings observed, when the meteorite was gently moved over the iron filings, (figure 18).

2.

i. The needle of the mariner compass did not show deflection when Campo-del-cielo meteorite (1) was kept near the compass (figure 3), but slight deflection observed when the meteorite was moved from left to right and back over the compass, which is not shown in the figure.
ii. A. Campo-del-cielo meteorite (1) was strongly attracted towards the magnet.
B. Attraction of a meteorite towards magnets of different strength at a certain distance has been noted down in table 5, figure 25.
iii. The iron filings were not found to be attracted towards Campo-del-cielo meteorite (1) nor any movement of iron filings was observed, when the meteorite was gently moved over iron filings, (figure 21).

3.

i. The needle of mariner compass did not show deflection when unknown iron Meteorite (1) was kept near the compass (figure 4), but slight deflection observed when the meteorite was moved from left to right and back over the compass, which is not shown in the figure.
ii. A. The unknown iron meteorite (1) was strongly attracted towards the magnet.
B. Distance of attraction of meteorite towards magnets of different strength has been noted down in table 5, figure 26.
iii. The iron filings were not found to be attracted towards the unknown iron meteorite (1), nor any movement of Iron filings were observed when unknown meteorite was gently moved over iron filings, figure 16.

4.

i. The needle of the mariner compass did not show deflection when Campo-del-cielo meteorite (2) was brought near the compass (figure 7), but slight deflection observed when the meteorite was moved from left to right and back over the compass, which is not shown in the figure.
ii. A. Campo-del-cielo meteorite (2) was strongly attracted towards the magnet, (figure 12).
B. Distance of attraction of meteorite towards magnets of different strength has been noted down in table 5, figure 23.
iii. The iron filings were not found to be attracted towards Campo-del-cielo meteorite (2), nor was any movement of iron filings observed, when the meteorite was gently moved over iron filings, figure 17.

5.

i. The needle of mariner compass did not show deflection when unknown iron meteorite (2) was brought near the Compass (figure 5), but slight deflection observed when the meteorite was moved from left to right and back over the compass, which is not shown in the figure.
ii. A. The unknown iron meteorite (2) was strongly attracted towards the magnet, (figure 11).
B. Distance of attraction of meteorite towards magnets of different strength has been noted down in table 5.
iii. The iron filings were not found to be attracted towards unknown iron meteorite (2), nor any movement of Iron filings were observed when the meteorite was gently moved over iron filings.

6.

i. The needle of mariner compass did not show deflection when unknown iron meteorite (3) was brought near the Compass (figure 6), but slight defection observed when the meteorite was moved from left to right and back over the compass, which is not shown in the figure.
ii. A. The unknown iron meteorite (3) was strongly attracted towards the magnet, (figure 10).
B. Distance of attraction of meteorite towards magnets of different strength has been noted down in table 5, figure 22.
iii. The iron filings were not found to be attracted towards unknown iron meteorite (3), nor any movement of Iron filings were observed when the meteorite was gently moved over iron filings, (figure 19).

7.

i. The needle of mariner compass was not deflected when Chelyabinsk meteorite was brought near the compass. (Figure 8).
ii. A. Chelyabinsk meteorite was strongly attracted towards the magnet, (figure 14).
B. Distance of attraction of meteorite towards magnets of different strength has been noted down in table 5, figure 27.
iii. The iron filings were not found to be attracted towards Chelyabinsk meteorite, nor any movement of Iron filings were observed when the meteorite was gently moved over iron filings covered with a butter paper, (figure 20).

The results of physical parameters and results of XRF analysis of elemental composition of meteorites and their oxides composition are given in table 1, 2, 3 and 4. While the distance of force of attraction was in progress, as each meteorite was moved slowly towards the magnet to study the distance of force of attraction, it was observed that at certain distance away from the magnet, the meteorites were found to move slightly, which showed that a little shift of the meteorites towards the magnet, would strongly attract the meteorites towards it. And this was the distance of maximum attraction or strongest attraction. Beyond this limit, the force of attraction between meteorites and magnets of different strength and size would not operate. Whether it is North Pole or South Pole, the distance of force of attraction between magnets and meteorites was found to be the same.

