

LUNAR PLAGIOCLASE: ANOMALOUS COMPOSITION REFLECTS MAGMA COMPOSITION;

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The anomalous composition of lunar plagioclases (1) is not due to the selective volatilization of alkalis under vacuum. Separated terrestrial plagioclase heated for one week at 1000°C in vacuo (10^{-7} torr) showed no change in composition (fig 1). The relatively high albite content and complete exposure of the plagioclase surface to the vacuum would be more favourable to alkali volatilization than is the case with lunar plagioclase.

Phenocryst and groundmass plagioclases in terrestrial basalts exhibit no anomalies in composition (fig 2), (the plagioclase compositions are illustrated by the same method as Wiell *et al* (2)). The composition of plagioclases in most individual lunar rocks varies from normal at 95% anorthite to extremely anomalous (fig 3 and 4). The extent of departure from normality is directly proportional to the albite content of the plagioclase. All the plagioclases in rocks 14310 have normal compositions irrespective of their albite content (fig 5).

The anomalous composition of the lunar plagioclases is not obviously correlated with the cooling rate, as defined by the textures of the rocks (4) and is not entirely a disequilibrium feature because it persists unchanged (figs 3, 4 and 5) even in plagioclase totally reequilibrated in experiments and then rapidly quenched (although total Fe + Mg does increase (fig 6)).

The dominant factor which gives rise to the anomalous composition of lunar plagioclase appears to be the composition of the liquid from which the plagioclase crystallized.

The departure from ideal composition is greatest for those plagioclase which have crystallized from the melts poorest in normative feldspar.

In the case of Apollo 12 samples the similarity of these liquids regardless of whole rock chemistry has been illustrated (3) and as shown in fig 4 their plagioclases show similar departures from ideality for similar albite contents.

As indicated in fig 3 a similar correlation exists for the Apollo 11 samples where the liquids are more titanium-rich than those of Apollo 12 (3). The anomalous composition of the lunar plagioclases probably reflects the structural groups and hence the activities of the ions, in particular Al^{3+} , in the co-existing melt. The influence of sodium and/or water may be critical in this respect and it is probable that their higher concentration in terrestrial melts is responsible for the ideal compositions of terrestrial plagioclases.

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LUNAR PLAGIOCLASE

Storey, W.C. et al.

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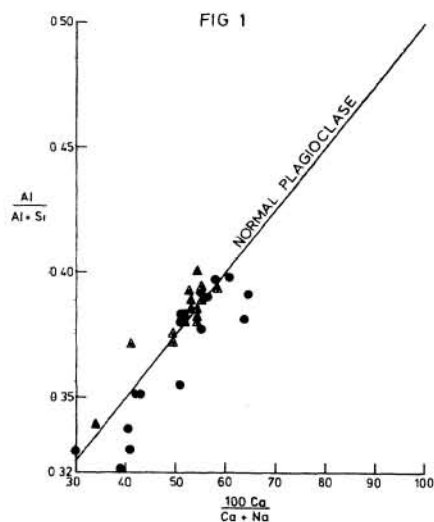


Fig 1. Effect of heating plagioclase in vacuo on composition Δ original \bullet after heating at 1000°C, 10^{-7} torr for one week.

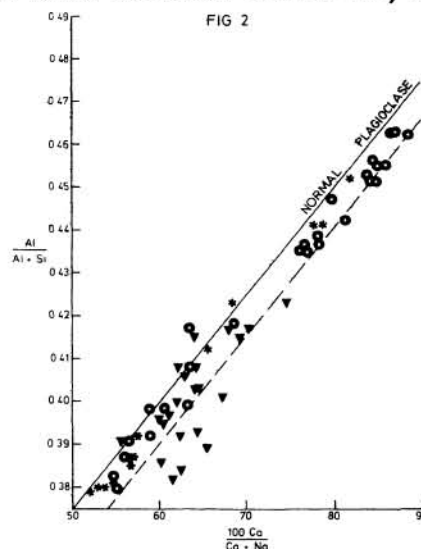


Fig 2. Terrestrial plagioclase compositions from \bullet Reunion \bullet Aden (5) and \blacktriangle Hawaiian basalts (16), ground-mass plagioclase

LUNAR PLAGIOCLASE

Storey, W.C. et al.

