**GEOGRAPHIC INFLUENCES ON EVAPORITE FORMATION DURING WEATHERING OF ANTARCTIC METEORITES.**

A. Losiak[1] and M. A. Velbel[2], [1]Department of Geological Sciences, 206 Natural Science Building, Michigan State University, East Lansing, MI 48824-1115 (losiakan@msu.edu), [2]Department of Geological Sciences, 206 Natural Science Building, Michigan State University, East Lansing, MI 48824-1115 (velbel@msu.edu).

**Introduction:** Terrestrial weathering of Antarctic meteorites is important for two main reasons. The first is that weathering processes can modify characteristics (e.g., trace-element abundances) of meteorites and thereby interfere with retrieval of information about pre-terrestrial Solar System processes (e.g. [1,2]). This problem can be especially significant when dealing with rare types of meteorites. The second reason to study Antarctic meteorites is because it can provide information about environment of Antarctica (e.g. [3,4]).

There are two main types of weathering products on Antarctic meteorites that are visible at the hand-sample scale: rust and evaporites. Few articles have been published about the evaporitic deposits on Antarctic meteorites (e.g. [5-8]). To date, the influence of geographic location of meteorite-bearing ice fields on evaporite occurrence has not yet been investigated. The aim of this paper is to research this relationship.

**Methods:** Data on evaporite distributions on Antarctic ordinary chondrites recovered by the ANSMET program was retrieved from the most recent version of the online Antarctic meteorite classification database available on the NASA Astromaterials Curation web page (http://curator.jsc.nasa.gov/antmet/) that includes information on 15263 meteorites recovered up to 2006 (although data from 2005 and 2006 is not complete). This is more than ten times the number of meteorites that were available at the time of the last such weathering census [6]. Total number of meteorites as well as number of meteorites with evaporites was determined for each meteorite-yielding ice field. Meteorites were also divided depending on their classification, because it was shown [6] that probability of evaporite occurrence is dependent on the compositional type of meteorite.

**Results:** Results are presented in the Table 1. Only ice fields from which a total of more than 100 meteorites have been recovered and classified are shown. Colors represent deviation in the proportion of evaporite-bearing meteorites from each ice field (as a fraction of all meteorites from the same ice field) from the average value calculated for entire population of a given type of meteorite. Values were calculated for the entire population (first 3 columns of Table 1) as well as for ordinary chondrites, the most abundant meteorite classes (to control for the composition). Pairing is not taken into account in Table 1.

Major results from this census are:

1) Approximately 5.0% of all U.S. Antarctic meteorites have evaporites. This is consistent with previous findings (5.4% in [6]).
2) The proportion of meteorites with evaporites varies with compositional classification (e.g., a smaller fraction of LL chondrites are evaporite-bearing than L or H chondrites). This is consistent with previous work [6].
3) Some meteorite-bearing ice fields show consistently high (GRO, MIL) or low (DOM, LAP, MAC, MET, RBT) proportions (relative to the entire-population average) of evaporite-bearing meteorites, for all analyzed compositional groups.
4) Other meteorite-bearing ice fields do not show such uniform over- or under-abundance of evaporite bearing meteorites. In these cases, for the same field, evaporite-bearing meteorites are over-abundant relative to the population mean for some of the analyzed compositional groups, while meteorites of other compositions show lower-than-average proportions of evaporite bearing meteorites (e.g. EET, PCA, QUE).

**Discussion:** Velbel [6] showed that susceptibility of meteorites to evaporite formation is a function of meteorite composition. This work demonstrates that environmental factors can be also very important (e.g. [1]). If evaporite formation were fully controlled by composition, there should be no large differences in evaporite formation among different geographic ice-fields of origin for compositionally controlled populations. For example, for H chondrites the average number of meteorites with evaporites is 5.3% (of a population of 4908), and proportion of evaporite-bearing H chondrites varies for different fields from less than 3% (RBT, ALH, DOM) to more than 9% (GRO, MIL, QUE). Similarly for L and LL chondrites, the percentage of meteorites with evaporites varies from less than 1% to 15.9% and from less than 1% to 8.3% respectively. The fact that some ice-fields show constantly increased or decreased proportions of evaporite-bearing meteorites for all analyzed compositional classes of meteorites suggests that environmental characteristics at these sites favor the formation of evaporites.

If the source of evaporites were terrestrial contamination such as sea salt, one might hypothesize that the number or proportion of evaporite-bearing meteorites decreases with increasing distance from the sea. However results do not support this hypothesis (Figure 1). Fields with over- or under-abundances of evaporite-bearing meteorites seem to be distributed relatively randomly with respect to distance from marine coasts. This is consistent with previous results indicating that evaporites on Antarctic meteorites are not of terrestrial marine (e.g., sea salt) origin ([8,9]). It is also noteworthy that ice fields with higher-than-average abundances of evaporite-bearing meteorites (for all compositional groups) are immediate neighbors of those with lower than average proportions of evaporite-bearing meteorites (e.g. RBT, GRO, MAC). This precludes a macroclimatic influence. An alternative explanation is that environmental conditions at the micro-scale are more important. Micro-scale conditions can include microclimatic conditions characteristics for particular meteorite field, or hydrologic setting [10].

