MAN-INDUCED CHANGES IN C STORAGE DURING THE 20TH CENTURY: ENVIRONMENTAL AND GEOCHEMICAL RECORD

F. Dominguez-Castro[1], J.I. Santisteban[2], R. Mediavilla[1], W.E. Dean[3], E. Lopez-Pamo[4], M.J. Gil-García[5] and M.B. Ruiz-Zapata[5].

[1]*Dirección de Geología y Geofísica, Instituto Geológico y Minero de España, c/ Calera 1, 28760 Tres Cantos, Madrid, Spain. f.dominguez@igme.es r.mediavilla@igme.es*
[2]*Dpt. Estratigrafía, Fac. Ciencias Geológicas, Univ. Complutense de Madrid, 28040 Madrid, Spain. juancho@geo.ucm.es*
[3]*Earth Surface Processes, United States Geologycal Survey, Box 25046, MS 980,Federal Center Denver, CO 80225. dean@usgs.gov*
[4]*Dirección de Recursos Minerales, Riesgos Geológico y Geoambiente, Instituto geológico y Minero de España, c/ Ríos Rosas, 23, 28003 Madrid, Spain. e.lopez@igme.es*
[5]*Dpt.Geología, Univ. Alcalá, N-II, km. 33,600, 28871 Alcalá de Henares, Madrid, Spain. blanca.ruiz@uah.es mjose.gil@uah.es*

ABSTRACT
Despite their relative small extension, wetlands are important as sources or sinks of C. But, due to their intermediate position between land and permanent water, they have been modified in the name of “health” or “productivity.” Such changes have altered substantially their ability to store/produce C greenhouse gasses but the main point is to establish until which point this changes are “structural” (implying the intrinsic environmental mechanisms), and therefore unrecoverable, or “casual” (implying not the environment processes but its “external”–not directly implied in the C storage/emission-components), and consequently recoverable. Temperate wetlands are strongly dependant on water availability due to their position but, on the other hand, use to be occupied by resistant species able to survive hard conditions. The example shown below presents a case of intense human activity on a Mediterranean wetland that has caused very intense changes in the flooded area but not so evident and perdurable in the main ecological relations implied in the C cycle.

WETLAND-CLIMATE-MAN RELATIONS
Las Tablas de Daimiel National Park is a temperate wetland fed by sulphated-carbonated waters. Sedimentation is mostly composed by organic matter (hygrophyte vegetation, water depth-limited) and bioinduced carbonates (charophytes, light availability-limited), which represent two competing environments in the wetland, plus gypsum and siliciclastics in the marginal areas. This composition has been constant for the last millennia until recent human activity has disturbed the ecosystem.

Under a normal cycle, water expansion/retraction controls the position and extent of emergent and submerged vegetation and, consequently, the amount of C produced/stored. Thus, during the wetter (usually warmer) periods, water body expanded and charophyte mats spread while emergent vegetation shifted outwards resulting in higher C storage. During the drier (usually colder) periods, charophyte mats moved towards the deeper areas while emergent vegetation colonized prior submerged areas. If the drought is too long, saline soils develop, the outermost vegetation died and there was a real loss in C.

This climatically-driven cycle was modified in the last centuries by human activity. Despite that first documented human modifications of the wetland come from the 10th century, when there are written news about water mills, it was not until the late 19th-early 20th century that these changes are not noticeable in the geochemical record of the environment. During this period, land use and ownership changed from small traditional farming pieces to wide scale agriculture. That implied clearance not only of forested areas but also of the marginal areas of the wetland and old channels increasing the amount of detritals arriving to the wetland (Fig. 1, 1). This increased turbidity of the waters and produced a decrease in charophyte productivity. Consequently, C bioproduction and storage diminished.

But this change had nothing to do compared to the desiccation attempt of the middle 20th century. Draining of the wetland caused a lowering of the water table so saline soils developed and, as result of clearing of the margins to easy the works, the emergent vegetation retreated (Fig. 1, 2a). Wetland extent changed from 100 km^2 (1937) to 60 km^2 (1965) and 15 km^2 (1971, year when the desiccation was stopped) and, following this trend, salinity increased (Fig. 1, 2b). Concurrently, water overexploitation broke the link between the wetland and the groundwater and the water body surface reduced up to 0.4 km^2 (1987). This artificial drought caused an important rise in salinity (Fig. 1, 3a) and the charophyte community was reduced to a minimum (Fig. 1, 3b) until, in late 1980's, artificial supply of water was provided in order to reach a 1.2 km^2 of flooded area (Fig. 1, 4-5). At present moment, there are no evidences of recovery of the system to previous levels of C storage. However, comparing this situation with analogous cycles in the 16th and 18th, it seems plausible to expect a recovery of the previous levels after few decades if water supply is guaranteed.

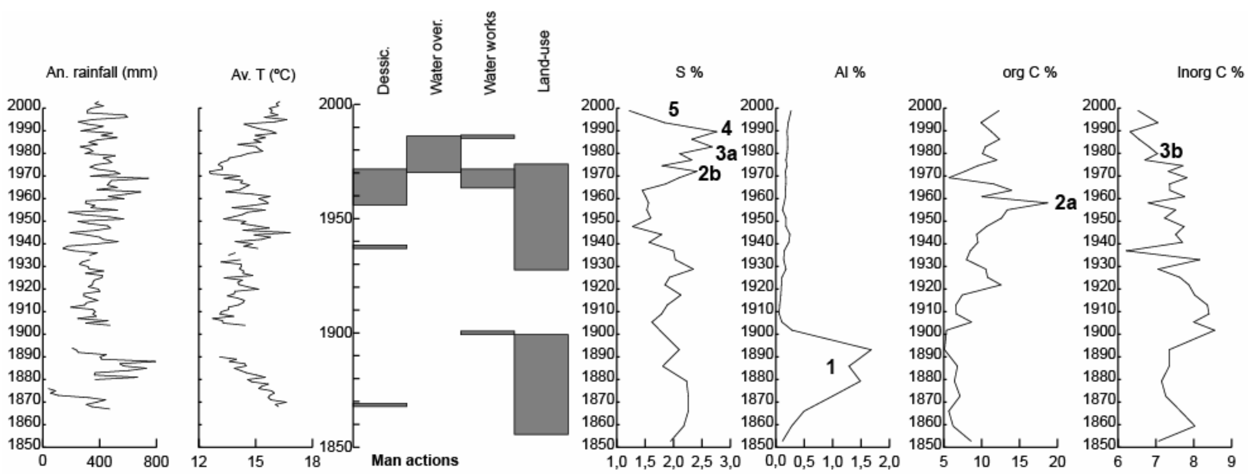

Fig. 1. Climate-man-wetland interactions recorded in the Las Tablas de Daimiel National Park. Climatic trends, natural and human induced events, and main geochemical parameters for the recent deposits.

ACKNOWLEDGMENTS

This research is supported by the Spanish Ministry of Science and Education (MEC) research projects REN2002-04433-CO2-01 and REN2002-04433-CO_2-02 and F.D.C. research is supported by the grant BES-2003-0482 of the Formation of Research Personnel plan of the MEC.