214
2007 1 3

CHEMISTRY OF CARBONACEOUS XENOLITHS FROM THE EREVAN HOWARDITE; M. A. Nazarov, Vernadsky Institute of Geochemistry and Analytical Chemistry, Moscow 117975, Russia, F. Brandstätter and G. Kurat, Naturhistorisches Museum, Postfach 417, A-1014 Vienna, Austria, B. Spettel and H. Palme, Max-Plank-Institut für Chemie, Postfach 3060, D-55022 Mainz, Germany

The Erevan howardite is a polymict breccia with abundant xenoliths resembling carbonaceous chondrites [1]. Xenoliths with affinities for carbonaceous chondrites have been described from the Kapoeta, Jodzie, and Bholghati howardites [2-4], and the LEW 85300 polymict eucrite [5]. All these xenoliths have basically CM chondrite mineralogy. Apparently, the HED parent body was bombarded by a CM chondrite population in contrast to the ureilite parent body recording a CI chondrite component [6]. However, trace element data for the Bholghati and LEW 85300 xenoliths differ significantly from CM and CI chondrite patterns [5,7,8]. Our INA-bulk-analyses of clasts and EMP-analyses of matrices of Erevan carbonaceous xenoliths are compatible with CM chondrites, except for a significant Na depletion. Textural and chemical inhomogeneties identified in the clasts may be related to nebular processes.

TRACE ELEMENT PATTERN. Two carbonaceous clasts of 0.065 mg (ERW2) and 0.33 mg (ERW3) were analyzed for major and trace elements by INAA at the MPI Mainz laboratory. Both xenoliths show similar elemental abundances (Fig.1). Major differences are found in Ca, Br, and Au contents, probably related to inhomogeneous distribution. The elemental abundances match those of CM chondrites, with the larger clast ERW3 showing a better fit. When compared to CM chondrites the Erevan xenoliths are richer in refractory lithophile elements, and are characterized by a strong Na depletion (Fig.1).
The clasts consist of high-temperature components surrounded by a mantle of fine-grained material resembling accretionary dust mantles commonly observed in CM chondrites [9]. Core and mantle are embedded in a matrix rich in cronstedtite and tochilinite. High-temperature core components are forsterite (Fa 1.1-3.6), enstatite (Fs 1.0-3.6), and spinel-rich CAIs containing diopside. Some high-temperature grains are also present as isolated clasts in the Fe-rich matrix, and are not surrounded by fine-grained mantles. In addition, the matrix contains rare grains of Fe-rich olivine (Fa 30.4) and pyroxene (Fs 30.3; Wo 0.2), and Ca-carbonate. Main accessories are pentlandite, pyrrhotite, barringerite, and a P-rich sulfide described in more detail in [10].

MATRIX CHEMISTRY. The matrix of 30 carbonaceous clasts from .05 to 2 mm was analyzed by EMP techniques . The averaged data for 28 clasts are given in the Table and are shown in Figs. 2-3. Most matrix compositions are close to those of CM chondrites (Fig.2), except for a few clasts which are enriched in Si and Mg. We found only one clast that has a CI mineralogy but its matrix chemistry is closer to that of CM chondrites. Carbonaceous clasts from ureilites [6], mineralogically similar to CI-chondrites, also have a CM matrix chemistry (Fig.2). The Erevan xenolith matrices are strongly depleted in Ca, S and Na relative to CI composition (Fig.3). When compared to CM matrices they are commonly poorer in Na, and richer in K, Ti, Cr, and Mn. Therefore, the Erevan matrices are significantly different from carbonaceous chondrite matrices in their high K/Na ratio. Similar high K/Na ratios are observed only in the CI clasts from ureilites [6] and in micrometeorites [11]. Accretionary mantles are mainly composed of serpentine (high Mg and Si contents) whereas the xenolith matrix is rich in cronstedtite and tochilinite (Fig.2, Table). Both lithologies are characterized by high K/Na ratios.

DISCUSSION. In contrast to geochemical studies of the Bholghati and LEW 85300 carbonaceous clasts [5,7,8] our INAA data confirm the mineralogical identification of CM material in the Erevan howardite [1]. However, the comparison also shows that mineralogical features may be insufficient to distinguish different types of carbonaceous chondrites. In fact, the mineralogically identified CI clasts in ureilites [6] show CM matrix chemistry. The high-temperature grains (cores), accretionary mantles, and the Fe-rich matrix record a sequence of nebular processes of decreasing temperatures.

EREVAN CC XENOLITHES: Nazarov M.A. et al.

A prominent feature of the Erevan CM clasts is the strong Na depletion seen in bulk clast and clast matrix compositions. Similar Na depletions were found in bulk samples of CM and CV chondrites [12] and related to nebular processes. Other authors suggested that the Na-K fractionation in CM matrices is controlled by phyllosilicate - water ion exchange during aqueous alteration in a parent body regolith [13].

