

LETTER

Determination of planetary basalt parentage: A simple technique using the electron microprobe

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ABSTRACT

Many basaltic meteorites are being discovered in old and new meteorite suites including those from cold- deserts (e.g., Antarctica) and hot-desert environments. It is important to establish the specific planetary body source. Proven techniques for establishing planetary parentage include stable-isotopic signatures (especially oxygen), certain elemental ratios in bulk samples, and certain elemental ratios in specific minerals. Some of these techniques are expensive, require considerable sample preparation, and are adversely affected by weathering processes on the parent body or on Earth. We have been seeking key major and minor elemental ratios (in pyroxene, olivine, and feldspar) that can be measured by the electron microprobe on standard thin sections. These ratios may be preserved in unweathered portions of mineral grains and thus “see through” weathering processes. In addition, if the sample is too small to provide a representative bulk composition, it may still have key information recorded in individual minerals. We have found that some of the most useful chemical parameters are Fe/Mn (atomic) in olivine or pyroxene and the percent anorthite (%An) in plagioclase solid solutions. A plot of Fe/Mn in pyroxene and/or olivine versus %An defines compositional fields that are significantly different for Earth, Mars, Moon, 4 Vesta, and the angrite parent body. This method may be especially powerful when combined with oxygen isotope data.