

Abstract

LEAD ISOTOPES AND VOLATILE TRANSFER IN THE LUNAR SOIL

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The high-temperature volatility of lead isotopes in Apollo 11 and 12 lunar fines has been investigated as a means of indicating the nature and chronology of geochemical fractionations in the moon, and in particular of evaluating the role of volatile transfer in lunar processes. In stepwise heating at temperatures from 700 to 1100 °C in vacuo the volatiles were collected either together or separately, and the amount and isotopic composition of the lead in each condensate were determined by mass spectrometry. Distinct differences were observed between Apollo 11 and Apollo 12 fines (Nos. 10084 and 12070, respectively). In the latter case comparable amounts of well-defined labile and refractory components were present, whereas in the former the refractory lead and total lead were less abundant. In both cases the labile lead contains most of the Pb^{204} and has Pb^{207}/Pb^{206} ratios indicating an "old" character, whereas the refractory component is highly radiogenic and relatively "young". The single-stage-model apparent ages of the total lead, 4.67 Gy for Apollo 11 and 4.50 Gy for Apollo 12, differ mainly because of the differing relative proportions of the "old" and "young" components, and neither is a true age of the moon or of its regolith. The Apollo 12 data have been fitted by a three-component two-stage model, the labile component being regarded as a mixture of low- μ lead which was enriched in the regolith by volatile transfer and of exogenous lead from meteoritic and cometary infall. The indicated

time of the postulated major fractionation was 4.3 Gy ago. The observations and the fit to the model support the suggestion of Silver (1970) that volatile transfer of certain elements is an important continuing lunar process, but not necessarily involving "parentless" lead. Alternate interpretations of Silver's data on Apollo 11 fines, which do not require the assumption of an age of the moon appreciably greater than of the meteorites and the earth, are presented.

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