Almahata Sitta Meteorite MagSus Classification Database – the Enstatite Chondrites

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Numerous individuals of different lithologies of the Almahata Sitta (AS) meteorite have been found in the desert of N Sudan after the fall in 2008. Our knowledge concerning the formation, structure and life cycle of asteroids was significantly deepened since [1-3]. Almahata Sitta - classified as a polymict ureilite - does not only contain small clasts or fragments of different meteorite lithologies but consists of individuals of a growing number of different meteorite types and classes (rubble pile asteroid parent body): various ureilite types and related lithologies (several unknown before) and a growing number of enstatite, ordinary and carbonaceous chondrites. Even unique and new meteorite lithologies such as Trachy-Andesites or an individual with affinity to Rumuruti chondrites have been discovered [1,2].
We have developed a database on the magnetic susceptibility (MagSus, and other magnetic parameters) of all so far by us investigated Almahata Sitta individuals and samples. Three sample sets are discriminated, details are found in earlier contributions [2]: AS (AHS), MS and MS-MU. Recently, we have extended our database of the MagSus values incorporating now all investigated individuals/samples of the Almahata Sitta fall of 2008.

In this contribution we focus on the enstatite chondrite lithologies of the Almahata Sitta fall: 33 of all reported 136 individuals [1,2]. It should mentioned that also 2 enstatite achondrite lithologies have been classified in the AS sample set: both are characterized by an extremely high metal (kamacite) content which discriminates both from the "normal" enstatite achondrites (aubrites) (MS-MU 019 and 036). Fioretti et al. [4] reported recent investigations on 63 additional Almahata Sitta stones/ individuals, stored at Univ. of Khartoum (sample set AhS). Presently we cannot include this sample set as long as MagSus and precise classification data are not available.

We decided to treat the AS enstatite chondrites in more detail and to also include all published enstatite chondrite fall MagSus data. Enstatite chondrites are highly reduced meteorites and Fe is only present in metallic iron phases (kamacite, taenite) or Fe-bearing sulphides (troilite, daubreelite etc.) [5-7]. Therefore enstatite chondrites are extremely sensitive to terrestrial weathering effects, which means as a consequence, only falls can be included in any substantiated MagSus database. The presently accepted enstatite chondrite classification scheme discriminates two goups depending on the bulk iron content: the EH group contains ~30% total iron, while the EL group contains only ~25%. A further discrimination between the two subgroups is made by the Si content of metal: the EH subgroup has a higher Si content in kamacite (EH: 1.9–3.8 wt% vs. EL: 0.3–2.1 wt%). However, it was shown by Macke [14] that the two groups do not significantly differ in their iron content, and that they are indistinguishable in density, porosity, and magnetic susceptibility as well.

In figures 1-3 MagSus values are plotted as a function of petrographic type for E-H, E-L and all enstatite chondrite (E-C) falls. We can summarize the results as follows:

- For the first time, incorporating AS E-C we have now for both E groups a nearly full cover of all petrographic types.
- All MagSus values represent average values of 3 databases and several samples each, respectively. So we consider the MagSus values as representative.
- The influence of local variations in Fe metal concentrations (eg veins) can be neglected: this was shown on Neu-schwanstein 2 (EL 6) whereby a full profile across the main mass was sampled and investigated and no significant variations in MagSus were found [15-17].
- It is evident that MagSus values of the AS E-C are generally lower, in case of both groups. This is specifically significant in the case of the EL 6.
- The Macke [14] findings can be confirmed – in our study only falls are taken into account.
- MagSus values do not provide a clear picture concerning grouping of E-C into high- and low-iron, respectively.
- E-H: we find a minor trend between MagSus and petrographic type – increase of MagSus with petrographic type, or degree of equilibration. The significance of the trend will have to be discussed
- E-L: we can not find any trend between MagSus and petrographic type, so the degree of equilibration seems not to play a major role in case of E-L.
- Consequently, bulk or total iron does not allow a clear classification into different E-C groups
- Further, taking into account the Si content of metal as a classification parameter is questionable.

