

Calcite and gypsum solubility products in water-saturated salt-affected soil samples at 25°C and at least up to 14 dS m⁻¹

F. VISCONTI^a, J. M. DE PAZ^b & J. L. RUBIO^a

^aCentro de Investigaciones sobre Desertificación-CIDE (CSIC-UVEG-GV), Dpto. Degradación y Conservación de Suelos, Camí de la Marjal s/n, 46470 Albal, València, Spain, and ^bInstituto Valenciano de Investigaciones Agrarias-IVIA (GV), Dpto. Recursos Naturales, Crta. Moncada-Náquera Km 4.5, 46113 Moncada, València, Spain

Summary

Calcite and gypsum are salts of major ions characterized by poor solubility compared with other salts that may precipitate in soils. Knowledge of calcite and gypsum solubility products in water-saturated soil samples substantially contributes to a better assessment of processes involved in soil salinity. The new SALSOL-CHEMIS code for chemical equilibrium assessment was parameterized with published analytical data for aqueous synthetic calcite and gypsum-saturated solutions. Once parameterized, SALSOLCHEMIS was applied to calculations of the ionic activity products of calcium carbonate and calcium sulphate in 133 water-saturated soil samples from an irrigated salt-affected agricultural area in a semi-arid Mediterranean climate. During parameterization, sufficiently constant values for the ionic activity products of calcium carbonate and calcium sulphate were obtained only when the following were used in SALSOLCHEMIS: (i) the equations of Sposito & Traina for the free ion activity coefficient calculation, (ii) the assumption of the non-existence of the $\text{Ca}(\text{HCO}_3)^+$ and CaCO_3^0 ion pairs and (iii) a paradigm of total ion activity coefficients. The value of 4.62 can be assumed to be a reliable gypsum solubility product (pK_s) in simple aqueous and soil solutions, while a value of 8.43 can only be assumed as a reliable calcite solubility product (pK_s) in simple aqueous solutions. The saturated pastes and saturation extracts were found to be calcite over-saturated, with the former significantly being less so ($pIAP = 8.29$) than the latter ($pIAP = 8.22$). The calcite over-saturation of saturated pastes increased with the soil organic matter content. Nevertheless, the inhibition of calcite precipitation is caused by the soluble organic matter from a dissolved organic carbon threshold value that lies between 7 and 12 mM. The hypothesis of thermodynamic equilibrium is more adequate for the saturated pastes than for the saturation extracts.