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**Table 1. Number of meteorites found along with number of meteorites with evaporite deposits in ice fields with 100 or more total cataloged meteorites. Colors correspond to deviation of the % of evaporite bearing meteorites from each ice field from the average value for all meteorites of the given type (row labeled "All").**

| | Total | Ev. | % | H chon. | Ev. | % | L chon. | Ev. | % | LL chon. | Ev. | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| All | 15263 | 757 | 5,0% | 4908 | 258 | 5,3% | 5880 | 246 | 4,2% | 2985 | 52 | 1,7% |
| ALH | 1473 | 76 | 5,2% | 846 | 23 | 2,7% | 414 | 19 | 4,6% | 55 | 0 | 0,0% |
| **DOM** | 151 | 1 | 0,7% | 36 | 1 | 2,8% | 53 | 0 | 0,0% | 59 | 0 | 0,0% |
| EET | 2187 | 119 | 5,4% | 392 | 17 | 4,3% | 1485 | 40 | 2,7% | 59 | 3 | 5,1% |
| *GRA* | 227 | 13 | 5,7% | 120 | 6 | 5,0% | 60 | 3 | 5,0% | 2 | 0 | 0,0% |
| GRO | 356 | 48 | 13,5% | 63 | 7 | 11,1% | 214 | 34 | 15,9% | 57 | 2 | 3,5% |
| LAP | 1447 | 23 | 1,6% | 283 | 11 | 3,9% | 579 | 4 | 0,7% | 467 | 4 | 0,9% |
| LEW | 1870 | 123 | 6,6% | 1178 | 79 | 6,7% | 503 | 23 | 4,6% | 81 | 6 | 7,4% |
| MAC | 890 | 33 | 3,7% | 382 | 14 | 3,7% | 393 | 8 | 2,0% | 75 | 2 | 2,7% |
| MET | 1129 | 34 | 3,0% | 325 | 10 | 3,1% | 394 | 13 | 3,3% | 306 | 5 | 1,6% |
| **MIL** | 312 | 29 | 9,3% | 76 | 7 | 9,2% | 140 | 13 | 9,3% | 69 | 5 | 7,2% |
| PCA | 599 | 44 | 7,3% | 239 | 11 | 4,6% | 256 | 18 | 7,0% | 35 | 0 | 0,0% |
| QUE | 3443 | 159 | 4,6% | 718 | 66 | 9,2% | 1036 | 48 | 4,6% | 1578 | 19 | 1,2% |
| RBT | 223 | 4 | 1,8% | 79 | 1 | 1,3% | 93 | 0 | 0,0% | 37 | 1 | 2,7% |
| *RKP* | 135 | 10 | 7,4% | 59 | 2 | 3,4% | 48 | 4 | 8,3% | 12 | 1 | 8,3% |

| | | Total | H | L | LL |
|---|---|---|---|---|---|
| | >(av+2%) | >7% | >7,3% | >6,2% | >3,7 |
| | (av+1%)- (av+2%) | 6-7% | 6,3-7,3% | 5,2-6,2% | 2,7-3,7% |
| | (av) to (av+1%) | 5-6% | 5,3-6,3% | 4,2-5,2% | 1,7-2,7% |
| | (av) to(av-1%) | 4-5% | 4,3-5,3% | 3,2-4,2% | 1,7-0,7% |
| | (av-1%)to(av-2%) | 3-4% | 3,3-4,3% | 2,2-3,2% | <0,7% |
| | <av-2% | <3% | <3,3% | <1,2% | 0% |

Red - fields where there is more evaporites than on average, Blue - fields where there is less meteorites than on average, Bolded-all the same category; Italic - not enough meteorites, Underlined - not certain

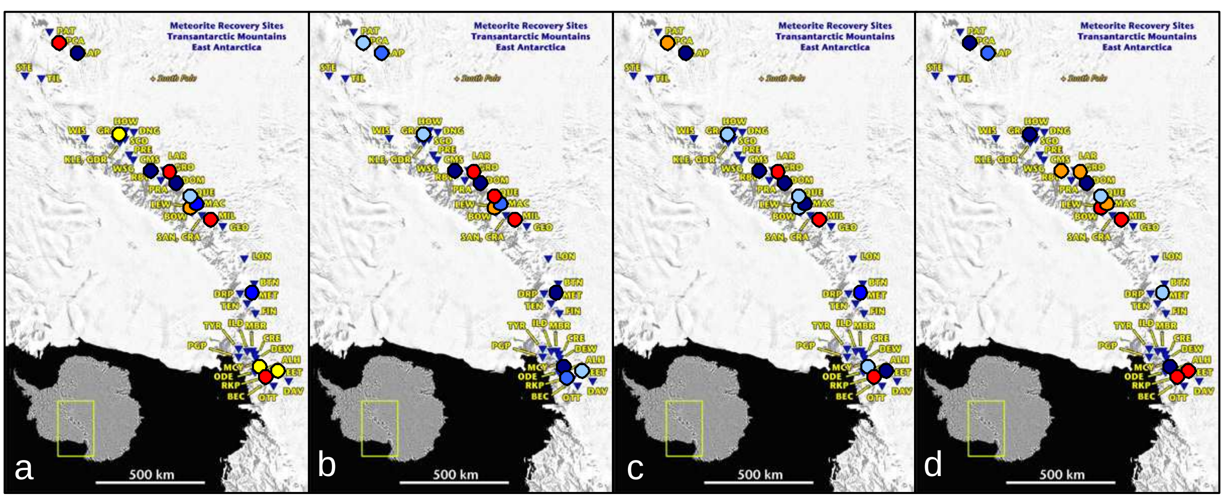


**Figure 1 Map of meteorite fields on Antarctica. Colors represent deviation from the average number of meteorites with evaporites – scale is consistent with one presented in table 1 a) statistics for all meteorites found in a specific field, b) statistics only for H chondrites.**