POIKILITIC AND CUMULATE TEXTURES IN ROCK 77017, A CRUSHED ANORTHOSITIC GABBRO. Rosalind T. Helz and Daniel E. Appleman, U.S. Geological Survey, Washington, D.C. 20244.

Rock 77017 belongs to the group of brecciated anorthositic to gabbroic rocks recognized by the Apollo 17 Preliminary Examination Team (1) as possibly preserving pre-brecciation textures and mineral compositions. They noted the presence of plagioclase-rich areas with apparent cumulate texture, large pyroxene oikocrysts surrounding plagioclase and olivine, and veinlets of later (?) glass. As shown by the PET chemical analysis (1) the rocks is very plagioclase-rich and the bulk normative pyroxene contains approximately 15% Wo. This contrasts with typical Apollo 16 poikilitic rocks which contain 10 to 30% less plagioclase than 77017, coexisting with predominantly low-Wo pyroxene (2,3,4).

Our study is based on petrographic examination of polished thin sections 77017,68; 77017,75; 77017,84; and 77017,87; with microprobe analyses of major phases in sections 68 and 75. The apparent sequence of events in the development of rock 77017 is as follows.

1. Formation of a very plagioclase-rich rock, apparently by a process of crystal accumulation. All sections examined contain areas consisting of a mosaic of equant plagioclase grains with local interestitial olivine. No pyroxene was observed in these areas. The texture of these patches resembles that of terrestrial plagioclase-rich cumulates. Within these patches, plagioclase and olivine are now both mildly shocked.

2. Granulation. The plagioclase-rich rock was then crushed. This granulation was rather variable in its effects, leaving some areas of cumulate texture almost intact.

3. Growth of augite and pigeonite oikocrysts. The oikocrysts include olivine and plagioclase grains, but on pyroxenes. The olivines are rounded and unzoned with limited compositional range (Fo63-60). A typical analysis is given in Col. 6, Table 1. Plagioclase inclusions may be subhedral and equant; rounded; angular fragmental; or metamict. The textural variety of these inclusions indicates clearly that the oikocrysts are secondary. The An content of different grains may be anywhere between 85 to 93 mol %, but individual plagioclase inclusions show little systematic variation in their Ca/Na/K contents. All chadacrysts are slightly enriched in Fe at their margins: FeO content ranges from 0.18-0.31 wt. % in plagioclase chadacryst cores, versus 0.31-0.53 in rims. A typical plagioclase chadacryst analysis is given in Col. 7, Table 1; this is fairly representative of average plagioclase in the rock. Both plagioclase and olivine chadacrysts contain tiny sub-spherical inclusions of each other.

The oikocrysts are zoned from all grain boundaries so that the sequence across any given channel between inclusions is high-low-high Ca for augite oilocrysts and low-high-low Ca for pigeonite, with zoning most extreme where channels are widest. This zoning pattern suggests that each oikocryst grew as a chemically isolated system, which is consistent with their present physical isolation from each other. Nowhere are pigeonite and augite oikocrysts observed in contact. The ranges of pigeonite and augite compositions are shown in Fig. 1, with representative analyses in Table 1, Cols. 1-5.

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Note the very limited Fe/Mg variation. Pigeonite oikocrysts, despite their extensive zoning, appear to be single-phase and monoclinic throughout. No exsolution lamellae were detected in them either optically or by microprobe; X-ray investigation is in progress. In contrast, augite oikocrysts have prominent lamellae of low-Ca pyroxene. Our sections, as well as the bulk analysis (1), indicate that augite oikocrysts are more common than pigeonite.

4. More granulation. In this stage, the oikocrysts themselves were crushed and rolled, with trails of oikocryst pyroxene fragments extending into the more finely granulated portions of the rock. Crushing was accompanied by reheating sufficient to sinter the crushed groundmass. Possibly at this time, veinlets of light brown glass, whose composition is shown in Table 1, Col. 8, were injected into the rock. The origin of this glass is uncertain, but it may have been produced by impact melting.

5. Formation of rounded clasts. Each of these clasts may include all of the materials described above, and their boundaries transect oikocrysts, granulation zones and glass veinlets alike. The clasts are coated with a dark-brown, highly vesicular, TiO_2-rich glass (Col. 9, Table 1). This glass contains ilmenite phenocrysts (Col. 10, Table 1). It appears to be completely unrelated chemically to the rest of rock 77017, and is presumably derived from high-Ti mare basalts, which occur among the Apollo 17 samples. Where this glass transects the older glass veinlets, there is a narrow zone in which Ti has diffused into the veinlet and Al towards the selvedge. There is no evidence for any subsequent heating or deformation.

