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Rare Earth Elements, K/Rb, and Sr Isotope Ratios as Some Additional Clues to the Presence of Chemical Elements in Atmospheric Precipitations in a Continental Interior Location in the U.S.A.

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Samples of rain and snow collected in Manhattan, Kansas for a period of nearly one year were analyzed for their various elemental contents and relative distributions of several elements. The samples had chondrite-normalized REE distribution patterns with an enrichment in the light rare earth elements, having a range of chondrite-normalized La/Yb ratios from 4.5 to 15.3, and the presence of both positive and negative Eu and Ce anomalies of different magnitudes. In a PAAS-normalized representation of the data, the REE distribution patterns are marked invariably by both a positive Eu anomaly and enrichment in the middle rare-earth elements. In addition, most of the samples had a negative Ce anomaly and a few had either positive Ce anomaly or a lack of the anomaly.

The K/Rb ratios of samples ranged from 185 to 2,636. The samples that had K/Rb ratios equivalent to typically silicate-material values (50-650) were either with a positive Ce anomaly or with little or no Ce anomaly in a PAAS-normalized REE distribution pattern. The remaining samples had K/Rb ratios generally much higher than the silicate-material values and had prominent negative Ce anomalies. Only five samples were analyzed for their $^{87}Sr/^{86}Sr$ ratios. Two of these were enriched in radiogenic strontium, relative to materials of marine origin, with the Sr isotopic values of 0.710278 and 0.709529, but the other three, having the Sr isotopic values of 0. 708341, 0.708599 and 0.709167, had strontium isotopic compositions equivalent to that of ma-

terials of marine origin. The two ^{87}Sr enriched samples had relatively much lower Sr contents, and as expected much lower Ca contents, than the other three samples. The collective chemical and isotopic data seem to point out that contribution from direct marine aerosol particle to these atmospheric precipitations is negligible and that significant amounts of the chemical constituents in these atmospheric precipitations appear to be related to combined sources of silicate, phosphate fertilizer, and plant exude related aerosols.