

# **Physiochemical Behavior of Carbonate Minerals in Soils, Sediments and Water of Tidal Flats, Northern West part of Arabian Gulf and Shatt Al-Arab River**

**D. K. Al-Kazaeh<sup>\*</sup>, K.M. Awad<sup>\*\*</sup> and B. N. Albadran<sup>\*\*\*</sup>**

<sup>\*</sup>Marine Science Centre, Basrah Univ. Iraq.

<sup>\*\*</sup>Soil and water science department, College of Agriculture, Basrah Univ. Iraq.

<sup>\*\*\*</sup>Geology Department, College of science, Basrah Univ. Iraq.  
(*E-mail: badir5759@yahoo.com*).

## **Summary**

Several thermodynamic parameters are used in order to estimate the chemical composition and determine the solubility and stability of various carbonate minerals that could be found in soils, sediment and water of the tidal flat of northern-west part of the Arabian Gulf and Shatt Al-Arab water way, through different equilibrium experiments, and X-Ray diffraction studies. It was found that all collected samples have highly carbonate content and it was ranged between 116 to 440 gm.Kg<sup>-1</sup> soil with mean value of 267.31 gm.Kg<sup>-1</sup> soil in all marine location and ranged between 177.5 to 506 gm.Kg<sup>-1</sup> soil with mean value of 284.25 gm.Kg<sup>-1</sup> soil with alluvial location. Active carbonate content in all samples were taken a similar trend. Data of X-Ray diffraction was used to detect carbonate crystalline minerals in all the studied samples. Results indicate that the crystalline calcite is present in high content and ranged from 38% to 70% with the mean value of 57% from the total carbonate minerals content. The crystalline dolomite is also detected and ranged from 5 to 11% with the mean value of 7.8% from the total carbonate minerals content. In addition, the studied samples are also contained Mg-calcite with various amount of Mg-containing calcite. This means, the calcite formation in geochemical environment was more rapid than that of dolomite. Aragonite and magnesium carbonate are not detected in all samples.

Results of thermodynamic parameters showed the following statements:-

1- The calculated values of ionic activity products (pIAP) after equilibrium are ranged between 7.69 to 9.28 with mean value of 8.04 in marine soils, sediments solution and between 7.78 to 10.02 with mean value of 8.74 in alluvial soil and sediment solutions, indicating that all the studied

sample solutions are supersaturated with respect of pure calcite mineral and under saturated with respect of hydrated calcium carbonate minerals. Lowering values of ionic activity products than that of solubility products of aragonite does not mean the presence and controlling of this mineral in the equilibrium solutions , but the solutions are saturated with calcite minerals.

2- Results found that the distribution coefficient of magnesium ions in calcite minerals composition was ranged between 0.14 to 14.4% mole  $MgCO_3$  in the marine soils and between 0.28 to 13.4% mole  $MgCO_3$  in the alluvial soils and sediments, suggesting the presences various Mg-bearing calcite minerals.

3- Results found that the value of ionic activity products in all the studied soil and sediments solutions were under saturated with respect to magnesium carbonate minerals. This may be due to the replacement possibility of magnesium ion into calcium sites through precipitation processes and calcite crystal growth.

4-The value of ionic activity product (pIAP) for dolomite mineral was ranged between 15 to 18.28 with mean value of 16.11 in marine soils and sediments and between 15.38 to 20.12 with mean value of 17.18 in alluvial soils and sediments. All these values(except Karmat Ali soil and sediments) were reduced than that of solubility product of pure dolomite, showing the super saturation state for dolomite and the ( $K_{eq}$ )value was more than the standard value that is pointing the calcite- dolomite equilibrium and suggesting the more stability of dolomite mineral in the most samples of the study than calcite mineral.

5-The chemical potential was ranged between 6.14 to 7.64 or between 5.62 to 7.02 in the marine and alluvial soil and sediments , respectively. This means that all solution are super saturated with respect to calcite and aragonite and under saturated with respect to hydrated calcium carbonate. The intermixture of magnesium ion in calcite mineral increased the chemical potential values of calcite .In addition, the chemical potential of dolomite was ranged between 6.07 to 7.74,indicating the samples were super saturated with respect to dolomite mineral that controlling the behavior of calcium and magnesium ion in equilibrium solutions. Solubility diagram data was agreed with these conclusions.

6-Almost values of the calculated free energy of formation for Mg-containing calcite were increased than that of free energy of formation for pure calcite and ranged between -268.19 to -270.04 Kcal. mol<sup>-1</sup> in marine soil and sediments and between -269.31 to -272.68 Kcal.mol<sup>-1</sup> in alluvial soil and sediments. These results indicate that all Mg-containing calcite in the studied soils and sediments are more soluble and less stable than the formed and pure calcite.

7- The calculated results of ionic activity carbonate minerals showed the super saturated state of surface and sub- surface marine and river water in calcite , dolomite and Mg- containing calcite with 0.082-1.11% mole MgCO<sub>3</sub> in marine water and 0.092-1.33% mole MgCO<sub>3</sub> in river water. There is not magnesite formation.

8-Our study is recommended that either Davies& Jones or Reddy & Nancollass may describe the mechanical of carbonate minerals precipitation. It is consisted of suddenly precipitation of calcium carbonate with energy of 41.66 K.J.mol<sup>-1</sup> and the crystal rearrangement to crystal growth formation . precipitation coefficient rate for the first stage is more than the second stage .