5. RESULTS AND DISCUSSIONS

From the XRF analysis of the meteorites and their originality confirmed from Table 1, 2, 3 and 4. All the above four experiments conducted are related to magnetic property.

5.1 The deflective property

When a bar magnet, lodestone (natural magnet) was brought near a mariner compass, it showed deflection to a large degree. Based on this, experiment was conducted with meteorites to search deflective property in meteorites. From table 2, it is observed that when the meteorites of iron nature when moved from left to right over the magnetic needle of mariner compass, small deflection were observed (which has not been shown in the figure and also has not been mentioned in table 2), but when the meteorites were kept near mariner compass, without moving towards left or right, when the needle stood at standstill pointing towards north and south direction, the needle was not found to be deflected figure 2-8. Stony meteorite Chelyabinsk when placed near the mariner compass also, the needle did not deflect at all. This shows that the iron meteorites, though has deflective property to a very small degree, but stony meteorites under study do not show any deflective property, this could possibly be due to the small size of the sample (figures 8). The small deflection of iron meteorites may possibly be due to presence of earth elements as impurities, when meteorites landed on the earth surface in a hotter state, may have absorbed earth elements as impurities or contaminates and hence may show deflection to a small degree, because deflection of the needle is related to earth, and meteorites are extra terrestrial objects. This has been confirmed when an old sickle of iron was taken and brought near a mariner compass, it showed deflection to a small degree, similar to that observed for meteorites. Also an old iron rod of length 5 feet when brought near a mariner compass showed deflection, which infers that there may be components of unknown nature present in the earth and meteorites, which is reflected in the form of minor deflection of the needle. From this study it has also been known that mariner compass has two properties. 1) Directive property and Deflective property. Directive property is useful on earth. 2) Deflective property, where if any magnetic or a magnetic components brought near it, the needle of the compass will deflect, which is likely to be useful on earth as well as in space. It is possible that existence of any magnetic field in space can be detected by mariner

compass through deflective property, provided the mariner compass must be large enough to detect any magnetic fields, but the reaction of the needle in space whether it will react or not is unknown.

5.2 Attractive Property

When iron meteorites were brought near a bar magnet, (figure 10-14), they were found to be strongly attracted towards a magnet table 2, figure 10-14, which shows that the magnet has attractive property in other words it can be said that the magnet attracted the meteorites. The stony meteorite Chelyabinsk when brought near the bar magnet was also found to be strongly attracted towards a magnet. This may possibly be due to Fe compounds like iron (Fe) and nickel (Ni), (figure 14). From figures 22-27 and table 5, shows that the distance of force of attraction of meteorites towards magnets of different strength has been taken to find at what distance, they were found to attract each other. The attraction when a meteorite brought near a magnet is known but at what distance does the force of attraction takes place is not known till date. For this work bar magnets of standard nature i.e., 2" and 3" were used having different strength (table 5), yet the distance of attraction between a meteorite and a bar magnet of different size and strength was found to be the same. For each meteorite the distance of attraction is found to be different (table 5). Beyond this distance the attraction of meteorites towards a magnet is not found to take place, which means as is shown in table 5 and figure 22-27, this is the maximum limit of distance where attraction of meteorites towards a bar magnet and horse shoe magnet can take place.

From table 5, it is observed that a bar magnet of 2" and 3" shows the same distance, thought the strength of 3" is found to be higher than 2", yet the distance is found to be the same. Whereas the strength of horse shoe magnet of 2" is found to be still weaker than the 2" bar magnet and thus shows closer distance of attraction. From this experiment, it infers that the distance of force of attraction of meteorites towards magnets of different strength, is not dependent on the strength of magnets (table 5), Fe compounds (table 4), density of meteorites (table 3), dimensions (table 3) etc., but it may possibly be due to presence of unknown components besides Fe compounds, which being the major components in meteorites. This is the only possibility of finding the distance of force of attraction (i.e., attractive property) of meteorites towards magnets of different strength. The unknown components present in meteorites of iron nature and old iron sickle and old iron rod are found to be present in the earth's interior, which has been reflected through deflective property and through attractive property found in meteorites through contaminations of earth elements.

