to the surface as a bidentate species with two Fe atoms 3.38 nm from the selenium atom. Selenate had no Fe atom in the second coordination shell of Se, which indicated that its hydration sphere was retained on adsorption.

Most other anions such as molybdate, arsenate, arsenite, phosphate, and silicate appear to be strongly adsorbed as inner-sphere complexes, and adsorption occurs through a ligand exchange mechanism. The adsorption maximum is often insensitive to ionic strength changes. Adsorption of anions via ligand exchange results in a shift in the pzc (discussed below) of the oxide to a more acid value.

POINTS OF ZERO CHARGE

Definition of Terms

One of the most useful and meaningful chemical parameters that can be determined for a soil or soil component is a point of zero charge, which is abbreviated to pzc to denote a general point of zero charge. The pzc can be defined as the suspension pH at which a surface has a net charge of zero (Parks, 1967). If the measured pH of a colloid is lower than the pzc, the surface is net positively charged; if the pH > pzc, the surface is net negatively charged.

Soil components have a wide range of pzc values (Table 5.5). Oxides (Fe– and Al–) have high pzc values, while silica and SOM have low pzc values. The

TABLE 5.5. Point of Zero Charge (pzc) of Minerals[a,b]

Material	pzc
α-Al_2O_3	9.1
α-$Al(OH)_3$	5.0
γ-AlOOH	8.2
CuO	9.5
Fe_3O_4	6.5
α-FeOOH	7.8
α-Fe_2O_3	6.7
"$Fe(OH)_3$" (amorphous)	8.5
MgO	12.4
δ-MnO_2	2.8
β-MnO_2	7.2
SiO_2	2.0
$ZrSiO_4$	5.0
Feldspars	2–2.4
Kaolinite	4.6
Montmorillonite	2.5
Albite	2.0
Chrysotile	> 10

[a] The values are from different investigators who have used different methods and thus are not necessarily comparable.

[b] From Stumm, W., and Morgan, J. J. (1981), "Aquatic Chemistry." Copyright © 1981 John Wiley & Sons, Inc. Reprinted by permission of John Wiley & Sons, Inc.