

IMPACT FEATURES AND PRODUCTS IN THE APOLLO XI AND XII SAMPLES

by

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Abstract: The differences in bulk composition between Apollo XI and XII crystalline rocks, e.g. higher Fe, Mg and lower Ti in the XII basalts, are reflected mostly in different proportions of the main mineral phases. The composition of the individual minerals as indicated by electron probe and ion probe analysis, however, are very similar except for a few trace elements.

Although the Apollo XII "fines" and breccias are not simply ground up basaltic material, the relatively low Ti and high Fe content (as compared to Apollo XI) indicate that a substantial part is derived from the local basalts. Analysis of a large number of glass particles indicate three general groups, although there are overlaps. A high iron, low aluminum ($\sim 11-19\%$ Fe, $< 7\%$ Al) and a high aluminum, low iron ($\sim 13\%$ Al, $\sim 5\%$ Fe) type may be derived by local impact from various proportions of the main minerals of the basalts, and consequently resemble Apollo XI glasses although mostly lower in Ti and somewhat higher in Mg, Fe and Al on the average. The third group with intermediate iron content has higher contents of silicon and alkalis ($\sim 0.7\%$ Na, $0.2-0.5\%$ K), and may be the product of a mixture of basaltic material with material similar to rock 12013. Trace element analyses in progress seem to support this hypothesis. Glasses in breccia fragments from the "coarse fines" show little variation with varying density, degree of welding and abundance of shock features. Generally they resemble the "group 3" glasses with relatively high alkali and silica. Although some constituents of the breccias are clearly derived by impact, the lithification is apparently mostly due to welding of hot particles and partly plastic, probably relatively silica (and alkali) rich material serving as a glassy cement. The heating and lithification process was rapid and caused little chemical differentiation, analogous to the formation of ignimbritic rocks.

As the Apollo XI "fines" contained a great variety of rock fragments, some even similar to Apollo XII basalts, so do the Apollo XII "fines". Several of these fragments, some of which are impact products are described. One severely shocked basalt fragment shows shock veins and brecciation exactly similar to those observed in most stony meteorites. Another fragment resembles parts of rock 12013 also in having two coexisting phosphates (one with $\sim 12\%$ RE) and zircon. Ion probe determinations of trace elements in individual phases are presented as well as attempts to date individual grains.

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