5.3 Magnetic Property

When the iron meteorites covered or wrapped by a butter paper moved gently over the iron filings the meteorite did not attract iron filings, nor did any movement of iron filings were observed (figure 16-21). Even when a stony meteorite Chelyabinsk covered or wrapped by a butter paper, gently rolled over iron filings no attraction of iron filings or no movement of iron filings were observed table 2, figure 16-21. From these three experiments, it shows that the iron meteorites and stony meteorites do not possess any magnetic property. This inference is drawn from experiments 1 and 3, (Figure 16-21).

The attraction of meteorites towards a magnet is not only due to Fe compounds in meteorites i.e. iron (Fe) and nickel (Ni), which is a characteristic feature of a magnet, but it is speculated that it may possibly also be due to unknown components present in meteorites besides Fe compounds, iron filings being of iron nature cannot attract iron compounds, which iron meteorites consist of in high percentage. The stony meteorites though contain less percentage of Fe compounds [Fe (iron) and Ni (nickel)] table 4, yet it shows strong attraction (figure 14) towards a magnet which means, it is possible that the stony meteorites may also contain certain compounds or elements of unknown nature because they are known to be the oldest of the rocks found in space of extra terrestrial origin. It is also possible that the meteorites being of extra terrestrial bodies i.e., not of the earth, and since the mariner compass is prepared or set according to earth's magnetic field or strength, the magnetic needle in mariner compass may not have that strength as required by meteorites to show deflection to a large degree or it is possible that the deflective property in meteorites is weak, hence may show deflection to a small degree. Or it is also possible that since the meteorites being of extra terrestrial nature may not respond to earth's magnetic field or strength, for which it may not deflect the needle. Whatever it may be, it is true that meteorites do not deflect the magnetic needle. The small deflection of the needle by iron meteorites may possibly be due to certain unknown elements present or may be impurities or contaminations for which it is showing deflection of the needle. In any circumstances, Fe compounds cannot show deflection even to a small degree, this inference is drawn, when a sickle of iron nature were kept near mariner compass did not show deflection, also when an iron rod of 5 feet of iron nature, when kept near a mariner compass, showed slight deflection, when these two components were moved left to right and back over the compass, it showed deflection similar to that observed for meteorites, which infers that the slight deflection of the needle by meteorites moving over the compass left to right and back is due to impurities or contaminations of the earth elements. Some of the earth elements may have fused with meteorites as it landed on the surface in a hotter state, which is reflected in meteorites through slight deflection of the needle in a mariner compass. The above components i.e., sickle and iron rod both of iron nature probably made from iron ore may have some magnetic components which resemble the core of the earth, for which it can be stated that the iron meteorites may have similar components but unknown which resemble the core of terrestrial planets.

Meteorites though show strong attraction towards a magnet as shown in the figure 10-14, that does not mean that it possesses magnetic property. Iron filings not being attracted towards meteorites, nor does any movement of iron filings is observed when meteorites covered by a butter paper were rolled gently over the iron filings (figure 16-21), shows that meteorites do not possess any magnetic property. Iron filings will only be attracted towards components possessing magnetic property. Iron filings will never be attracted towards meteorites because iron filings and meteorites of iron nature are of the same elements i.e., Fe compounds [Fe (iron) and Nickel (Ni)]. Stony meteorite Chelyabinsk, though the size was small was strongly attracted towards a magnet as shown in the figure 14. It is possibly because it also contains Fe compounds i.e., iron and nickel, though the content of Fe (iron) and Nickel (Ni) is found to be in less percentage (table 2 and 3), yet it is found to be attracted towards a magnet and that is the truth. But as per the studies carried on meteorites from the time they were known to be extra terrestrial bodies, no such

meteorite has ever been found so far, recorded or documented that contains magnetic property. In short it can be stated that attraction of Fe (iron) compounds towards a magnet is the fundamental property of a magnet.