Erevan CM clasts do not show evidence for chemical and/or mineralogical impact-induced features which should have formed as a result of accretion of the material on a parent body. The presence of unaltered carbonaceous clasts in the HED parent body regolith indicates gentle accretion of the xenolithes,i.e. the small relative velocities of the HED-parent body and the exotic clasts. It could also indicate a genetic link between host and clasts [14].

ACKNOWLEDGEMENTS. MAN was supported by the Russian Research Foundation (Project 93-05-9222). Support by the Austrian FWF (Project P 8125-GEO) is gratefully acknowledged.

REFERENCES. [1] Nazarov M. A. et al. (1993) LPSC, XXIV, 1053. [2] Brearley A. J. (1993) LPSC, XXIV, 183. [3] Bunch T. E. et al. (1979) GCA, 43, 1727. [4] Reid A. M. et al. (1990) GCA, 54, 2161. [5] Zolensky M. E. et al. (1992) Meteoritics, 27, 596. [6] Brearley A. J. and Prinz M. (1992) GCA, 56, 1373. [7] Laul J. C. and Gosselin D. C. (1990) GCA, 54, 2167. [8] Wang M. S. et al. (1990) GCA, 54, 2177. [9] Metzler K. et al. (1992) GCA, 56, 2873. [10] Nazarov M. A. et al.(1994) this volume. [11] Kurat G. et al. (1992) LPSC, XXIII, 747. [12] Spettel B. et al. (1978) Meteoritics, 13, 363. [13] Bunch T. E. and Chang S. (1980) GCA, 44, 1543. [14] Kurat G. (1990) Meteoritics, 25, 377.

Table:
Chemistry of carbonaceous matrices (wt %).

	Average Erevan matrix	S.d.	Serp.-rich lithology (dust mantle)	Cronst.-rich lithology
Na	0.18	0.12	0.05	0.04
Mg	10.68	1.66	12.05	7.84
Al	1.49	0.48	1.08	1.23
Si	14.02	1.28	14.31	11.78
S	3.13	1.16	1.79	2.92
K	0.11	0.08	0.00	0.00
Ca	0.60	0.53	0.58	0.10
Ti	0.08	0.03	0.06	0.06
Cr	0.60	0.67	0.17	0.12
Mn	0.23	0.08	0.14	0.16
Fe	23.67	3.84	12.98	28.92
Co	0.06	0.02	-	-
Ni	1.33	0.32	0.75	0.62

