TEXTURAL AND CHEMICAL ANALYSES OF CRYSTALLINE MELT BRECCIA CLASTS IN HOWARDITES AND POLYMICT EUCRITES R. Ostertag, Institut für Mineralogie, Universität Münster, 4400 Münster, FRG

Clasts of impact melt breccias are volumetrically minor components of polymict fragmental achondrite breccias such as howardites and polymict eucrites (1,2). Analyses of glassy or crystalline melt rocks and "dark matrix breccias" are available only for a restricted number of achondrites (e.g. 2,3,4). A survey of thin sections of Bialystok, Binda, Luotolax, Petersburg, Yurtuk, and Zmenj which were classified as polymict eucrites or howardites (5) showed that clasts of crystalline impact melt breccias are present in all of these meteorites. Textural and chemical characteristics of some of the clasts have been analyzed.

Figure 1 is a sketch map of a 3 mm clast in Zmenj. Shock-melting of plagioclase and silica resulted in a clear transparent melt which crystallized in fibrillar and spherulitic textures. Severely shocked orthopyroxene and clinopyroxene clasts with a distinct amber color are embedded in the clear crystallized melt. The edges of these mafic mineral clasts have been melted and a dark brownish pyroxene-rich melt extents as schlieren into the plagioclase-silica melt illustrating a flow texture. SEM pictures show that tiny opaques ($< 1\ \mu m$) cause the dark color of the pyroxene-rich melt in transmitted light. The chemical composition of the melt is rather heterogeneous. The pyroxene melt did not mix to a major extent with the plagioclase-silica melt the larger volume of which is of pure plagioclase composition (An 79-90). There is, however, even a melt bleb of pure silica composition. The heterogeneity of the melt implies that only small melt volumes formed locally which crystallized rapidly before homogenization was achieved. The source materials of this melt breccia (plagioclase, silica, orthopyroxene, clinopyroxene, Fe-Ni particles, chromite, ilmenite, and troilite) are all present in the host meteorite. A small-scale impact event in a porous fragmental breccia layer of the same modal and chemical composition as the Zmenj howardite matrix evidently produced this melt breccia.

A roundish breccia clast about 2 mm in diameter in the Yurtuk howardite consists of pyroxene fragments of seriate grain size, two large anorthite fragments, and a eucritic basalt clast embedded in a crystallized melt of intergranular to micropoikilitic texture of pyroxene and plagioclase. The mean grain size of the matrix is of the order of 10 µm. Again finely disseminated tiny opaques result in a brownish color of the crystalline melt matrix. The two large anorthite grains (0.5-1 mm) and one eucritic basalt clast show evidence of shock and recrystallization. One anorthite fragment has a granoblastic recrystallization texture in its central part while a 300 µm thick rim at the boundary to the melt crystallized in a fibrillar texture. This anorthite is very homogeneous in composition (An 94) and resembles in size and composition the anorthite grains in Binda. The recrystallization of the clasts and the more homogeneous chemical composition of the melt indicate that a somewhat larger melt volume was involved which allowed for better mixing of the melt and longer annealing times for the clasts as compared to the Zmenj melt breccia. Anorthite grains of the size as observed in the melt breccia clast were not detected in the Yurtuk clastic matrix. This implies either a heterogeneous distribution of clasts in the fragmental matrix and/or transport of the melt breccia clast from its point of formation to its resting point.

Another type of crystalline melt breccias is characterized by a

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ropoikilitic, sometimes spherulitic texture of pyroxene and plagioclase crystallized in a small grain size (5-10 µm), and pyroxene and plagioclase clasts. These melt breccias have previously been described as "dark matrix breccias" (2,4). Tiny opaques at the boundaries between matrix plagioclase and pyroxene cause the dark appearence of these breccias, texturally and compositionally similar breccias are transparent because less opaques are present. Melt breccias of this type were observed in all of the samples. Their chemical composition is closely related to the bulk composition of their host meteorite. The Binda crystalline melt breccias are mixtures of Binda orthopyroxene and Binda plagioclase (Fig. 2), and they average close to the Binda fusion crust which was taken as the approximate bulk composition of this meteorite. The Petersburg crystalline melt breccias in turn are mixtures of Petersburg orthopyroxene and Petersburg plagioclase, but a contribution of clinopyroxene is necessary to model their composition. They are mixtures of eucritic composition and therefore also resemble closely their host meteorite. The Yurtuk melt breccias are more variable and are compositionally intermediate between Binda and Petersburg. This reflects the polymict nature of Yurtuk and the larger content of orthopyroxene therein as compared to Petersburg.

The melt breccias are products of local melting and not fragments of a large homogeneous melt sheet.The crystalline melt breccias in howardites and polymict eucrites reflect the heterogeneity of their target lithologies and therefore also the heterogeneity of the surface layer on their parent body.

Acknowledgments: Thin sections were provided by the Smithsonian Institution, Washington, D.C. (Dr. B. Mason)- Binda USNM 1757-2; Petersburg USNM 1112-2; Yurtuk USNM 1422-1, and by the Naturhistorisches Museum, Wien, Austria (Dr. G. Kurat)- Bialystok L 4379, L 4380, and Zmenj L 4376, L 4377, L 4378.

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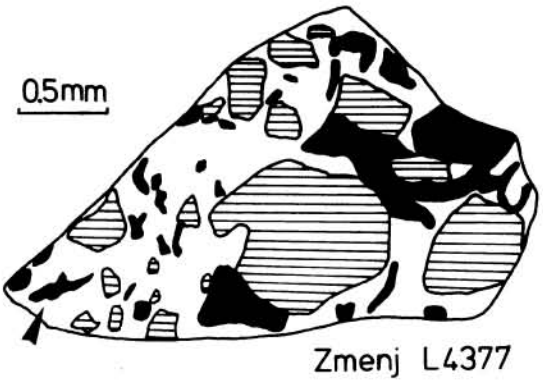

Fig.1: Sketch map of a large melt breccia clast in Zmenj. Black: clear plagioclase melt; arrow: pure SiO_2 melt; white: plag-px melt; striped: pyroxene.

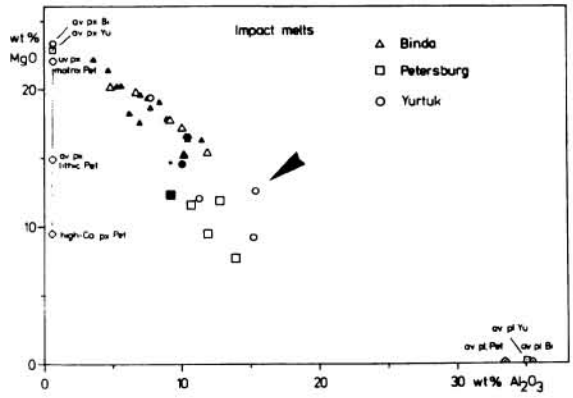

Fig. 2: MgO/Al_2O_3 content of various melt breccias. Open: average values; filled: additional single data; large filled symbols: fusion crust; arrow: large clast in Yurtuk. Microprobe data, defocussed beam analyses.