In table 5, it is observed that the distance at which the attractive property between the meteorites and a bar magnet takes place. Beyond this distance the attractive property between the meteorites and the bar magnet will not take place. i.e., this is the limit for the attractive property to take place between the meteorites and the bar magnet, which means the attractive property of meteorites under study may be dependent on the unknown components present in meteorites besides Fe compounds. For this study, standard bar magnets have been used. The attractive property operates on a very small scale as seen in the table 5. It is likely that the strength of the standard magnets used is weak.

Iron meteorites are metallic in nature, if they are burnt by the friction of the earth's atmosphere as they enter into the earth's atmosphere, the metallic character or characteristic feature being of metallic nature is not destroyed. The remaining part which lands on the earth's surface retains or maintains its identity as metallic nature and hence reflects through shown by attraction towards a magnet, and this property of meteorites showing attraction towards a magnet (whether it be iron or stony) has been attained at its initial stage of its existence or formation. This property is not found to be weakening because stony meteorites have Fe (iron) and Ni (nickel) in lesser percentage, yet it shows strong attraction. It is to be stated that iron meteorites are metallic in nature and hence, as long as metallic property persist in them, attractive property will remain, whereas stone meteorites are not metallic in nature, they are known to be representative of crust of terrestrial planets, yet Chelyabinsk meteorite (stony nature) shows strong attraction towards a magnet, which confirms that Chelyabinsk meteorite may contain certain elements of unknown nature of terrestrial planets or elements of unknown nature, not found on earth. As the time goes due to weathering or climatic conditions, the Fe (iron) compounds may get depleted. In space effect of heat and cold may affect the meteorites, but due to these parameters, it seems that the attractive property in meteorites towards a magnet is not lessened or has become weak or it is possible that the strength of the magnets may become weak in due course and hence may show weak attraction i.e., closer to the magnets.

The attraction of a magnet towards the object depends upon its composition. If the object has Fe elements (iron, nickel, cobalt, chromium and manganese), then and then only attraction is possible. At varying concentrations of Fe (iron) compounds, among the Fe (iron) compounds Fe (iron) is the predominant element which the magnet can attract, so the magnetic strength of a magnet depends upon the amount of Fe (iron) present in an object, other elements like Ni (Nickel), Co (Cobalt), Cr (Chromium), Mn (Manganese), has less attractive property towards the standard magnet, that's why some meteorites attract towards the standard magnet which contain Fe (iron) compounds, but those meteorites having high content of Fe (iron) then it's attraction is very strong at larger distance. False attraction or interfering attraction. When meteorites are contaminated with earth material, it loses its purity and it becomes impure, so it may possibly show false attraction (i.e., attraction of earth elements, where meteorite may have been contaminated), in other words attraction of unknown components towards the standard magnet. Hence it is necessary to study the fallen spot like agricultural field, sea, desert land, swampy place, industrial area etc., it means that what kind of spot undergoes the activities by manmade or natural. So contaminations vary from place to place, where meteorite has been fallen and the period of co habitation in that environment. Only purest form of meteorites is able to show strong attractive property (i.e., strong attraction).

