



## **Secondary CaCO<sub>3</sub> accumulation in soils: origin and role in carbon storage.**

**E.P. Verrecchia** (1), O. Braissant (1), G. Cailleau (1), C. Dupraz (1) and M. Aragno (2)

(1) Institut de Géologie, Université de Neuchâtel, CH, (2) Laboratoire de Microbiologie, Université de Neuchâtel, CH (eric.verrecchia@unine.ch / Fax : +41 32 7182601 / Phone : +41 32 7182579)

For the 50 years, calcium carbonate accumulations in soils have been mainly, if not exclusively, thought to be attributed to leaching, whatever the climatic zone. A far-fetched relationship has even been proposed between the rate of CaCO<sub>3</sub> accumulation and rainfall. Often, secondary soil CaCO<sub>3</sub> is incautiously used as a proxy for paleoclimatic reconstructions. In contrast, our extensive observations and laboratory experiments emphasize that secondary CaCO<sub>3</sub> accumulations in soils are most often due to mineral-organic interactions whatever the pedoclimate, making the leaching hypothesis purely speculative. The various processes involved in CaCO<sub>3</sub> sequestration in soils are more complex than the oversimplified sketch of dissolution in upper horizons and reprecipitation in deeper soil layers. First, field and laboratory experiments demonstrated that the soil pCO<sub>2</sub> is higher in the deeper soil than in the surficial horizon: so, how could it be possible to precipitate CaCO<sub>3</sub> in contradiction to the pCO<sub>2</sub> gradient? Second, secondary CaCO<sub>3</sub> accumulations need pore space to precipitate: how could some horizons accumulate about 90 % of calcium carbonate, which is much more than the available pore volume, e.g. in a detritic sand? Third, all secondary CaCO<sub>3</sub> accumulations in soils are related to biotic features (roots, bacteria, and fungi). This point stresses that if *per descensum* transportation of cations in solution is obvious, precipitation of secondary carbonate is mainly enhanced by organic matter. In order to demonstrate the lack of consistency in the leaching-precipitation hypothesis, various types of secondary CaCO<sub>3</sub> features will be presented. These features include diffuse needle-fiber calcite to hardpans, sampled in soils taken from different environments, from arid to tropical. Whatever the size of the features and the soil climate, life is al-

ways involved either directly, leading to precipitation of carbonate through its storage in organic tissues, or indirectly, through various metabolic pathways ( $H^+$  exchange in the rhizosphere, low molecular weight organic acid – carbonate cycles, etc.). In conclusion, secondary  $CaCO_3$  accumulations in soils should not be used as proxy for paleoclimatic reconstruction without being circumspect and critical of the data. More importantly, calcium carbonate accumulations in soils should not be overlooked as a serious alternative for long time residence carbon storage compared to soil organic matter.