Based on the observations summarized above, we conclude: 1. The original plagioclase cumulate sequence must have contained intercumulus pyroxenes as well as the preserved intercumulus olivine. These pyroxenes, from which the present generation of oikocrysts developed, had a limited Fe/Mg range, but there must have been extreme local variations in Wo from layer to layer in the sequence, because the present ratio of pigeonite to augite oikocrysts varies greatly from section to section. 2. Stage 2 above involved sufficient heating to cause local remelting of pyroxene-rich areas within the crushed cumulate. The oikocrysts and possibly the iron-rich rims of the plagioclase chadacrysts crystallized from these isolated pools of melt. They cannot have formed by subsolidus reaction; the zoning patterns observed, and the presence of single-phase pigeonite oikocrysts with the compositional range shown in Fig. 1 virtually require crystallization from a melt (5). 3. There was no mixing with other rock types until the final impact event, which was accompanied by injection of high-Ti glass.

References

(1) LSPET (Apollo 17 Preliminary Examination Team) (1973) Science 182, pp 659-672. (2) ALBEE, A. L. et al. (1973) in Proc. Fourth Lunar Sci. Conf., Geochim. Cosmochim. Acta Suppl. 4, Vol. 1, pp 569-595. (3) BENCE, A. E. et al. (1973), ibid, pp 597-611. (4) SIMONDS, C. H. et al. (1973), ibid, pp 613-632. (5) HUEBNER, J. S. and ROSS, M. (1972) in Lunar Science-III, pp 410-412.

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Table 1

	1 Pigeonite low-Ca	2 Pigeonite medium-Ca	3 Pigeonite high-Ca	4 Augite average	5 Augite high-Ca	6 Olivine	7 Plagioclase	8 Glass veinlet	9 Glass rim	10 Ilmenite
SiO_2	51.84	51.20	50.35	50.26	49.15	36.12	45.66	43.17	42.82	.00
TiO_2	.73	.77	.85	1.19	1.27	.09	.00	2.31	6.01	52.39
Al_2O_3	.86	1.25	1.47	2.08	2.27	.06	34.76	23.11	13.67	.29
Cr_2O_3	.42	.42	.45	.70	n.d.	.10	.04	.26	.45	.97
FeO	22.39	19.20	16.26	12.44	9.92	33.38	.29	9.02	14.91	42.77
MnO	.27	.27	.28	.12	n.d.	.33	.00	.12	.19	.51
MgO	22.12	21.37	18.79	16.66	15.56	29.88	.05	7.77	9.29	2.59
CaO	2.39	5.52	9.79	15.89	20.68	.16	18.08	13.96	12.29	.34
Na_2O	.03	.03	.02	.81	.86	.00	.57	.37	.41	n.d.
K_2O	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	.25	.20	.22	n.d.
P_2O_5	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	.07	.09	n.d.
Sum	101.08	100.03	98.26	100.15	99.71	100.12	99.70	100.36	100.35	99.86

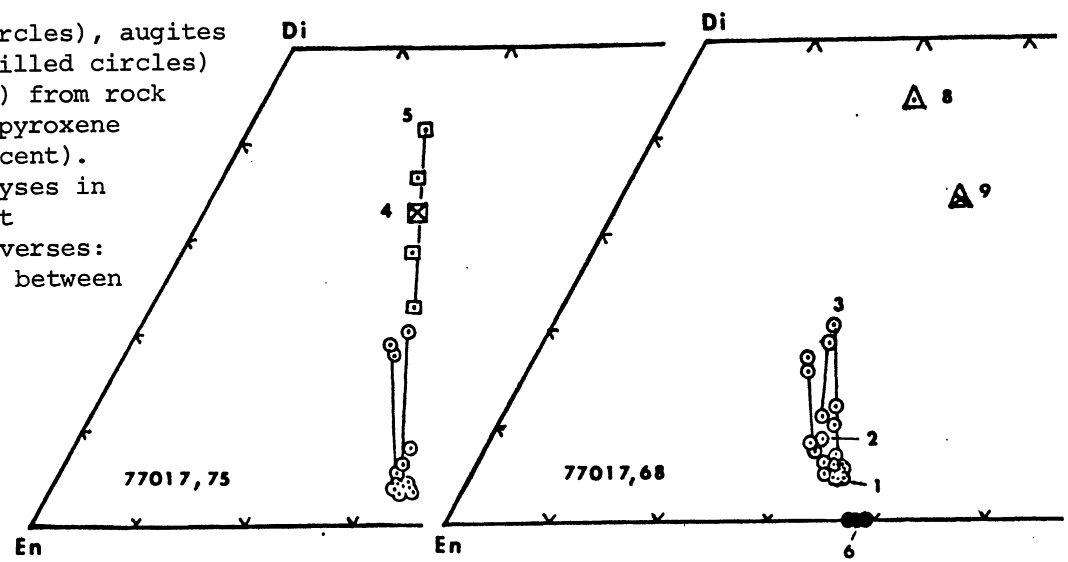

Fig. 1. Pigeonites (open circles), augites (squares), olivines (filled circles) and glasses (triangles) from rock 77017, plotted on the pyroxene quadrilateral (mol percent). Numbered points = analyses in Table 1. Lines connect adjacent points in traverses: they are not tie lines between two different phases.

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