Meteorites possess attractive property but not magnetic property, which has been observed through experiment 2. The meteorites are found to be strongly attracted towards a magnet, is it due to metallic property in meteorites? Iron meteorites are possible, but stony meteorite also shows strong attraction towards a magnet and the content of Fe_2O_3 and NiO is found to be in lesser percentage. Is it possible than that the meteorites may contain certain elements of unknown compositions, and which may be responsible for strong attraction towards a magnet besides Fe (iron) and Ni (Nickel). For this study, XRF analysis of Chelyabinsk meteorite was carried out again to confirm its true nature because of its small size, earlier XRF results[11] shows lesser percentage of oxides than present study, yet it showed strong attraction towards a magnet. Whatever it may be, whether high percentage of oxides composition or low percentage of oxide composition, which infers the possibility of unknown components of earth elements present as contaminates or presence of unknown components not known besides Fe compounds. Stony meteorites are known to be the oldest of the meteorites known and they represent the crust of the terrestrial planets. Hence unknown components of earth elements are possible. The magnetic needle in the mariner compass after all a magnet aligned to earth's magnetic field. The effect of no deflection is similar to no attraction of iron filings. It is possible that the bar magnet has a large surface area, where the magnetic intensity is large, whereas the magnetic needle has a very small surface area or it is a point, where the magnetic flux or intensity is very small or to a negligible intensity and hence due to this, the meteorites may be attracted to a larger area than the point, hence may not show deflection. If meteorites possess magnetic property, it should be reflected through attraction of iron filings or deflection of the needle in the mariner compass, which does not, seems to be.

If considered that meteorites possess magnetic property, then the needle of the mariner compass would show deflection to a large degree rather than showing to a small degree, which has not been the case. When meteorites were held near a magnet, either it will repel or attract, which is similar to like poles repel and unlike poles will attract, which is the rule of magnetism. This has not been observed. The meteorites are found to be attracted towards a magnet, irrespective whether it is North Pole or South Pole. From this, it shows that meteorites do not have or show any magnetic property. All the above three experiments were conducted 2-3 times on meteorites to come to proper conclusion. From the studies conducted on meteorites, the meteorites will never deflect the magnetic needle in a mariner compass (from exp. 1), because it neither is earth origin, nor will it attract iron filings (from exp. 3), because both have the same components. From the measurement of the three properties, iron meteorites do show deflection of the needle, but to a very marginal degree. Meteorites are space rocks. Since their size is small, they don't have their own heat phenomena in the interior, similar to earth, Jupiter and Io (one of Jupiter's moon), which has heat phenomena in the interior and which may possibly give rise to magnetism. Hence it is possible that magnetism may not be found in meteorites because magnetic

property is one of the characteristic features of magnetism. Earth has heat phenomena hence it has magnetic property similar to Jupiter and Sun where heat phenomena exist in the interior.

Finally, meteorites are nothing but considered as left out ash (spilt) material which means all reactive property are lost. Hence there is no question of magnetism in meteorites. It has attained stable form. Oxide condition of any component (especially metals) inert one is the last stage. It will not react any further i.e., it has no reactivity property because it is stable chemically and physically. It will not affect or be harmful to parent planet, but physically it will affect, but not chemically and biologically. All the mineral composition in it are satisfied in the form of oxides i.e., stable form.

6. CONCLUSION

From the experimental results, results by XRF analysis and discussions, it is found that the meteorites under study are original and hence it is clearly seen that whatever studies carried so far on meteorites from the time they were known to be of extra-terrestrial origin, with respect to magnetic property are all related to Fe compounds only. From the experiments carried out on 6 iron meteorites and a stony meteorite clearly indicates that meteorites possess strong attractive property but not magnetic property. The deflection of a magnetic needle to a very small degree when meteorites were moved left and right over the magnetic needle, but when kept near mariner compass did not show deflection. Iron meteorites contain Fe compounds and Fe compounds cannot deflect the needle. Hence it is possible that since the meteorites contain impurities or contaminations of earth elements, it shows slight deflection and not due to meteorites possessing any magnetic property. From the studies carried out it is clearly seen that meteorites possesses attractive property, but not magnetic property and this is the truth.

In this study stony iron meteorites were not available and hence their characteristic feature with respect to magnetic property is not included in this work. But it can be inferred that stony iron meteorites may also, do not possess magnetic property. Though all the meteorites under study show strong attraction towards a magnet, yet slight deflection of the needle in a mariner compass and no movement or no attraction of iron filings towards meteorite indicate that the meteorites do not possesses any magnetic property.

