

## Appendix 1

### DEFINITIONS AND REFERENCES FOR AQUEOUS GEOCHEMISTRY

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- Acid: a substance containing hydrogen that gives free hydrogen ions (H<sup>+</sup>) when dissolved in water; e.g., hydrochloric acid (HCl), nitric acid (HNO<sub>3</sub>). Strong acids release a greater proportion of their protons than weak acids.
- Acidity: the base neutralizing capacity of an aqueous system or the capacity to donate protons. Usually determined by titration with a standardized base to a reference pH.
- Alkalinity: the acid neutralizing capacity (ANC) of an aqueous system or the capacity to accept protons. Usually determined by titration with a standardized acid to a reference pH.
- Adsorption: the attachment of dissolved substances (e.g., ions) to solid surfaces.
- Aqueous geochemistry: the study of chemical reactions occurring between water and rocks.
- Base: a substance containing a hydroxyl group (-OH) that yields hydroxyl ions (OH<sup>-</sup>) when dissolved in water; e.g., potassium hydroxide (KOH), sodium hydroxide (NaOH).
- Compounds: substances that are composed of two or more elements in the same proportions, e.g., calcium carbonate (CaCO<sub>3</sub>) or pyrite (FeS<sub>2</sub>).
- Dissolution of minerals: the act or process of separating into component parts, e.g., dissolution of salt (sodium chloride; NaCl) by water forming dissolved sodium ions (Na<sup>+</sup>) and chloride ions (Cl<sup>-</sup>).
- Elements: substances that are composed of atoms that exhibit unique and identical properties, e.g., Fe, Zn, or Cu; see the attached periodic table of elements.
- Equilibrium: time-invariant, most stable state of a system at a given temperature and pressure.
- Hydrolysis: reactions leading to an excess of protons (H<sup>+</sup>) or hydroxyl ions (OH<sup>-</sup>) in solution; e.g., hydrolysis of ferric Fe (Fe<sup>3+</sup>) where  $Fe^{3+} + 2H_2O \leftrightarrow Fe(OH)_2^+ + 2H^+$ .
- Ion: an atom or group of atoms that carries a negative or positive charge as a result of having gained or lost one or more electron. Positive ions are called cations and negative ions are called anions.
- Kinetics: rates of change in a physical or chemical system.
- Neutralization: reactions between acid and bases that result in neither acidic nor basic conditions.
- Oxidation half-reactions: reactions that involve the loss of electrons from an atom or atoms.
- pH: the negative, base-10 logarithm of the hydrogen ion activity [ $pH = -\log(H^+)$ ]; pH values of most natural waters lie between 4 and 9 (e.g.,  $pH_{seawater} = 8.1-8.3$ ). The lowest observed pH values, including negative values, are found in systems where pyrite is being oxidized.
- Precipitation of minerals: reactions where dissolved ions combine to form insoluble solids.
- Reduction half reactions: reactions that involve the gain of electrons by an atom or atoms.
- Reduction-oxidation (redox) reactions: reactions that involve both oxidizing agents (a substance that accepts electrons) and reducing agents (a substance that donates electrons).

#### REFERENCE BOOKS

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