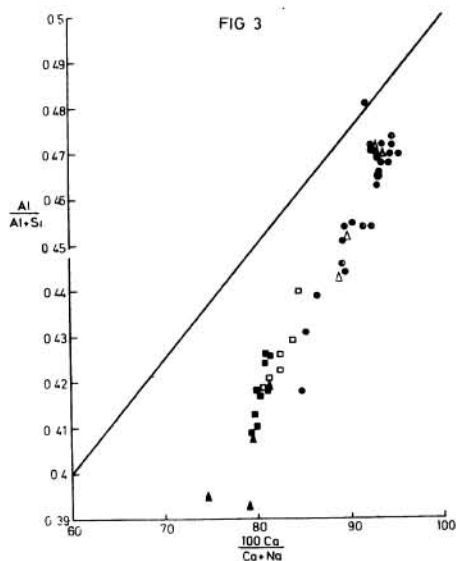


Fig 3. Apollo 11 plagioclase compositions ■ 10017, □ 10017 heated at 1108°C for 17 hrs in Mo $f_{O_2} \approx -13$, ▲ 10045 (6) (7), △ 10022 (8) (9), ● 10019 (10), ○ 10021 (10).

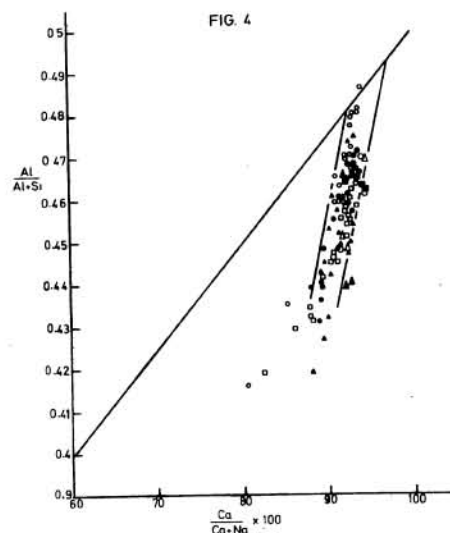


Fig 4. Apollo 12 plagioclase compositions ○ 12040, □ 12040 (11), ■ 12040 heated at 1149°C for 5 hrs in Mo $f_{O_2} \approx -12.5$, ▲ 12018 (11), ● 12051 (11), □ 12051, ▲ 12020. The compositions of plagioclase in 12021(11), 12004(11), 12063(12) and 12039(13) also plot within the area bounded by the solid lines

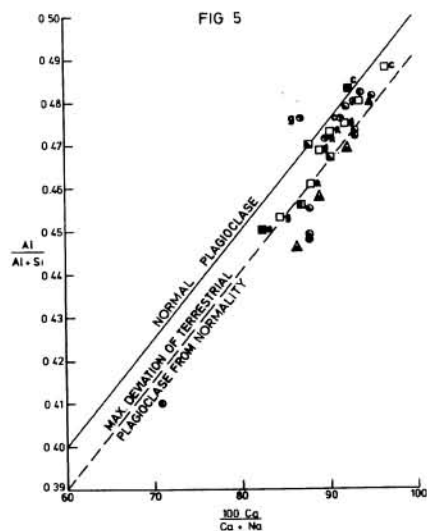


Fig 5. Plagioclase compositions in rock 14310 ● experimental (14) ▲ experimental (15), □, ○, ■, ▤, ▥, analysis published in Proc 3rd Lunar Sci Conf, Vol 1, pp 597, 136, 354, 223, 263 and 201 respectively; c=core, R=rims, g= groundmass.

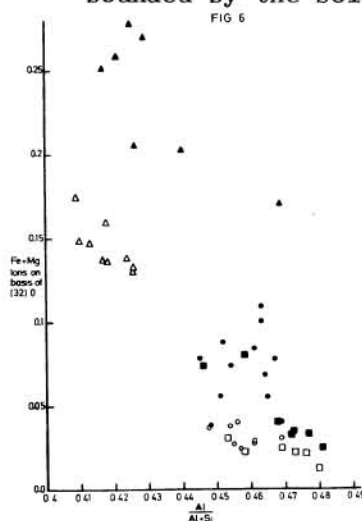


Fig 6. Fe+Mg contents of original and experimental plagioclase △ 10017(orig) ▲ 10017(exp) (for conditions see fig 3) ○ 12040 (orig) ● 12040 (exp) (for conditions see fig 4) □ 14310 (orig) ■ 14310 (exp) (14) (15)