THE EREVAN HOWARDITE: PETROLOGY OF GLASSY CLASTS AND MINERAL CHEMISTRY. M.A.Nazarov and A.A.Ariskin. Vernadsky Institute of Geochemistry and Analytical Chemistry, Moscow 117975, Russia.

The Erevan howardite is a polymict regolith breccia [1] containing xenoliths of carbonaceous chondrites [2]. In this work we studied glassy clasts, which could be considered as primary quenched melts, and mineral chemistry of the breccia. The study reveals that the Erevan howardite consists of common rocks of the HED suite. However, unique glassy clasts, which are present some eucritic melts, were identified. The mineral chemistry and the simulation of crystallization of the melts suggest that the compositions of the melts reflect those of some primary lithologies of EPB.

Glassy clasts. At present 3 glassy clasts have been analyzed by the broad-beam technique using the correction procedure [3]. The computer simulation of the crystallization of the melts was carried out by the method [4].

Clast ER-110 (0.3 mm) consists of a glassy material. It has a howardite composition (Table) which is close to the Erevan bulk composition. It suggests that the melt could be of impact origin. The calculated crystallization sequence of the melt is: OL (Fo 84-73); OL (Fo 72-67) + PIG (En 69-65, Wo 2); OL (Fo 66) + PIG (En 65, Wo 2.3) + PL (An 92).

Clast ER-300 (0.2*0.4 mm) is an extremly fine-grained (1-2 um) rock containing feldspar, pyroxene, ilmenite, Fe-sulphide and silica. No clasts are present in the melt. Its composition is completely different from HED compositions (Table, Fig.1). Compared to HEDs this melt is highest in Ti and Fe/Mg. The simulation [4] shows that the melt is co-saturated with feldspar (An 88) and pigeonite (En 52, Wo 11) followed by augite (En 41, Wo 33). These features suggest igneous origin of the melt as a result of a lava eruption.

Clast ER-400 (0.8 cm) contains big (1 mm) pyroxene crystals (En 48, Wo 2.5) enveloped by a basalt melt which consists of low-Ca pyroxene (En 42-46, Wo 5-8), high-Ca pyroxene (En 40, Wo 38) and feldspar (An 88-95) with minor ilmenite, Fe-sulphide and silica in a cotectic fine-grained (2-3 mm) texture. This melt has also a unique composition (Table). It is higher in Mg/(Mg+Fe) relative to noncumulate eucrites and it is higher in Ti as compared to cumulate eucrites (Fig.1). This is only the Pomozdino eucrite [5] which is close to the melt ER-400 in the composition (Table, Fig.1). According to the simulation [4] the ER-400 melt is co-saturated with olivine (Fo 71), plagioclase (An 91.5) and pigeonite (En 68, Wo 6), i.e. the composition is near to a peritectic involving these phases. The big pyroxene crystals are not equilibrated with the melt and, hence, they cannot be considered as phenocrysts. The unusual and peritectic composition of ER-400 suggests the melt to be a primary quenched liquid. If it is so then the pyroxene crystals are present a trapped material. However if the melt is of impact origin, these crystals should be considered to be a relic component of a source rock.

Mineral chemistry. Primary pyroxenes in Erevan are represented by both pigeonite and orthopyroxene. Pigeonite grains exhibit often microscopic exsolution but there are also grains without exsolution lamellae. It means that Erevan contains components of diogenites, unequilibrated (noncumulate) and equilibrated (cumulate) eucrites. Compositions of pyroxenes show some clustering (Fig.2). The Fe-rich pyroxenes (FM=Fe/(Fe+Mg)=60-62%) are typical for equilibrated eucrites. The pyroxenes with FM 44-46% could be related to the ER-300 melt. Diogenites could be a source for the pyroxenes with FM 26-28% but the same FM is a characteristic of pyroxenes which could be crystallized from the ER-110, ER-400 and Pomozdino melts. The Mg-rich pyroxenes (FM=14-16%) described also in Kapoeta and some diogenites [6,7] cannot be formed from common eucritic melts. Their source rocks are unknown.

