Chapter 19

Lithium, Sodium, Potassium, Rubidium, and Cesium

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GENERAL INTRODUCTION

Properties of the Alkali Metals

The elements in Group IA of the periodic table are known as the alkali metals. These elements have a single electron in their outermost shell. The low ionization potential for the outer electrons and the fact that the resulting cations have noble gas configurations and are thus spherical and of low polarizability result in the chemistry of these elements being essentially that of the single charged cation. These elements are more electronegative than H and occur solely as monovalent cations in nature. The chemistry of the elements is predominantly ionic, but a slight degree of covalent bonding occurs in bonds to O, N and C in various chelate and organometallic compounds. The tendency to covalence is greatest with Li and least with Cs, which is expected from their charge/radius ratios. Most compounds of these elements are soluble in water except some silicates and a few salts with large anions.

One isotope of potassium $^{40}\text{K}$ ($\beta^-$, $1.6 \times 10^9$ yr, 0.0119\% abundance) is radioactive. Rubidium also is naturally radioactive owing to $^{87}\text{Rb}$ ($\beta^-$, $6 \times 10^{10}$ yr, 27.2\% abundance). Both of these isotopes can be used in age determinations of rocks and minerals. Francium is not included in this chapter because all of its isotopes are radioactive with short half-lives. Francium occurs only as an ultratrace element in soils as a decay product of $^{227}\text{Ac}$.

The relative concentration of the alkali elements in soils reflect their relative cosmic concentrations, which in turn are controlled by the nuclear properties of the isotopes of the respective elements. The concentrations of Na and K can range up to several percentage points in soils while those of Li, Rb, and Cs rarely exceed several hundred micrograms per gram. The adsorption and ion exchange behavior of the alkali elements in soils and other exchange media is a strong func-