From all this finally, it can be concluded that meteorites of iron nature though show slight deflection of the needle, stony nature do not show any deflection of the needle and also non attraction of iron filings, hence can be said that it does not possess any magnetic property. From the time the studies on meteorites started, no meteorites find or fall showing magnetic property has been reported, recorded or documented till date, because magnetic property is found to be absent in meteorites from the studies carried out through the experiments conducted.

The meteorites have no magnetic property of their own, but show strong attraction towards a magnet. Also, for each meteorite under study, the distance of attraction was carried out, which may possibly be dependent on the unknown content of magnetic compounds besides Fe compounds, if any of these components is depleted, it may affect the distance of attraction. This conclusion is drawn from the experimental results. It is of the opinion that besides Fe compounds, there may be certain unknown elements and which may be responsible for attractive property in meteorites besides Fe compounds.

From the studies on meteorites and the experiments conducted on meteorites under study to search for the attractive property and magnetic property, it is stated that meteorites possess attractive property but not magnetic property. The strong attraction towards magnets of different strength is due to Fe compounds. Magnetic property if related to any compounds other than Fe (iron) and Ni (nickel) may be unknown to us, but it attracts Fe (iron) compounds and this is the fact. The attractive property (force of attraction) in meteorites existed from the time they came into existence. From then till now it remained in meteorites which show that this property was not affected in space for so many years.

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APPENDIX

Fig. 1: Mariner compass in a standstill pointing towards north and south direction

Fig. 2: Sikhote Alin Iron meteorite placed near mariner compass. Showing no deflection of the needle

Fig. 3: Campo-del-Ceilo (1) iron meteorite placed near Mariner compass. No deflection of the needle

Fig. 4: Unknown iron meteorite placed near Mariner compass. No deflection of the needle

Fig. 5: Unknown iron meteorite placed Near mariner compass. No deflection of the needle

Fig. 6: Unknown iron meteorite placed near Mariner compass. No deflection of the needle

Fig. 7: Campo-del-Ceilo (2) iron meteorite placed Mariner compass. No deflection of the needle

Fig. 8: Chelyabinsk stony meteorite placed near Mariner compass. No deflection of the needle

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Fig. 9: A plain bar magnet used to find attractive Property of meteorites

Fig. 10: Unknown iron meteorite strongly attracted towards a bar magnet

Fig. 11: Unknown iron meteorite strongly attracted towards a bar magnet.

Fig. 12: Campo-del-Ceilo iron meteorite strongly attracted towards a bar magnet

Fig. 13: Sikhote Alin iron meteorite strongly attracted towards a bar magnet

Fig. 14: Chelyabinsk stony meteorite strongly attracted towards a bar magnet

Fig. 15: Iron filings to find the magnetic property of meteorites

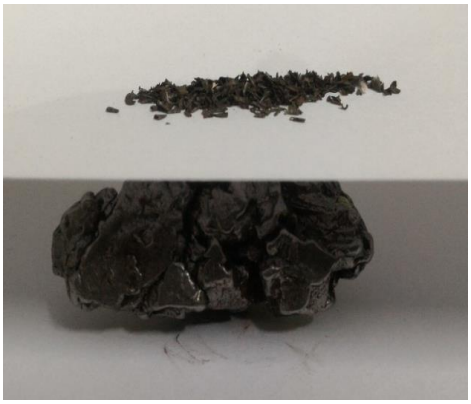

Fig. 16: Iron filings held over unknown iron meteorite to find the magnetic property. No movement of iron Iron filings observed

Fig. 17: Iron filings held over the unknown iron meteorite to find the magnetic property. No movement of iron filings observed

Fig. 18: An iron meteorite wrapped in a butter paper and rolled gently over iron filings to study the magnetic property. No movement or attraction of iron filings towards a meteorite observed