References

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Figures:

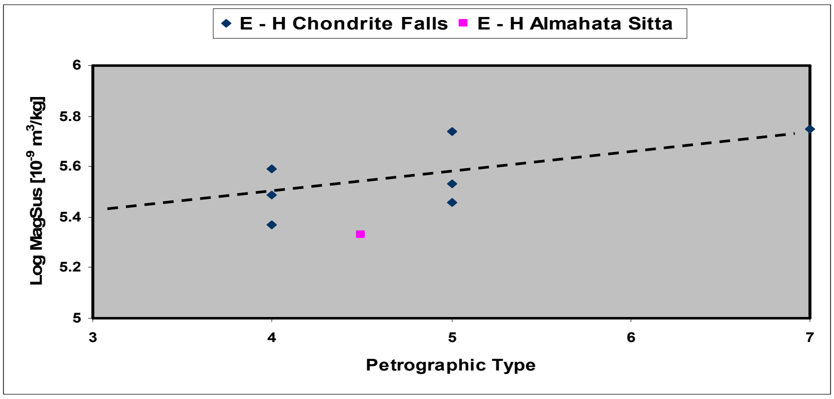

Figure 1: All enstatite chondrite E-H falls: magnetic susceptibility versus petrographic type, a trendline is given (estimate).

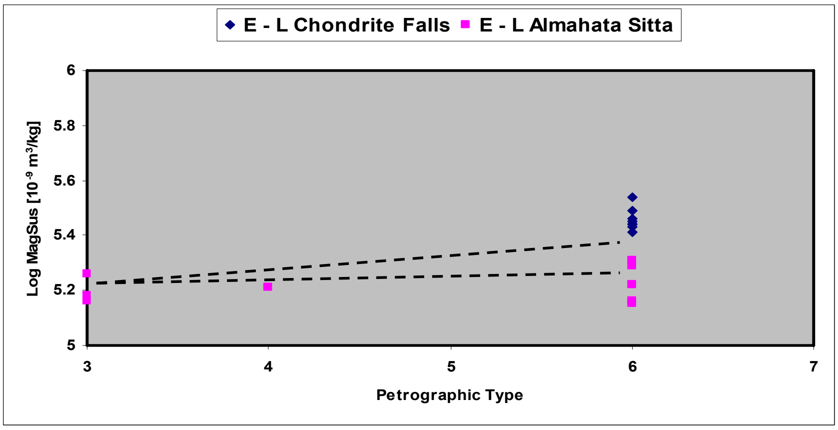

Figure 2: All enstatite chondrite E-L falls: magnetic susceptibility versus petrographic type, a trendline is given (estimate).

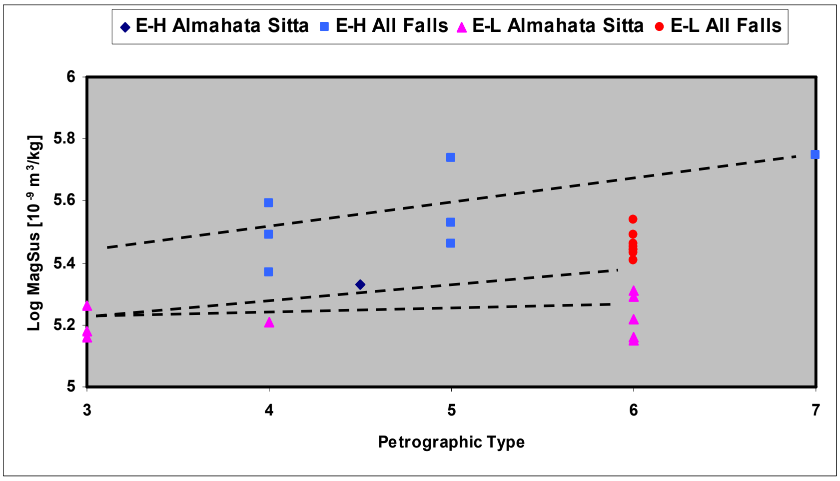

Figure 3: Compilation of all enstatite chondrite falls: magnetic susceptibility versus petrographic type, a trendline is given (estimate).