Feldspar compositions are very variable. They range from An 72 to An 98 with the majority of analyses at An 96-97 and An 88-89 (Fig.3). However one feldspar grain showed a Na-rich composition of An 44, Or3 which has never been reported in HEDs. On the other hand, Erevan contains more calcic lagioclase (up to An 98) than other HEDs. The plagioclases of An 88 could be derived from the melt ER-300. The compositions of An 91-92 may be related to ER-110, ER-400 or other eucrites whereas source rocks of more calcic feldspars are unknown.

Olivine is a minor component of the Erevan matrix. Three groups of olivine compositions were identified (Fig.4). The olivines of Fa 30-36 could be derived from common eucritic melts which have a liquidus olivine of the same composition [6]. The Er-400 and Pomozdino melts could produce the olivines with Fa 24-28. The Mg-rich olivines (Fa 12-16) match to a liquidus olivine of the ER-110 melt.

There are Ni-poor and Ni-rich metal grains in the breccia. The Ni-poor grains are most abundant. Some of them are enriched in Co (up to 2%). The Ni-rich grains are rare and contain 6-7% of Ni and .4-.5% of Co. These grains can present a foreign material but it is also possible that they are from EPB rocks [6].

Discussion. The Erevan breccia is composed mainly of common rocks of the HED suite and contains unique glassy clasts which are present some eucritic melts. From the textural and compositional characteristics the ER-300 melt only can be considered to be of igneous origin. However mineral compositions observed in the breccia can be related to all of the melts. Thus if even all of the melts are of impact origin, the compositions of the melts reflect those of some primary lithologies of EPB. Constraints on relations between the lithologies can be obtained from the simulation of the crystallization of the melts. Some results of the simulation of equilibrium crystallization of the ER-110, ER-300, ER-400 and Pomozdino melts are shown on Fig.1. The simulation shows that the ER-300 and ER-400 melts cannot be formed by fractional or equilibrium crystallization of the ER-110 melt. However the main group of eucrites could be derived by partial melting from a source of

THE EREVAN HOWARDITE
Nazarov, M.A. and Ariskin, A.A.

the ER-110 composition. The source could be resulted from partial melting of a silicate part of H chondrites. Therefore, at least two-stage melting should be suggested to produce the main group of eucrites from the H chondritic material. Pomozdino and the ER-400 rock can be cumulates from the ER-300 melt or melts of the Stannern group. Alternatively, Pomozdino and ER-400 could be due to a partial melting of a source enriched in Ti and Mg/Fe as compared to a source of eucrites. The ER-300 melt cannot be related to the main group of eucrites. It should be formed by a partial melting of Pomozdino or the ER-400 rock (Fig.1) or another source which must be higher in Ti and Fe/Mg than a source of eucrites. These relations suggest great heterogeneity in the mantle of EPB.

References: [1] L.Kvasha et al. (1978) Meteoritika, 37, p.80 (in Russian); [2] M.A.Nazarov et al. (1993) This volume; [3] M.A.Nazarov et al. (1982) LPSC XIII, p.582; [4] M.Frenkel and A.Ariskin (1984) Geochimiya, 10, p.1419 (in Russian); [5] P.H.Warren et al. (1990) PLSC XX, p.281; [6] E.Stolper (1977) GCA, 41, p.582; [7] R.O.Sack et al. (1991) GCA, 55, p.1111.

Table. Bulk Composition of Erevan glassy clasts

Sample	SiO2	TiO2	Al2O3	Cr2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	FeS
ER-110	51.57	.23	5.52	.69	18.19	.56	18.26	4.75	.22	-	.02	-
ER-300	48.44	2.07	9.95	.26	21.78	.67	4.50	10.96	.41	.04	.17	.75
ER-400	49.25	.99	13.55	.16	15.73	.45	7.66	10.79	.34	.01	.17	.89
Erevan	49.81	.28	8.55	.45	15.76	.33	17.25	6.97	.27	.02	.14	-
Pomozdino	50.11	1.03	11.34	.59	17.59	.56	8.79	9.32	.59	.07	-	-