Fig. 19: An iron meteorite wrapped in a butter paper and gently rolled over iron filings to study the magnetic property. No movement or attraction of iron filings towards a meteorite observed

Fig. 20: A stony meteorite wrapped in a butter paper and gently rolled over iron filings to study the magnetic property. No movement or attraction of iron filings towards a meteorite observed

Fig. 21: An iron meteorite wrapped in a butter paper and gently rolled over iron filings to study the magnetic property. No movement or attraction of iron filings towards a meteorite observed

Fig. 22: Measuring the distance of attraction of an Unknown iron meteorite (2), towards a bar magnet

Fig. 23: Measuring the distance of attraction of an iron meteorite Campo-del-Ceilo (2), towards a bar magnet

Fig. 24: Measuring the distance of attraction of an Alin towards a bar magnet

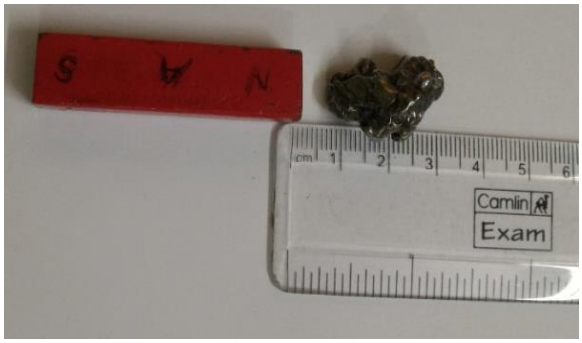

Fig. 25: Measuring the distance of attraction iron meteorite Sikhote Meteorite Campo-del-Ceilo (1) towards a bar magnet

Fig. 26: Measuring the distance of attraction of an Unknown iron meteorite (1), towards a bar magnet

Fig. 27: Measuring the distance of attraction of a Stony meteorite Chelyabinsk towards a bar magnet

Table 1: Physical parameters of meteorites

S. No.	Sample Name↓ Physical Parameters→	Lustre	Density g/cm³	Dimensions in cm	Class	Shape
1	Sikhote Alin Meteorite (Iron).	Metallic	6.2142	2.3x1.6x1.1	Iron	irregular
2	Campo-del-Cielo iron meteorite (1) .	Metallic	5.9409	2.0x1.4x1.5	Iron	irregular
3	Unknown Iron meteorite (1)	Metallic rust	7.9558	2.7x1.7x0.3	Iron	Sliced, flat
4	Chelyabinsk meteorite (stony).	Earthy	1.668	0.3x0.2x0.1	stony	irregular
5	Unknown Iron meteorite (2).	Metallic	7.48	3.9x4.5x2.9	Iron	irregular
6	Unknown Iron meteorite (3).	Metallic	7.3304	5.0x2.4x2.3	Iron	irregular
7	Campo-del-Cielo iron meteorite (2)	Metallic	8.48135	3.0x1.9x0.5	Iron	flat

Table 2: Measurement of Magnetic property in meteorites

Sr. No.	Instruments used→	Mariner compass	Bar Magnet 2''(50mm)	Iron filings
	Sample Name↓ Scope of work→	**Deflective property**	**Attractive property**	**Magnetic property**
1	Sikhote Alin Meteorite (Iron).	No deflection of the needle.	Strongly attracted towards a magnet.	No movement of iron filings.
2	Campo-del-Ceilo iron meteorite (1).	No deflection of the needle.	Strongly attracted towards a magnet.	No movement of iron filing.s
3	Unknown iron meteorite (1)	No deflection of the needle.	Strongly attracted towards a magnet.	No movement of iron filings.
4	Chelyabinsk meteorite (stony).	No deflection of the needle.	Strongly attracted towards a magnet.	No movement of iron filings.
5	Unknown iron meteorite (12.	No deflection of the needle.	Strongly attracted towards a magnet.	No movement of iron filings.
6	Unknown iron meteorite (3) .	No deflection of the needle.	Strongly attracted towards a magnet.	No movement of iron filings.
7	Campo-del-Ceilo iron meteorite (2).	No deflection of the needle.	Strongly attracted towards a magnet.	No movement of iron filings.

