

## Nitrate Deposits Origin: A Hypothesis

ARIAS, J., Santiago, Chile

The origin of Chile's continental nitrate deposits ( $19^{\circ}$  to  $26^{\circ}\text{S}$ ), containing mainly  $\text{NaNO}_3$ ,  $\text{KNO}_3$ ,  $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$  and  $\text{I}$ , has been debated since Darwin visited Tarapaca in 1835.

N thermodynamic data indicates  $\text{NO}_3^{-}(\text{aq.})$  and  $\text{NH}_4^{+}(\text{aq.})$  are the compounds most likely to form in aquatic media; these are also the main aqueous species in the N-O-H system Eh-pH stability diagram ( $25^{\circ}\text{C}$ , 1 bar),  $\text{N}_2$  water-solubility favouring N accumulation in algal biomass and therefore,  $\text{NO}_3^{-}$  and  $\text{NH}_4^{+}$  occurrence in sea-water. Algal N concentration is related to the negative gravity anomaly occurring above the 6-9 Km-deep Chile-Peru trench through algal life accumulation due to N, K and P nutrients cycling by a combination of sea-currents and seawater uplift in the reduced gravity field which produces tens of meters sea-surface rising. There, constant generation of collapse waves forms abundant sea-spray, later transported into the continent by dominant SW winds, thus linking algae  $\text{N}_2$  biological uptake with sea-spray dominant  $\text{NH}_4^{+}$  originating in algal-matter decay. Rising of sea-spray above the 2,000m-high Coast Range mountains and into the high solar radiation Atacama desert atmosphere ( $>1,000 \text{ W/m}^2$  at summer-noon in Antofagasta) would cause photo-oxidation of airborne  $\text{NH}_4^{+}$  to  $\text{NO}_3^{-}$ . The concentration of nitrate and associated salts on extremely arid land would occur both through inland marine-fog precipitation and sea-spray droplet desiccation in the hot/dry desert atmosphere followed by gravitational settling of airborne  $\text{NaNO}_3$ ,  $\text{KNO}_3$ ,  $\text{NaCl}$ ,  $\text{Na}_2\text{SO}_4$  and other crystalline solids, the latter process possibly being dominant.