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Pedogenic carbonates accumulation in a calcareous Mediterranean soil following introduction of irrigation

Isabel Sonsoles De Soto[1], **Iñigo Virto**[1], Alberto Enrique[1], Rodrigo Antón[1], Pierre Barré[2], and Kazem Zamanian[3]

[1]Departamento de Ciencias-ISFOOD. Universidad Pública de Navarra, Pamplona, Navarre, Spain (isabelsonsoles.desoto@unavarra.es)

[2]Laboratoire de Géologie, École Normale Supérieure de Paris, Paris, France

[3]Department of Soil Science of Temperate Ecosystems, Georg August University of Goettingen, Goettingen, Germany

In calcareous Mediterranean soils, pedogenic and lithogenic carbonates can be important constituents of the soil matrix. However, their relative proportion and their relation to soil functioning has been scarcely studied. The interest in determining the proportion of pedogenic carbonates relies on the fact that they can be related to the physical, chemical and biological properties of the soil and, therefore, affect plant growth and soil productivity. Carbonates dynamics can be affected by some farming management practices and land-use changes, such as the adoption of irrigation, due to changes in the soil water regime, the composition of the soil solution, the concentration of CO_2 in the soil atmosphere, and the changes related to fertilization.

To gain knowledge on the importance of the effect of the introduction of irrigation on carbonates dynamics in the tilled layer of agricultural soils, we studied the evolution of the proportion of pedogenic carbonates in a Mediterranean calcareous soil after seven years of irrigation. We used the isotopic signature of C in soil carbonates for these estimations. The study was conducted in two plots under contrasting agricultural management on the same soil unit: dryland wheat cropping, and irrigated corn for 7 consecutive years, in Enériz (Navarre, Spain).

Our results showed that the transformation of dryland wheat to irrigated corn, produced a preferential accumulation of pedogenic carbonates (31-56%) in the tilled layer (0-30 cm) of the irrigated soil only over 7 years after the land-use change. Therefore, the processes related to this land use change can alter the soil carbonates dynamics in a very short period of time, and they may have consequences in terms of plant nutrient dynamics and the soil structure. Future research on the origin of the soil carbonates (pedogenic or geogenic) in agricultural soils will help to understand the actual significance of carbonates dynamics in terms of the global C balance in these soils.