Table 3: Oxide composition of Chelyabinsk, stony meteorite by XRF in %

S. No.	Oxides	Result	In %
1	Fe_2O_3	46.4	In %
2	SiO_2	29.2	In %
3	MgO	6.47	In %
4	SO_3	5.07	In %
5	Al_2O_3	3.8	In %
6	P_2O_5	2.88	In %
7	CaO	2.07	In %
8	NiO	1.39	In %
9	Cr_2O_3	1.2	In %
10	Cl	0.785	In %
11	MnO	0.445	In %
12	TiO_2	0.165	In %
13	CuO	0.0871	In %
	Total	99.9621	In %

Table 4: Elemental Composition of meteorites by XRF analysis in %

Sr. No.	Elements↓/Legend→	1	2	3	4	5	6	7
1	Fe	93.7	90.4	93	57.5	97.8	92.5	92.3
2	Ni	4.79	5.75	4.29	3.17	1.48	6	5.42
3	Si	0.475	0.798		26	0.188	0.485	1.29
4	Al	0.405	0.234	0.364	3.45	0.134	0.17	0.142
5	P	0.399	1.77	0.212	2.52	0.234	0.527	0.686
6	Cu	0.12			0.173	0.029	0.02	0.0152
7	S	0.0664	0.121	1.11	1.29	0.125	0.287	0.117
8	Zr	0.012				0.005	0.009	0.0081
9	Cr	0.0095	0.005	0.0542	0.696	0.02	0.013	0.0403
10	Mo	0.0095	0.009	0.101		0.004		0.0062
11	Co		0.921	0.0013	0.456			
12	Au		0.003					

13	W		<0.0001	0.895				
14	Ca				3.19			
15	K				0.721			
16	Mn				0.664	<0.0001	<0.0001	<0.0001
17	Ti				0.138			
18	As				0.015			
19	Zn					<0.0001	0.0005	0.0009
	Total	99.986	100	100.03	99.98	100	100	100.03

Legend :

1. Sikhote Alin Iron meteorite
2. Campo-del-Cielo Iron meteorite (1)
3. Unknown Iron meteorite (1)
4. Chelyabinsk stony meteorite
5. Campo-del-ceilo iron meteorite (2)
6. Unknown iron meteorite (2)
7. Unknown iron meteorite (3)

Table 5: Measurement of distance of attractive property (force of attraction) in meteorites towards a magnet

Sr. No.	Meteorite class	Bar Magnet 2" (50mm) (1)		Bar Magnet 2" (50mm) (2)		Bar Magnet 3" (75mm)		Horse Shoe Magnet 2" (50mm)
		Strength 1.259 Gauss	Strength 1.295 Gauss	Strength 1.538 gauss	Strength 1.613 gauss	Strength 1.596 gauss	Strength 1.77 gauss	Strength 0.576 gauss
		A	B	A	B	A	B	A
1	Sikhote Aline iron meteorite	0.4	0.4	0.6	0.6	0.6	0.6	0.2
2	Campo-del-Ceilo iron meteorite (1)	0.7	0.7	0.7	0.7	0.7	0.7	0.4
3	Unknown iron meteorite (1)	0.6	0.6	0.6	0.6	0.6	0.6	0.3
4	Unknown iron meteorite (2)	0.4	0.4	0..4	0.4	0.4	0.4	0.2
5	Unknown iron meteorite (3)	0.5	0.5	0.5	0.5	0.5	0.5	0.2
6	Campo-del-Ceilo iron meteorite (2)	0.6	0.6	0.6	0.6	0.6	0.6	0.4
7	Chelyabinsk stony meteorite	0.2	0.2	0.2	0.2	0.2	0.2	No attraction

A= Mean of North pole + south pole.
B= Mean of North pole + south pole.