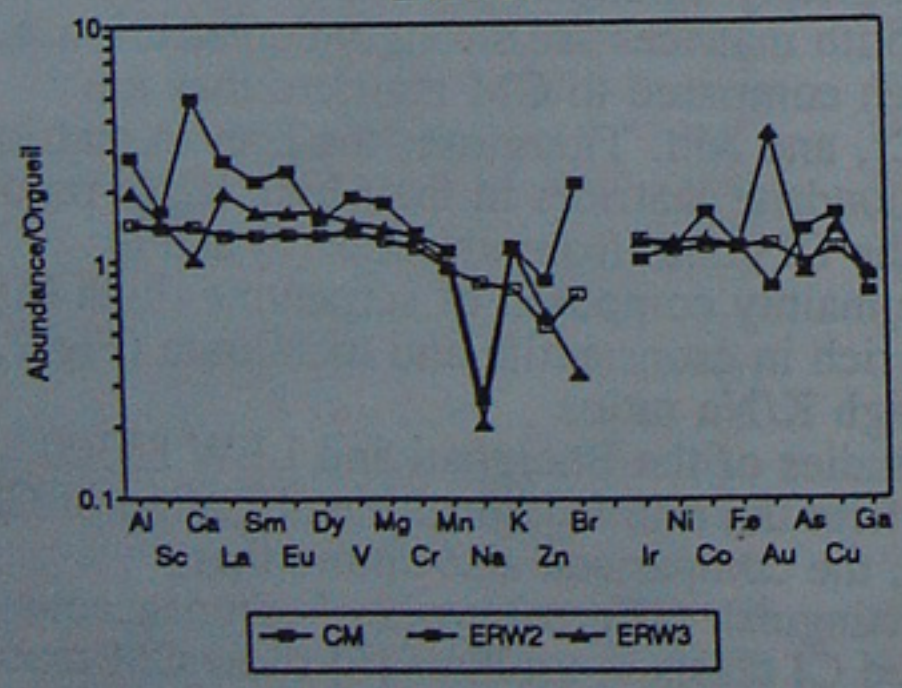

Figure 1

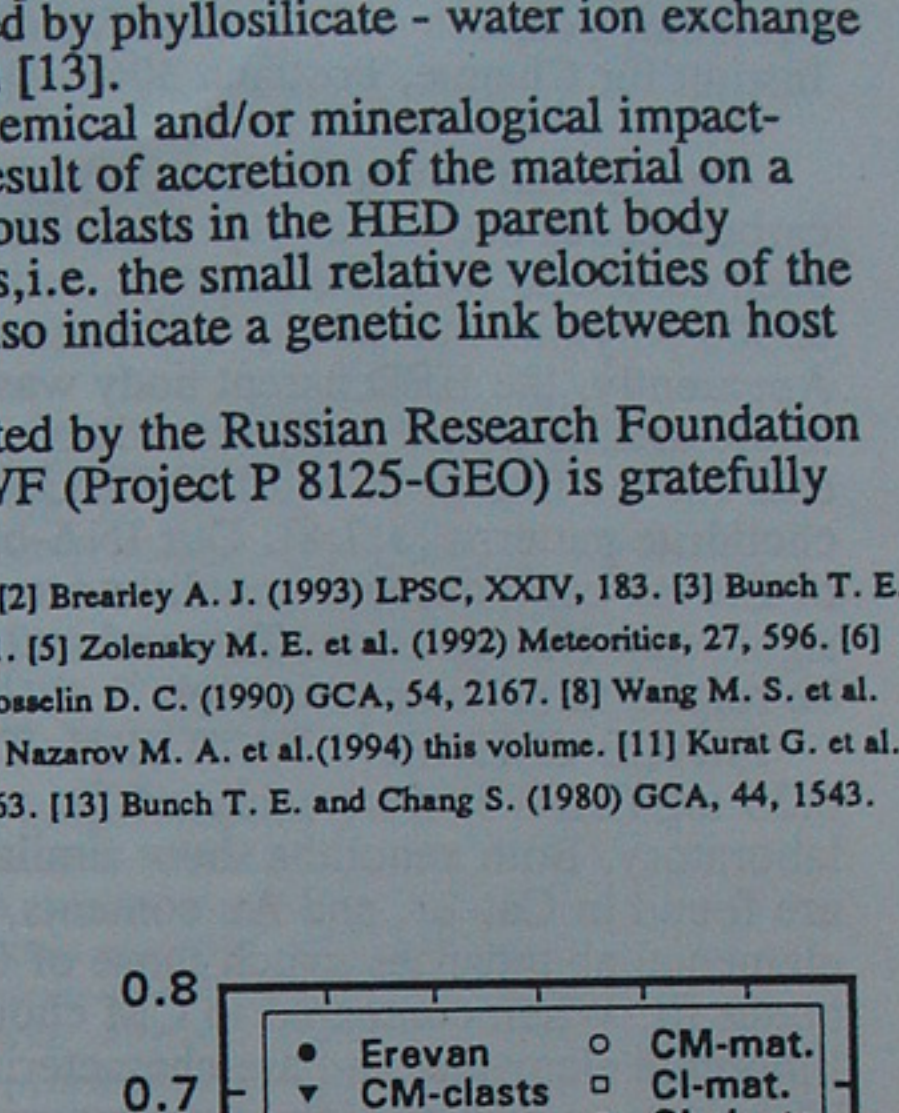

Figure 2

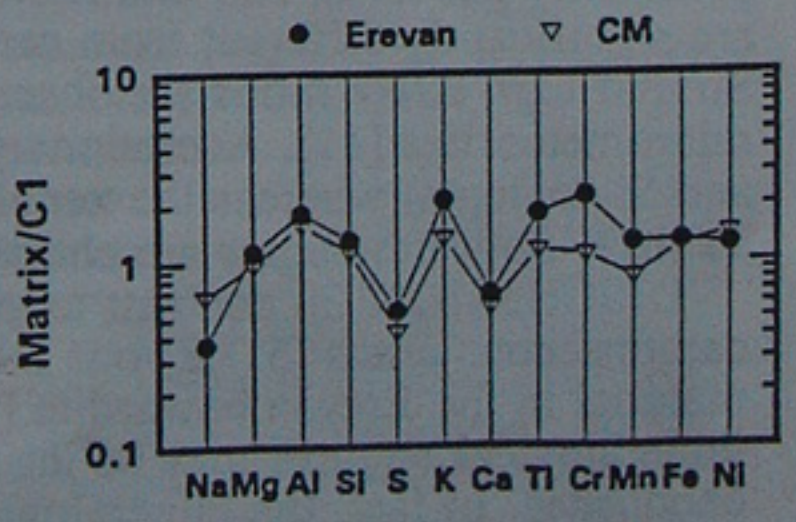

Figure 3