American Mineralogist, Volume 89, pages 1617–1624, 2004

The most reduced rock from the moon, Apollo 14 basalt 14053: Its unique features and their origin

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ABSTRACT

The Apollo 14 high-Al basalt, 14053, is the most reduced lunar rock examined to date. Both fayalite in the mesostasis and spinel minerals have been extensively reduced in the exterior of the rock, whereas the interior contains relatively limited reduction. It is shown that these products are the effects of solar-wind hydrogen that was implanted on the exterior of the "normal" 14053 basalt after it originally crystallized and was weathered to become part of the regolith. Subsequent reheating, probably in an impact-ejecta blanket, caused extreme subsolidus hydrogen reduction, particularly of the weathered exterior of this rock. The limited permeability of the rock prevented the entire rock from being subjected to the same degree of reduction. It is proposed that this extreme reduction, especially of the mesostasis, also affected the phosphate minerals, F-Cl apatite and merrillite, each of which vary greatly in REE contents. This effect on the phosphate minerals could relate to the upset Sm-Nd radiogenetic systematics, whereas the Rb-Sr system may have been largely immune to the subsolidus reduction.